



MATRIX AND SYLLABUS

For the Programme

Bachelor of Business Administration

NEP Based Curriculum (2021 onwards)

PEOs	Programme Educational Objectives
PEO1	The programme aims to nurture the students in intellectual, technical, interpersonal and social skills with a focus on holistic education and development to make informed decisions and equips graduates with the skills required to lead management positions.
PEO2	To provide students with modern business knowledge and competence in functional management disciplines.
PEO3	To promote management growth and entrepreneurship via experiential learning.
PEO4	To instil professional ethics, human values, and social responsibility for the growth of organisations and societies.
PEO5	To educate future business professionals who are able to apply theoretical understanding toward the development of viable solutions to challenges that exist in the actual world.

PO	Programme Outcomes
PO1	Demonstrate a deep understanding of functions of management communication ideas and principles.
PO2	Demonstrate an understanding of the knowledge of finance, accountancy, law, statistics, HR, operations, IT and management subjects required for business decisions and apply knowledge to integrate concepts from various disciplines, to identify and develop business strategies for effective problem-solving and decision-making in a contemporary organization environment.
PO3	Apply the necessary competencies and skills with a creative mindset, to undertake entrepreneurship as a desirable and feasible career option and able to adapt effectively as an individual and as a member or leader in teams, and in multidisciplinary settings by demonstrating life skills, coping skills and human values.
PO4	This programme brings out reflective, scientific and creative thinking in the students which to get deeper insights into the business world and tackle complex situations with the help of skills and knowledge acquired.
PO5	Imbibe ethical practices in profession and appreciate sustainability and evince a sense of social responsibility in their respective environments, by becoming citizens working for the welfare and benefit of the society, at large. Achieve higher levels of proficiency and self-actualization through the pursuit of life-long learning.

At the end of year	Exit Award	Outcomes Achieved	Credits
1 st Year	Certificate in Business Administration	PO1	50
2 nd Year	Diploma in Business Administration	PO1,PO2,PO3	100
3 rd Year	Bachelor's Degree in Business Administration	PO1,PO2,PO3,PO4	148
4 th Year	Honours Degree in Business Administration	PO1,PO2, PO3,PO4,PO5	190

NEP- Curriculum Framework

B.B.A - Matrix for I Semester (w.e.f. 2021-22 onwards)

I Semester							
Code	Course Code	Course	Teaching Hours	Course Components			Credits
				L	T	P	
AECC	M21KN 1.1/ M21HN 1.1/ M21AE 1.1	Language I (Kannada/Hindi/Additional English)	45	3	1	-	3
AECC	M21GE 1.1	Language II (Generic English)	60	3	1	-	3
DSC	M21DC 1.1	Management Principles & Practice	60	4	-	-	4
DSC	M21DC 1.2	Fundamentals of Business Accounting	60	4	-	-	4
DSC	M21DC 1.3	Business Economics	60	4	-	-	4
OE-1	M21OE 1.1	Business Organisation	45	3	-	-	3
SEC- SB	21SBC 1.1	Digital Fluency - I	30	1	-	2	2
SEC-VB	21VBC 1.1	Health and Well-being	30	-	-	2	1
SEC-VB	21VBC 1.2	Yoga	30	-	-	2	1
Total							25

Note 1:

AECC- Ability Enhancement Compulsory Course

DSC - Discipline-Specific Course

OE- Open elective (course offered by the department to students of other stream)

SEC - VB Skill Enhancement Course -Value Based

SEC - SB Skill Enhancement Course -Skill Based

Continuous Internal Assessment – Scheme of Evaluation For Theory Courses

End Semester Examination: 60%

Continuous Internal Assessment: 40%

Activities (CIA: 40 Marks)	Proposed and Approved Scheme		Total Marks (40)
	IA-1	IA-2	
Session Test Maximum Marks	30	30	
1. Weightage (Marks)	10	10	20
2. Assignment (Marks)	20		20
i. Writing	10		
ii. Quiz / Presentation / Creating diagrams/charts / Classwork/ Case study / Viva / Field work etc.	05		
iii. Classroom participation	05		
Total			40

M21DC 1.1: MANAGEMENT PRINCIPLES AND PRACTICE**Total Teaching Hours: 60****No. of Hours per Week: 4****(4 credits)**

CObj	Course Objectives
CObj_1	To provide an understanding of the functions and responsibilities of managers.
CObj_2	To familiarize students with the tools and techniques to be used in the performance of the managerial job.
CObj_3	To enhance students understanding to develop cognizance of the importance of management principles.

CO	Course Outcomes
	After completion of this module, students should be able to:
CO1	Able to demonstrate their understanding of various concepts, principles, and functions of business management.
CO2	Able to Demonstrate the roles, skills and functions of management
CO3	The ability to create organization structures based on authority, task and responsibilities.
CO4	The ability to understand the complexities associated with management of human resources in the organizations and integrate the learning in handling these complexities.
CO5	The ability to understand the requirement of good control system and control techniques

CO-PO Mapping

	PO_1	PO_2	PO_3	PO_4	PO_5
CO_1	*				
CO_2		*		*	*
CO_3	*				
CO_4			*		
CO_5			*		

Course Content

S. No	Unit title	Course Content	Number of Hours	Skills Developed
1	Unit- I Introduction To Management	Introduction –Meaning, Evolution of management thought, Pre-Scientific Management Era, Classical Management Era, Neo-Classical Management Era, Modern Management Era; Nature and Characteristics of Management - Scope and Functional areas of Management; Management as a Science, Art or Profession; Management and Administration; Principles of Management.	12 Hrs	Cognitive Skills
2	Unit- II Planning And Decision Making	Nature, Importance and Purpose of Planning - Planning Process; Objectives; Types of plans (Meaning only); Decision making- Importance and steps;MBO and MBE (Meaning only)	8 Hrs	Life Skills
3	Unit- III Organizing And Staffing	Nature and purpose of Organization; Principles of Organizing; Delegation of Authority; Types of Organization - Departmentation, Committees; Centralization vs Decentralization of Authority and Responsibility, Span of Control; Nature and importance of Staffing (Case Study)	8 Hrs	Employable Skills
4	Unit- IV Directing And Communicating	Meaning and Nature of Direction, Principles of Direction; Communication - Meaning and Importance, Communication Process, Barriers to Communication, Steps to overcome Communication Barriers, Types of Communication; Motivation theories – Maslow’s Need Hierarchy Theory, Herzberg’s Two Factor Theory, Mc.Gregor’s X and Y theory. Leadership – Meaning, Formal and Informal Leadership, Characteristics of Leadership; Leadership Styles – Autocratic Style, Democratic Style, Participative Style, Laissez Faire Leadership Styles, Transition Leadership, Charismatic Leadership Style. (Case Study)	14 Hrs	Life Skills

5	Unit- V Coordinating AndControlling	Coordination–Meaning, Importance and Principles. Controlling-Meaning and steps in controlling, Essentials of Effective Control system, Techniques of Control (in brief).	8 Hrs	Life Skills
6	Unit- VI Business Social Responsibility AndManagerial Ethics	Business Social Responsibility - Meaning, Arguments for and against Business Social Responsibility; Green management - Meaning, Green Management Actions; Managerial Ethics – Meaning - Importance of Ethics in Business, Factors that determine Ethical or Unethical behavior.	10 Hrs	Cognitive Skills

Books for Reference:

1. Robbins, S. P. (2021). Management. Pearson.
2. Koontz, H., & O'Donnell, C. (2005). Management. McGraw Hill.
3. Prasad, L. M. (2019). Principles of Management. Sultan Chand and Sons.
4. Rao, V. S. P., & Bajaj, P. (2009). Management Process and Organization. Excel Books.
5. Appanniah, H. R., & Reddy, P. N. (2017). Management. HPH.
6. Ramaswamy, T. (2017). Principles of Management. HPH.

Web Resources:

1. <https://courses.lumenlearning.com/boundless-management/>
2. <https://www.managementstudyguide.com/principles-of-management.htm>
3. https://www.tutorialspoint.com/management_concepts/index.htm
4. <https://www.investopedia.com/terms/p/principles-of-management.asp>
5. <https://study.com/academy/course/business-101-principles-of-management.html>

Journals:

1. Academy of Management Journal
2. Journal of Management Studies
3. Harvard Business Review
4. Administrative Science Quarterly
5. Journal of Business Ethics

M21DC 1.2: FUNDAMENTALS OF BUSINESS ACCOUNTING**Total Teaching Hours: 60****No. of Hours / Week: 04****(04 Credit)**

CObj	Course Objectives
CObj_1	To acquaint students with the accounting concepts, tools and techniques influencing business organizations.
CObj_2	To make the students understand the basic accounting concepts and conventions
CObj_3	To familiarize the students to work with ratio analysis and bank reconciliation statement

CO	Course Outcomes
	After completion of this module, students should be able to:
CO1	Acquires the knowledge in accounting, system of maintenance of accounts, journal, ledger, bill of exchange, and account current, average due date and bank reconciliation statement. The Ability to pass journal entries and prepare ledger accounts.
CO2	Understand the basic accounting concepts and conventions, preparation of subsidiary books and final accounts, account of Consignment, Joint venture and non-trading concerns.
CO3	Develops the analytical skills in accounting equation, preparation of trial balance and suspense account, normal loss in consignment. Analysing the reasons for differences between pass book and cash book transactions in the Bank Reconciliation Statement.
CO4	Prepare the vertical and Horizontal Analysis and Ratio Analysis.
CO5	Analyse and interpret published financial information.

CO-PO Mapping

	PO_1	PO_2	PO_3	PO_4	PO_5
CO_1	*				
CO_2	*		*		
CO_3		*			*
CO_4	*			*	
CO_5			*		*

Course Content

S. No	Unit/chapter title	Course Content	Number of hours	Skills Developed
1.	Unit- I Introduction to Fundamentals of Accounting	Introduction – Meaning and Definition – Objectives of Accounting – Functions of Accounting – Users of Accounting Information – Limitations of Accounting – Accounting Cycle - Accounting Principles – Accounting Concepts and Conventions. Basics of Accounting Standards – Accounting Equations.	08 Hrs	Cognitive Skills
2.	Unit- II Accounting Process	Meaning of Double entry system – Process of Accounting – Types of Accounts – Rules -Transaction Analysis – Journal – Ledger – Balancing of Accounts – Trial Balance – Numerical	13 Hrs	Cognitive Skills
3.	Unit- III Subsidiary Books	Meaning – Significance – Types of Subsidiary Books –Preparation of Purchases Book, Sales Book, Purchase Returns Book, Sales Return Book, Bills Receivable Book, Bills Payable Book. Types of Cash Book- Simple Cash Book , Double Column Cash Book , Three Column Cash Book and Petty Cash Book (Numericals only on Three Column Cash Book and Petty Cash Book) Preparation of Bank Reconciliation Statement.	15 Hrs	CognitiveSkills & AnalyticalSkills
4.	Unit- IV Final Accounts Of Proprietary Concern	Preparation of Statement of comprehensive income and financial position of a proprietary concern with special adjustments like depreciation, outstanding and prepaid expenses, provision for doubtful debts, drawings and interest on capital etc.(Case Study)	12 Hrs	Analytical Skills
5.	Unit- V Financial Statements Analysis	Meaning - Users of Financial statement - Analysis of financial statements – Vertical and Horizontal Analysis (Numericals) – Basics of Ratio analysis and Interpretation.	12 Hrs	Analytical Skills

Books for Reference:

1. Hanif and Mukherjee (2015). *Financial Accounting*. McGraw Hill Publishers
2. Arulanandam & Raman (2013). *Advanced Accountancy*, Himalaya Publishing House
3. S.Anil Kumar, V.Rajesh Kumar and B.Mariyappa. (2014). *Fundamentals of Accounting*, Himalaya Publishing House.
4. Maheswari, S. N. (2018). *Financial Accounting*. (6/e), Vikas Publication.
5. Jain, S. P., & Narang, K. L. (2016). *Financial Accounting*. Kalyani Publication.
6. Radhaswamy, & Gupta, R. L. (2015). *Advanced Accounting*. Sultan Chand.
7. Shukla, M.C., & Goyel. (2017). *Advanced Accounting*. (19e), S Chand.

Web Resources:

1. <https://www.accountancyknowledge.com/journal-entry-problems-and-solutions/>
2. <https://www.toppr.com/guides/fundamentals-of-accounting/books-of-prime-entry/what-are- subsidiary-books/>
3. https://www.brainkart.com/article/Final-accounts-with-adjustments_34241/
4. <https://www.accountingtools.com/articles/financial-statement-analysis>

Journals:

1. Duff, A., Hancock, P. and Marriott, N., 2020. The role and impact of professional accountancy associations on accounting education research: An international study. *The British Accounting Review*, 52(5), p.100829.
2. Jenkins, J., Popova, V. and Sheldon, M., 2020. Monitoring the accounting profession under the AICPA code of professional conduct: An analysis of state board of accountancy participation. *Journal of Accounting and Public Policy*, 39(3), p.106742.
3. Power, S., Cleary, P. and Donnelly, R., 2017. Accounting in the London Stock Exchange's extractive industry: The effect of policy diversity on the value relevance of exploration- related disclosures. *The British Accounting Review*, 49(6), pp.545-559.

M21DC 1.3: BUSINESS ECONOMICS**Total Teaching Hours: 60****No. of Hours / Week: 04****(04 Credit)**

CObj	Course Objectives
CObj_1	To impart the fundamentals of economics with an objective to develop the application based knowledge
CObj_2	To apply micro economics concepts techniques in evaluating the business decisions taken by the firms
CObj_3	To develop basic knowledge on production cost and revenue.

CO	Course Outcomes
	After completion of this module, students should be able to:
CO1	Understand fundamental concepts in Economics and relate it to business
CO2	Analyze Consumer Behavior and understand how he behaves at different levels of satisfaction and to know indifferent behavior of the consumer
CO3	Analyze Law of demand, concepts and determinants of demand Computation of demand forecasting
CO4	Analyze the decisions made by the firm using different production techniques with element of time involved it
CO5	Explore the macroeconomic concepts like NI, Business Cycle, Fiscal and Monetary Policy

CO-PO Mapping

	PO_1	PO_2	PO_3	PO_4	PO_5
CO_1	*	*			
CO_2		*		*	*
CO_3	*				
CO_4			*	*	
CO_5			*		*

Course Content

S. No	Unit title	Course Content	No of Hours	Skills Developed
1	Unit- I Introduction to Business Economics	Business Economics - meaning, characteristics, distinction between business economics and economics, scope of business economics, uses/objectives of business economics, role and responsibilities of business economist, Micro, Macro-meaning, differences	08 Hrs	Cognitive Skills
2	Unit- II Theory of Consumer Behavior, Demand & Supply	Consumer Behavior, Approaches to the Study of Consumer Behavior- cardinal approach, the law of equi-marginal utility, law of diminishing marginal utility, ordinal approach, indifference curve analysis; Consumer Surplus, consumer equilibrium. Theory of demand analysis; Demand - demand determinants, law of demand, characteristics, exceptions; Elasticity of Demand – meaning and types, Demand Forecasting methods; problems on trend projection by least square method. Case Study	16 Hrs	Cognitive Skills
3	Unit- III Production Function	Meaning of pricing, determinants of pricing and methods of pricing, Meaning of cost, types & concepts of costs, Theory of cost at short and long run, cost problems, Concepts of revenue - TR, AR and MR, production function, LVP, Production equilibrium. Law of Supply - meaning, determinants of supply, elasticity of supply, market equilibrium analysis. Case Study.	16 Hrs	Evaluation and Synthesis
4	Unit- IV Market Structure	Meaning, types of market-meaning, features, perfect competition, monopoly, monopolistic, oligopoly.	8 Hrs	Cognitive Skills
5	Unit- V Macro-economic indicators	Business cycles-meaning, phases of business cycle, monetary policy, fiscal policy, National income, components.	12 Hrs	Analytical Skills

Books for Reference:

1. Ahuja, H.L. (2004). Business Economics (5th Ed). New Delhi: Sultan Chand & Sons.
2. Mithani, D.M. (2012). Managerial Economics. New Delhi: Himalaya Publishing House.
3. Pandey, K.M., and Others (2010). Economics for Managerial Decisions.
4. Reddy, P. N., & Appanaiah, H. R. (2017). Essentials of Business Economics.
5. Sankaran. (2020). Business Economics.
6. Samuelson, W. F., & Marks, S. G. (2014). Managerial Economics (8th ed). Wiley.
7. Reddy, P. N., & Appanaiah, H. R. (2021). Essentials of Business Economics. HPH.
8. Allen, W. B., Doherty, N. A., & Ando, A. L. (2012). Managerial Economics: Theory, Applications, and Cases (8th ed). W. W. Norton.

Web Resource:

1. Investopedia - Business Economics Section
2. The Economist - Business and Finance Section
3. Harvard Business Review - Economics Topic

Journals:

1. Journal of Business Economics
2. International Journal of Business Economics and Management Research
3. Journal of Business and Economic Policy

M21OE 1.1: BUSINESS ORGANISATION**Total Teaching Hours: 45****No. of Hours / Week: 03****(3 Credit)**

CObj	Course Objectives
CObj_1	To impart the fundamentals of Business Organisation with an objective to develop the basic knowledge of operations and functions of organisation
CObj_2	To enable the use of basic concepts of management in business organization
CObj_3	To have a proper understanding of social responsibility towards business and principles of management

CO	Course Outcomes
	After completion of this module, students should be able to:
CO1	An understanding of the nature, objectives and social responsibilities of business
CO2	An ability to describe the different forms of organisations
CO3	An understanding of the basic concepts of management
CO4	An understanding of functions of management
CO5	An understanding of different types of business combinations

CO-PO Mapping

	PO_1	PO_2	PO_3	PO_4	PO_5
CO_1	*	*			
CO_2		*		*	*
CO_3	*				
CO_4			*	*	
CO_5			*		

Course Content

S. No	Unit/chapter title	Course Content	Number of hours	Skills Developed
1	Unit- I Introduction to Business	Business: Meaning, Nature, Scope and Social responsibility of Business, Objectives, Essentials of successful business; Functional areas of business. Concept of Business Organisation.	10 Hrs	Cognitive Skills
2	Unit- II Forms of Business Organization	Sole proprietorship: Definitions, Features, Merits and Demerits. Partnership: Definitions, partnership deed, Features, Merits and Demerits. Joint Stock Company: Definitions, Features, Merits and Demerits. Co-operatives: Definitions, Features, Merits and Demerits.	12 Hrs	Cognitive Skills
3	Unit- III Public Enterprises	Departmental Undertaking: Definitions, Features, Merits and Demerits. Public Corporations: Definitions, Features, Merits and Demerits. Government Companies: Definitions, Features, Merits and Demerits	08 Hrs	Evaluation and Synthesis
4	Unit- IV Business Combinations	Meaning Definitions, Causes, Types, Forms, merits and demerits of Business Combinations, Recent Trends in Business Combinations.	08 Hrs	Cognitive Skills
5	Unit- V Management of Organizations	Management- Meaning, Definitions, Difference between Management and Administration, Levels of Management, Objectives of Management, Functions of management- planning, organizing, staffing, directing, coordinating, controlling, Principles of Management.	07 Hrs	Analytical Skills

Books for Reference:

1. C B. Guptha. (2020). Business Organisation and Management, Sultan Chand & Sons.
2. Saxena, S. C. (2021). Business Administration & Management. Sahitya Bhawan.
3. Shukla, M. C. (2010). Business Organisation and Management. S Chand & Company Pvt. Ltd.S.A Sherlekar - Business Organization, Himalaya Publishing House.
4. Bhushan, Y.K. (2016). Fundamentals of Business Organisation and Management. Sultan Chand & Sons.
5. Sharma, R.K. (2018). Business Organisation & Management. Kalyani Publishers.
6. Sahai, I.M., & Asthana, P. (2021). Business Organisation & Administration. Sahitya Bhawan Publications.

Web Resource:

1. U.S. Small Business Administration (SBA)
2. Entrepreneur
3. Investopedia
4. SCORE
5. Harvard Business Review (HBR)
6. The Wall Street Journal (WSJ)
7. Forbes

Journals:

1. Journal of Business Research
2. Harvard Business Review
3. Academy of Management Journal
4. Journal of Management Studies
5. Strategic Management Journal
6. Organization Science
7. Journal of Organizational Behavior
8. Administrative Science Quarterly
9. Journal of Business Ethics
10. Organization Studies

21SBC 1 .1: DIGITAL FLUENCY

Total Teaching Hours: 30

No. of Hours 2

(2 Credits)

CObj_ID	Course Objectives
CObj_1	To learn about advanced formulas for business administration
CObj_2	To equip participants with the knowledge to debug and audit the advanced formulas
CObj_3	To explore and analyze data using advanced excel.

CO_ID	Course Outcomes
	After completion of this module, students should be able to:
CO_1	Understands to apply basic principles of laying out excel models for decision making..
CO_2	Examines spread sheet concepts and explore the Microsoft office Excel environment
CO_3	Use excel functions to summarize quantitative data graphically, including pivot table and charts.
CO_4	Gains ability to apply formulas to lay data in readiness for analysis.
CO_5	Explores the best practices by troubleshooting complex models.

CO-PO Mapping

	PO_1	PO_2	PO_3	PO_4	PO_5
CO_1	*	*			
CO_2	*	*			
CO_3		*	*		
CO_4		*	*	*	
CO_5		*			*

Course Content

S. No	Unit/chapter title	Course Content	Number of hours	Skills Developed
1	Create Worksheets & Workbook	Create of Workbook, Navigation within the Workbook (Clipboard), Import Data from De Limited Text Files, Add the Worksheet for the Existing workbook. Navigating using GOTO Special.	2 Hrs	Employable Skills
2	References & Table Format	Type of References: Absolute Reference, Mixed References, Relative References, Apply the Different Table Format. (Working with 2 Case Studies)	2 Hrs	Employable Skills
3	Summarize data by using Functions / Statistical Functions.	Define Name, Perform Calculations by using the SUM, SUMIF, SUMIFS, COUNT, COUNTA, COUNTIF, COUNTIFS, COUNT BLANK, AVERAGE, AVERAGEIF, MAX, MIN RANK FUNCTIONS ETC (Working with 2 Case Studies)	2 Hrs	Employable Skills
4	Lookup & Reference Section.	VLOOKUP, HLOOKUP, Index, Match, & If error. (Working with 2 Case Studies)	2 Hrs	Employable Skills
5	Create & Format Charts	New Chart, Data Series, Switch b/w Rows & Columns, Analyses data by using Quick Analysis, Resize Charts & Add & Modify The Chart Elements, Layouts & Styles, Move Chart to Chart Sheets (Working with 1 Case Studies)	2 Hrs	Employable Skills
6	Format & Modify Text by using Functions.	Format Text by using RIGHT, LEFT, MID, UPPER, LOWER, PROPER, Concatenate, TRIM, Clean, Char, TEXT JOIN, LEN, FIND, Search, Replace & Substitute. (Working with 1 Case Studies)	2 Hrs	Employable Skills
7	Create Advanced Tables & Charts	Create & Manage Pivot Tables, Create & Manage Pivot Charts , Working Slices , Timeline Filters , Sorting Options, Designing the PIVOT Tables ETC. (Working with 2 Case Studies)	2 Hrs	Employable Skills
8	DATE Functions	Working the Date Formats, Working the Various Date Functions Like DATE, TODAY, NOW, EOMONTH, WORKDAY, WORKDAY.INTL, NETWORKDAY, and NETWORKDAY.INTL. ETC. . (Working with 1 Case Studies)	2 Hrs	Employable Skills
9	Functions	Working the Various Logical Functions	2 Hrs	Employable

		like IF, IFS, AND, OR, SWITCH ,TRUE or False . (Working with 1 Case Studies)		Skills
10	Financial Functions	PMT, IPMT, CUMIPMT,RATE, NPER,FV. (Working with 1 Case Studies)	2 Hrs	Employable Skills
11	Data Analytics Tools	Working with Custom Sort & Advanced Filter, Text to Columns, Remove Duplicates, Data Validation, Consolidation, what if Analysis (Scenario Manager, Goal Seek FORCAST, FORCAST.ETS, FORCAST.CONFINT, FRCAST. ETS.SESONALITY, FORCAST. ETS.STAT, FORCAST & Data Table), FORECASTING.LINEAR) (Working with 1 Case Studies)	3 Hrs	Employable Skills
12	Creating for Dynamic Charts using Functions.	An Excel Dashboard provides insight, analysis and alerts. They're fully interactive and dynamic and can help with project management, customer service, retail management,financial forecasting and much more. (Working with 1 Case Studies)	3 Hrs	Employable Skills
13	Power PivotTable	Advanced Pivot Table, Working with Relationship, Introduction of DAX Functions, Data Modelling, Queries & Connections, Designing Pivot Chart & Table. (Working with 1 Case Studies)	2 Hrs	Employable Skills
14	Working with Add ons	Working Various Add ons Analytics Tool Pack, Power Maps, Solver Add in.	2 Hrs	Employable Skills

Books for Reference:

1. Microsoft Excel 2019 Bible: The Comprehensive Tutorial ResourceExcel: Quickstart Guide from Beginner to Expert
2. Excel 2019: All-In-One for Dummies Microsoft Excel Dashboards and Reports
3. Ctrl+Shift+Enter Mastering Excel Array FormulasExcel for Beginners
4. Microsoft Excel 2019 Formulas and Functions

Web Resources:

1. www.google.com
2. <https://youtube.com/c/edurekaIN>
3. <https://openoregon.pressbooks.pub/beginningexcel19/>
4. <https://corporatefinanceinstitute.com/resources/ebooks/excel-book-pdf/>
5. <https://doc.lagout.org/operating%20system%20/Windows/Excel/Microsoft%20Excel%202010%20Step%20by%20Step.pdf>
6. <https://www.linkedin.com/learning/excel>
7. <https://www.youtube.com/channel/UCVLbzhxVTiTliVKeGV7WEBg>

Journals:

1. Journal of Financial Planning
2. Journal of Business and Economic Statistics
3. Journal of Applied Business Research
4. Journal of Financial Education
5. Journal of Accounting Education

NEP- Curriculum Framework

B.B.A - Matrix for II Semester (w.e.f. 2021-22 onwards)

II Semester							
Code	Course Code	Course	Teaching Hours	Course Components			Credits
				L	T	P	
AECC	M21KN 2.1/ M21HN 2.1/ M21AE 2.1	Language I (Kannada/Hindi/Additional English)	45	3	1	-	3
AECC	M21GE 2.1	Language II (Generic English)	60	3	1	-	3
DSC	M21DC 2.1	Functions of Management	60	4	-	-	4
DSC	M21DC 2.2	Cost Accounting	60	4	-	-	4
DSC	M21DC 2.3	Business Mathematics	60	4	-	-	4
OE-2	M21OE 2.1	People Management	45	3	-	-	3
AECC	21SBC 2.1	Environmental Studies	30	2	-	-	2
SEC-VB	21VBC 2.1	NCC/NSS/Cultural	30	-	-	2	1
SEC-VB	21VBC 2.2	Sports	30	-	-	2	1
Total							25

Note 1:

AECC- Ability Enhancement Compulsory Course

DSC - Discipline-Specific Course

OE- Open elective (course offered by the department to students of other stream)

SEC - VB Skill Enhancement Course -Value Based

SEC - SB Skill Enhancement Course -Skill Based

Continuous Internal Assessment – Scheme of Evaluation

For Theory Courses

End Semester Examination: 60%

Continuous Internal Assessment: 40%

Activities (CIA: 40 Marks)	Proposed and Approved Scheme		Total Marks (40)
	IA-1	IA-2	
Session Test Maximum Marks	30	30	
1. Weightage (Marks)	10	10	20
2. Assignment (Marks)	20		20
i. Writing	10		
ii. Quiz / Presentation / Creating diagrams / charts / Classwork / Case study / Viva / Field work etc.	05		
iii. Classroom participation	05		
Total			40

M21 DC 2.1: FUNCTIONS OF MANAGEMENT

Total Teaching Hours: 60

No. of Hours / Week: 04

(04 Credit)

CObj	Course Objectives
CObj_1	To provide an idea on various types of management.
CObj_2	To improve the overall employability skills of students.
CObj_3	To provide an understanding to students in choosing their specialization course of their interest.

CO	Course Outcomes After completion of this module, students should be able to:
CO1	Improved knowledge on various types of management.
CO2	Strong basics of all the different types of management.
CO3	Ease in choosing their specialization course of their interest.
CO4	Improved management skills and employability skills.
CO5	Improved skills in marketing, human resource, finance, events and service management.

CO-PO Mapping

	PO_1	PO_2	PO_3	PO_4	PO_5
CO_1	*				
CO_2		*	*		
CO_3			*		
CO_4			*	*	
CO_5					*

Course Content

S. No	Unit/chapter title	Course Content	Number of hours	Skills Developed
1	Unit- I Human Resource Management	Introduction: Meaning of HRM, Objectives of HRM, Importance of HRM, Functions and Process of HRM, HR Manager, Duties and Responsibilities, Recent trends in HRM.	12 Hrs	Employable Skills
2	Unit- II Marketing Management	Definition; nature; scope and importance of marketing; approaches to the study of marketing; functions of marketing, Marketing Mix.	12 Hrs	Life Skills
3	Unit- III Services Management	Meaning of Services, Concepts of Services, Growth of Service Sector	10 Hrs	Employable Skills
4	Unit- IV Financial Management	Introduction: Meaning of Finance, Business Finance, Finance Function, Aims of Finance Function, Organization structure of finance, Financial Management, Goals of Financial Management, Financial Decisions, Role of a Financial Manager, Financial Planning, Steps in Financial Planning, Principles of a Sound Financial Planning.	14 Hrs	Analytical Skills
5	Unit- V Events Management.	Event-Meaning, why event management, Analysis of event, scope of event. Decision makers, event manager technical staff, establishing of policies and procedures, developing record keeping systems.	12 Hrs	Employable Skills

Books for Reference:

1. Appannaiah, H. R. (2018). Management Process. Himalaya Publishing House.
2. Ghosh, B. (2001). Fundamentals of Marketing Management. New Central Book Agency.
3. Agarwala, T. (2007). Strategic Human Resource Management. Oxford University Press.
4. De Nisi, A. S. (2005). Human Resource Management. Biztantra.
5. Clark, E. (2002). International Financial Management. Cengage Learning Publications.

Web Resource:

1. <https://www.investopedia.com/>
2. <https://www.ft.com/>
3. <https://www.wsj.com/>
4. <https://www.hubspot.com/>
5. <https://www.marketingprofs.com/>
6. <https://www.hr.com/>
7. <https://www.hrexecutive.com>
8. <https://www.eventmanagerblog.com/>
9. <https://www.bizbash.com/>
10. <https://www.smg.com/>
11. <https://www.servicemanagement101.com/>

Journals:

1. International Journal of Services, Economics and Management (<https://www.inderscience.com/jhome.php?jcode=ijsem>): Publishes research articles and papers on various aspects of services management.
2. International Live Events Association (<https://www.ileahub.com/>): Offers resources, webinars, and events for professionals in the live events industry.
3. Ahmad, S., & Schroeder, R. G. (2003). The impact of human resource management practices on operational performance: recognizing country and industry differences. *Journal of Operations Management*, 21(1), 19-43.
4. Gentry J. (1988), State of the Art of Short-Run Financial Management, *Financial Management*, N. 17, p. 41-57.

M21 DC 2.2: COST ACCOUNTING**Total Teaching Hours: 60****No. of Hours / Week: 04****(04 credit)**

CObj	Course Objectives
CObj_1	The objective of this subject is to familiarize students with the various concepts and element of cost.
CObj_2	To enable students to reconcile results as per Cost and Financial Accounts
CObj_3	To enable students to discuss the concepts related to Process Costing and enable them to make Process Accounts and Statements of joint products and by-products.

CO	Course Outcomes
	After completion of this module, students should be able to:
CO1	Understand the concepts of preparation of cost sheet.
CO2	Apply techniques used to find the pricing of materials.
CO3	Gain ability to analyze the wage rates.
CO4	Prepare the machine hour rate and allocation of overhead distribution.
CO5	Preparation of Reconciling the cost and financial accounts.

CO-PO Mapping

	PO_1	PO_2	PO_3	PO_4	PO_5
CO_1	*				
CO_2		*	*		
CO_3			*		
CO_4			*		
CO_5			*		*

Course Content

S. No	Unit/chapter title	Course Content	Number of hours	Skills Developed
1	Unit- I Introduction to Cost Accounting	Introduction – Meaning & amp; Definition of Cost, Costing, Cost Accounting and Comparison between Financial Accounting and Cost Accounting, Cost Concepts, Classification of Costs, Cost Unit, Cost Center, Elements of Cost, Preparation of Cost Sheet, Tenders and Quotations.	12 Hrs	Cognitive Skills
2	Unit- II Material Cost Control	Meaning: Types, Direct Material, Indirect Material, Material Control, Purchasing Procedure, Store Keeping, Techniques of Inventory Control, Setting of Stock Levels, EOQ [Numerical], Methods of Pricing Material Issues, FIFO, LIFO, Weighted Average Price Method and Simple Average Price Method. ABC Analysis, VED Analysis, Just In-Time, Perpetual Inventory System, Documents used in Material Accounting [Theory only]	14 Hrs	Employability Skills
3	Unit- III Labour Cost Control	Meaning: Types – Direct Labour, Indirect Labour, Timekeeping, Time booking, Idle Time, Overtime, Labour Turn Over. Methods of Labour Remuneration - Time Rate System, Piece Rate System. Incentive Systems – Halsey plan, Rowan Plan, Taylors differential Piece Rate System and Merricks Differential Piece Rate System [Numerical]	10 Hrs	Employability Skills
4	Unit- IV Overhead Cost Control	Meaning and Definition – Classification of Overheads, Procedure for Accounting and Control of Overheads, Allocation of Overheads, Apportionment of Overheads, Primary Overhead Distribution Summary, Secondary Overhead Distribution Summary, Repeated Distribution Method and Simultaneous Equations Method – Absorption of Factory Overheads – Methods of Absorption – Machine Hour Rate [Numerical]	14 Hrs	Analytical Skills

5	Unit- V Reconciliation of Cost and Financial Accounts	Need for Reconciliation – Reasons for differences in Profit or Loss shown by CostAccounts and Profit or Loss shown by Financial Accounts, Preparation of Reconciliation Statement and Memorandum Reconciliation Account.	10 Hrs	Analytical Skills

Books for Reference:

1. Prasad, N.K. (1979). Cost Accounting. Book Syndicate pvt Limited.
2. Nigam, A., & Sharma, S. (1982). Cost Accounting. Himalaya Publishing House.
3. Khanna Pandey, & Ahuja. (2015). Practical Costing. 2011th edition. S.Chand Limited.
4. Jain, & Narang. (2018). Cost Accounting. Kalyani Publishers.
5. Palaniappan, & Hariharan. (2012). Cost Accounting. I.K. International Publishers.
6. Maheshwari, S.N., & Mittal. (2015). Cost Accounting. Sixth Edition. Mahavir Publications.

Web Resources:

1. https://www.dynamictutorialsandservices.org/2019/04/cost-sheet-solved-practical-problems-2_68.html
2. <https://eponlinestudy.com/fifo-lifo-exam-based-problems-and-answers/>
3. <https://egyankosh.ac.in/bitstream/123456789/13676/1/Unit-11.pdf>

Journals:

1. Stark, A., 1987. Some thoughts on “A cost-benefit analysis of accounting for inflation”. Journal of Accounting and Public Policy, 6(3), pp.209-217.
2. C Llarke, P., Hill, N. and Stevens, K., 1999. ACTIVITY-BASED COSTING IN IRELAND: BARRIERS TO, AND OPPORTUNITIES FOR, CHANGE. Critical Perspectives on Accounting, 10(4), pp.443-468. Science, 2005. First In, Last Out. 307(5717), pp.1843-1843.

M21DC 2.3: BUSINESS MATHEMATICS**Total Teaching Hours: 60****No. of Hours / Week: 04****(04 credit)**

CObj	Course Objectives
CObj_1	To provide basic knowledge of mathematics and their application to Commercial situations.
CObj_2	To make students equipped with the concepts of interest, rate of interest, annuity and instalments
CObj_3	To make students familiar with the concepts of ratio, proportion, variation and percentage.

CO	Course Outcomes
	After completion of this module, students should be able to:
CO1	Understands the basic concepts of business maths and apply them to create solve and interpret application problems in business
CO2	Solves problems on various types of equation.
CO3	Solves problems on Matrices and execute the laws of indices, law of logarithm and evaluate them.
CO4	Apply the concept of simple interest and compound interest bills discounted etc. and apply them in day-to-day life.
CO5	Solves problems on Arithmetic progression, Geometric progression and construct logical application of these concepts.

CO-PO Mapping

	PO_1	PO_2	PO_3	PO_4	PO_5
CO_1	*				
CO_2		*	*		
CO_3			*		
CO_4			*	*	
CO_5				*	*

Course Content

S. No	Unit/chapter title	Course Content	Number of hours	Skills Developed
1	Unit- I Number System	Introduction: Natural Numbers - Even Numbers, Odd Numbers, Integers, Prime Numbers, Rational and Irrational numbers, Real Numbers, HCF and LCM (Simple problems).	6 Hrs	Cognitive Skills
2	Unit- II Theory Of Equations	Introduction – Meaning - Types of Equations – Simple/ Linear Equations and Simultaneous Equations (only two variables), Elimination and Substitution Methods only. Quadratic Equation - Factorization and Formula Method ($ax^2 + bx + c = 0$ form only). Simple problems.	12 Hrs	Analytical Skills
3	Unit- III Indices, Matrices and Logarithms	Meaning, types, operation on matrices, additions, subtractions and multiplication of two matrices, transpose, determinants, minor of an element, co-factor of an element, inverse, crammers' rule in two variables, problems. Indices and Logarithms: Meaning- Basic Laws of Indices and their application for simplification. Laws of Logarithms – Common Logarithm, Application of Log Table for Simplification.	16 Hrs	Analytical Skills, Cognitive Skills
4	Unit- IV Commercial Arithmetic	Simple Interest, Compound Interest including yearly and half yearly calculations, Annuities, Percentages, Bills Discounting, Ratios and proportions, duplicate-triplicate and sub-duplicate of a ratio. Proportions: third, fourth and inverse proportion - problems.	16 Hrs	Analytical Skills Employable Skills
5	Unit- V Progressions	PROGRESSIONS: Arithmetic Progression - Finding the 'nth' term of AP and Sum to nth term of AP. Insertion of Arithmetic Mean Geometric Progression – Finding the 'nth' term of GP and sum to 'nth' term of GP and insertion 10 Hrs of Geometric Mean.	10 Hrs	Analytical Skills, Cognitive Skills

Books for Reference:

1. Saha. Mathematics for Cost Accountants. Central Publishers.
2. Saha, R.G., & Others. (2017). Methods and Techniques for Business Decisions. VBH.
3. Sancheti., & Kapoor. (2011). Business Mathematics and Statistics. Sultan Chand.
4. Zameerudin, Q., Bhambri, S.K., & Khanna, V.K. (1986). Business Mathematics. 2nd Edition. Vikas Publishing House.
5. Madappa, Hassan, M.H., & Taiyab, M.I. Business Mathematics. Subhash.
6. Veena, G.R., & Seema. (2019). Business Mathematics and Statistics. I.K. International Publishers.

Web Resource:

1. Khan Academy Business and Finance
2. MathIsFun Business Math
3. MIT OCW Mathematics for Business and Personal Finance
4. Investopedia Financial Mathematics
5. Coursera Business Mathematics Courses

Journals:

1. Journal of Business Mathematics and Statistics
2. International Journal of Business and Management Studies (IJBMS)
3. Journal of Mathematics and Statistics
4. Journal of Applied Quantitative Methods (JAQM)
5. International Journal of Business Quantitative Economics and Applied Management Research (IJBEMR)

M21OE 2.1: PEOPLE MANAGEMENT**Total Teaching Hours: 45****No. of Hours / Week: 03****(3 Credit)**

CObj	Course Objectives
CObj_1	Examine individuals' personality and behaviours to resulting in better management of people in the organisation
CObj_2	Resolve and manage conflicts quickly.
CObj_3	Understand the process of goal setting.

CO	Course Outcomes
	After completion of this module, students should be able to:
CO1	Understands diversity at the workplace.
CO2	Apply personal effectiveness through goal setting and time management.
CO3	Design the process of performance appraisal
CO4	Develop the interpersonal relationship and networking.
CO5	Develop the functions and importance of communication.

CO-PO Mapping

	PO_1	PO_2	PO_3	PO_4	PO_5
CO_1	*				
CO_2	*		*		*
CO_3	*				
CO_4		*		*	
CO_5			*		

Course Content

S. No	Unit/chapter title	Course Content	Number of hours	Skills Developed
1	Unit- I Introduction to People Management	Diversity in organization: age, gender, ethnicity, race and ability. People management: meaning, features, significance of people, difference between people management and human resource management, impact of individual and organizational factors on people management.	06 Hrs	Analytical Skills
2	Unit- II Getting work done and Assessment and Evaluation	Getting work done: Challenges of getting work done, significance of prioritization and assigning work to team members. Performance management: meaning, role of a manager in the different stages of the performance management process. Types of performance assessment, Assessment and Evaluation process of evaluation of tasks in the organization. Modern tools of assessment and Evaluation of tasks and performance.	12 Hrs	Cognitive Skills
3	Unit- III Building peer networks and essentials of communication	Building peer Networks: Understanding the importance of peer networks in an organization, being able to influence those on whom you have no authority, challenges peer networking and different types of people networking in the workplace. Essentials of communication: concept of communication process with reflection on various barriers to effective communication and ways to overcome, types of communication and channels of communication	12 Hrs	Analytical Skills
4	Unit- IV Motivation	Meaning, importance and need for motivation, team motivation-meaning, importance of team motivation, types of motivators and modern methods of motivation.	08 Hrs	Cognitive Skills
5	Unit- V Managing self	Reflection on what does it mean to be a people manager, building a personal development plan for oneself, self-stress management: causes for stress, work life balance, importance of work life balance, factors influencing work life balance.	07 Hrs	Cognitive Skills

Books for Reference:

1. DeSimone, R. L., & Werner, J. M. (2012). Human Resource Development. 6th ed. Cengage Learning.
2. Kumar, V. (2022). *People Management* . Kalyani Publishers.
3. Nirmala, K., Jyothi, A., & Tabassum, S. (2017). Human Resource Management. Himalaya Publishing House.
4. Thomson, R. (2015.). *People Management*. University Press.

Web Resources:

1. <https://courses.lumenlearning.com/suny-oneonta-education106/chapter/6-1-assessment-and-evaluation/>
2. <https://granite.pressbooks.pub/organizationalcommunication/chapter/chapter-6-communication-networks-and-leadership/>
3. <https://www.verywellmind.com/what-is-motivation-2795378>
4. <https://www.mayoclinic.org/tests-procedures/stress-management/about/pac-20384898#:~:text=Stress%20management%20offers%20a%20range,response%20to%20a%20challengin>

Journals:

1. West P. Making sense of epilepsy. In: Osborne DJ , Grunneberg M , Eisner J , eds. Research in psychology and medicine, Volume 2. London: Academic Press, 1979: 162—9.
2. Bury M. Chronic illness as biographical disruption. *Sociol Health Illness* 1982; 4: 167—82.
3. Charmaz K. Experiencing chronic illness. In: Albrecht G, Fitzpatrick R, Scrimshaw S, eds. *The handbook of social studies in health and medicine*. London: Sage, 2000: 277—92.
4. Achterberg, J., Kenner, C., & Lawlis, G. F. (1988). Severe burn injury: A comparison of relaxation, imagery, and biofeedback for pain management. *Journal of Mental Imagery*, 12, 71–87.
5. Agras, S., & Jacob, R. (1979). Hypertension. In O. F. Pomerleau & J. P. Brady. *Behavioral medicine: Theory and practice*. Baltimore: Williams and Wilkins.

NEP- Curriculum Framework

B.B.A - Matrix for III Semester (w.e.f. 2021-22 onwards)

III Semester							
Code	Course Code	Course	Teaching Hours	Course Components			Credits
				L	T	P	
AECC	M21KN 3.1/ M21HN 3.1/ M21AE 1.1	Language I (Kannada/Hindi/Additional English)	45	3	1	0	3
AECC	M21GE 3.1	Language II (Generic English)	60	3	1	0	3
DSC	M 21 DC 3.1	Organizational Behaviour	60	4	0	0	4
DSC	M 21 DC 3.2	Statistics for Business	60	3	0	1	4
DSC	M 21 DC 3.3	Financial Management	60	3	0	1	4
OE-3	M21OE 3.1	Financial Literacy	45	3	0	0	3
SBC	21SBC 3.1	Digital Fluency II	30	1	-	2	2
SEC-VB	21VBC 3.1	NCC/NSS/Cultural	30	-	-	2	1
SEC-VB	21VBC 3.2	Sports	30	-	-	2	1
Total							25

Note 1:

AECC- Ability Enhancement Compulsory Course

DSC - Discipline-Specific Course

OE- Open elective (course offered by the department to students of other stream)

SEC - VB Skill Enhancement Course -Value Based

SEC - SB Skill Enhancement Course -Skill Based

**Continuous Internal Assessment – Scheme of Evaluation
For Theory Courses**

End Semester Examination: 60%

Continuous Internal Assessment: 40%

Activities (CIA: 40 Marks)	Proposed and Approved Scheme		Total Marks (40)
	IA-1	IA-2	
Session Test Maximum Marks	30	30	
1. Weightage (Marks)	10	10	20
2. Assignment (Marks)	20		20
i. Writing	10		
ii. Quiz / Presentation / Creating diagrams / charts / Classwork / Case study / Viva / Field work etc.	05		
iii. Classroom participation	05		
Total			40

M 21 DC 3.1: ORGANISATIONAL BEHAVIOUR**Total Teaching Hours: 60****No. of Hours / Week: 04****(04 credit)**

CObj	Course Objectives
CObj_1	To enable the students to understand the organisational behaviour and organizational change and dynamics of group.
CObj_2	To enable the students to understand the importance of attitude and personality
CObj_3	To enable the students to understand the principles of learning.

CO	Course Outcomes
	After completion of this module, students should be able to:
CO1	Identify behavioral issues in an Organization
CO2	Apply the concept of Perception, attitudes and personality to understand the behavior of people in the organization.
CO3	Analyze different types of learning followed by each individual.
CO4	Design different types of groups in an organization and how it influences the behavior of the individuals.
CO5	Demonstrates the resistance for change, its causes and how to overcome.

CO-PO Mapping

	PO_1	PO_2	PO_3	PO_4	PO_5
CO_1	*				
CO_2		*			
CO_3	*			*	
CO_4		*			*
CO_5		*		*	

Course Content

S. No	Unit/chapter title	Course Content	Number of hours	Skills Developed
1	Unit- I Organizational Behaviour	Organization Behavior– Definition, Scope and Application in Management, Contributions of other disciplines to OB, Emerging issues in Organizational Behavior.	08 Hrs	Cognitive Skills
2	Unit- II Personality, Perception and Attitudes	Personality: Meaning-Determinants of Personality - Biological factors, Cultural factors, Family and Social Factors, Situational factors, Personality attributes influencing OB, Interactive Behaviour and Interpersonal Conflict - Case study Perception: Meaning – Need, Perceptual Process, Perceptual Mechanism, Factors influencing perception. Attitude: Meaning of Attitude, Characteristics of Attitude, Components of Attitude, Attitude and Behaviour, Attitude formation, change in attitude and barriers to attitude. Values: Values - Meaning, Definition, Nature, Types, Importance, Sources of values, Managerial implications of values	16 Hrs	Life Skills
3	Unit- III Group Dynamics	Meaning - Types of Groups, Functions of small groups, Group Size Status, Managerial Implications, Group Behaviour - Group Norms, Cohesiveness, Group Think	12 Hrs	Leadership Skills
4	Unit- IV Organizational Conflict, Change And Development	Conflict: Meaning – Process-causes- types of conflict-consequences of conflict, conflict resolution strategies. Organizational Change: Meaning - Nature of work change, Pressure for change, Change process, Types of change, Factors influencing change, Resistance to change, Overcoming resistance. Organizational Development – Meaning and different types of OD interventions. Case Study.	14 Hrs	Employability skills
5	Unit- V Organization culture	Culture, Definition, Culture's function, need and importance of Cross Cultural management, Stress and its Management.	10 Hrs	Employability skills

Books for Reference:

1. Aswathappa, K. (2017). Organizational Behaviour. HPH.
2. Appanniah &, Management and Behavioural Process, HPH.
3. Rekha, & Vibha. (2022). Organizational Behavioural. Vision Book House.
4. Robbins, S. P. (2005). Organizational Behaviour. International Book House.
5. Newstrom, J. W., & Davis, K. (1993). Organizational Behaviour. 11th ed. McGraw Hill.
6. Aquinas, P. G. (2013). Organizational Behavior. Excel Books.
7. Luthans, F. (1998). Organizational Behavior. 8th ed. McGraw Hill.

Web Resources:

1. https://saylordotorg.github.io/text_organizational-behavior-v1.1/
2. <https://opentextbc.ca/organizationalbehavioropenstax/chapter/content-theories-of-motivation/>
3. <https://www.sscasc.in/wp-content/uploads/downloads/BBM/Organizational-Behaviour.pdf>
4. <https://old.mu.ac.in/wp-content/uploads/2014/04/Management-PAPER-II-Organizational-Behavior-final-book.pdf>

Journals:

1. Albert, S. (1992). The algebra of change. Research in Organizational Behavior, 14, 179–229.
2. Kilduff, M., & Brass, D. J. (2010). Organizational social network research: Core ideas and key debates. Academy of Management Annals, 4, 317–357.
3. Kilduff, M., & Lee, J. W. (2020). The integration of people and networks. Annual Review of Organizational Psychology and Organizational Behavior, 7, 8.1–8.25.
4. Kilduff, M., Tsai, W., & Hanke, R. (2006). A paradigm too far? A dynamic stability reconsideration of the social network research paradigm. Academy of Management Review, 31, 1031–1048

M21DC 3.2: STATISTICS FOR BUSINESS

Total Teaching Hours: 60 Hours

No. of Hours / Week: 04

(04 credit)

CObj	Course Objectives
CObj_1	To develop the students ability to deal with numerical and quantitative issues in business
CObj_2	To enable the use of statistical, graphical and algebraic techniques wherever relevant.
CObj_3	To have a proper understanding of Statistical applications in Economics and Management.

CO	Course Outcomes
	After completion of this module, students should be able to:
CO1	Acquire the conceptual skill and working knowledge of tabulation of data and different types of samples
CO2	Apply methods of solving problems on central tendency, measures of dispersion, skewness and kurtosis.
CO3	Develop the knowledge of correlation and Regression analysis and interpretation of results.
CO4	Solve and interpret application problems in business.
CO5	Interpret the statistical tools to perform analysis of data through descriptive methods

CO-PO Mapping

	PO_1	PO_2	PO_3	PO_4	PO_5
CO_1		*			
CO_2				*	
CO_3		*			*
CO_4		*			
CO_5			*		

Course Content

S. No	Unit/chapter title	Course Content	Number of hours	Skills Developed
1	Unit- I Introduction to Statistics	Background and Basic concepts: introduction, definition of statistics- Functions- scope- limitations, classifications and Tabulations of Data.	08 Hrs	Analytical Skills
2.	Unit- II Descriptive Statistics	Average-Mean, Median and Mode [individual, discrete and continuous series], Weighted Average Measures of Dispersion, Range, Co- efficient of Range, Quartiles, Inter-Quartile Range and Quartile Deviation, Coefficient of Quartile Deviation, Standard Deviation, Coefficient of Variation, Skewness and Kurtosis; Measures of Skewness: Absolute and Relative; Co-efficient of Skewness: Karl Pearson's and Bowley's.	20 Hrs	Evaluation and Synthesis
3	Unit- III Inferential Statistics	Introduction to Correlation, Co-efficient of Correlation, Correlation through Scatter diagrams, Interpretation of Correlation Co- efficient. Regression-Spearman's Rank Correlation- Karl Pearson Co-efficient of Correlation- Co-efficient of determination.	10 Hrs	Analytical Skills
4	Unit- IV Probability	Sample space and Events, Simple and Compound Events, Probability and Probability distributions: Normal Distribution, Binomial and Poisson distribution- Bayes Theorem	12 Hrs	Cognitive Skills
5	Unit- V Index Number	Meaning and Definition- Uses Classification Construction of Index Numbers Methods of constructing Index Numbers Simple Aggregate Method Simple Average of Price Relative Method Weighted Index numbers, Fishers ideal Index (including Time and Factor Reversal tests) Consumer Price Index Problems	10 Hrs	Evaluation and Synthesis

Books for Reference:

1. Kirk, R. E. (2008). *Statistics: An Introduction* (5th ed.). Thomson-Wadsworth.
2. McClave, J. T., Benson, P. G., & Sincich, T. (2005). *Statistics for Business and Economics* (11th ed.). Pearson Prentice Hall.
3. Levin, J., & Fox, J. A. (2014). *Elementary Statistics in Social Research*. Pearson Education.
4. Gupta, S.P. (2021). *Statistical Methods*. S. Chand Publication.
5. Chikkodi, C. M. (2017). *Quantitative Methods For Business-II*. Himalaya Publishing House.
6. Anderson, D. R. (2015). *Quantitative Methods For Business*. 13th edition. Cengage Learning.
7. Sweeney, D. J., & Anderson, D. R. (2012). *Quantitative Methods For Business*. Thomson.

Web Resources:

1. <https://www.investopedia.com/ask/answers/032515/what-does-it-mean-if-correlation-coefficient-positive-negative-or-zero.asp>
2. <https://byjus.com/maths/probability/>
3. <https://www.economicdiscussion.net/price/index-number/index-numbers-characteristics-formula-examples-types-importance-and-limitations/31211>
4. <https://byjus.com/maths/central-tendency/>

Journals:

1. De Vos, I., and Everaert, G. (2019), "Bias-Corrected Common Correlated Effects Pooled Estimation in Homogeneous Dynamic Panels," *Journal of Business & Economic Statistics*
2. Everaert, G., and De Groote, T. (2016), "Common Correlated Effects Estimation of Dynamic Panels With Cross-Sectional Dependence," *Econometric Reviews*, 35, 428–463.
3. Gagliardini, P., and Gouriéroux, C. (2017), "Double Instrumental Variable Estimation of Interaction Models With Big Data," *Journal of Econometrics*, 201, 176–197.
4. Hayakawa, K. (2016), "Identification Problem of GMM Estimators for Short Panel Data Models With Interactive Fixed Effects," *Economics Letters*, 139, 22–26.

M21DC 3.3: FINANCIAL MANAGEMENT**Total Teaching Hours: 60 Hours****No. of Hours / Week: 04****(04 credit)**

CObj	Course Objectives
CObj_1	To offer the students relevant, systematic, efficient and actual knowledge of financial management
CObj_2	Develop knowledge on the allocation, management and funding of financial resources.
CObj_3	Improving students' understanding of the time value of money concept and the role of a financial manager in the current competitive business scenario.

CO	Course Outcomes
	After completion of this module, students should be able to:
CO1	To familiarize students with the concept of fundamental financial concepts, especially time value of money.
CO2	To create an awareness about capital structure
CO3	To make them understand the cost of capital in wide aspects
CO4	To provide knowledge about dividend policies
CO5	To enable them to understand working capital management

CO-PO Mapping

	PO_1	PO_2	PO_3	PO_4	PO_5
CO_1	*				
CO_2			*	*	
CO_3		*	*		
CO_4			*		
CO_5			*		*

Course Content

S. No	Unit/chapter title	Course Content	Number of hours	Skills Developed
1	Unit- I Introduction To Financial Management & Valuation Concepts	Part- A: Meaning of Finance: Business Finance, Finance Function, Financial Management, Goals of Financial Management, Financial Decisions, Role of a Financial Manager, Financial Planning, Steps in Financial Planning, Principles of a Sound Financial Planning, and Objectives of the firm. Part –B: Concept of Time value of Money, Process of Compounding and Discounting, Future Value of a Single amount, Future Value of an Annuity, Present Value of a Single Amount, Present Value of an Annuity, Rule of 69 and 72.	14 Hrs	Analytical Skills
2	Unit- II Financing Decision	Introduction – Meaning of Capital Structure, Factors influencing Capital Structure, Optimum Capital Structure, EBIT, EBT, EPS, Analysis, Leverages, Types of Leverages – Point of indifference, Cost of capital, Weighted Average, cost of capital, Simple Problems.	12 Hrs	Analytical Skills
3	Unit- III Investment Decisions	Introduction – Meaning and Definition of Capital Budgeting, Features, Significance, Process, Techniques – Payback Period, Accounting Rate of Return, Net Present Value, Internal Rate of Return, Profitability Index, Simple Problems- Case Study. Case Study	12 Hrs	Research Skills
4	Unit- IV Dividend Decision	Introduction – Meaning and Definition – Determinants of Dividend Policy, Types of Dividends, Provisions under Companies Act in relation to dividends	10 Hrs	Analytical Skills
5	Unit- V Working Capital Management	Introduction – Concept of Working Capital, Significance of Adequate Working Capital, Evils of Excess or Inadequate Working Capital, Determinants of Working Capital, Sources of Working Capital, Cash Management – Receivables Management, Inventory Management.- simple Problems on Operating cycle and estimation of working capital (Only Concepts).	12 Hrs	Analytical Skills.

Books for Reference:

1. Pandey, I. M. (2021). Essentials of Financial Management. Twelfth Edition. Vikas Publications.
2. Rustagi, R.P. (2017). Basic Financial Management. Sultan Chand: New Delhi.
3. Singh, J.K. (2016). Financial Management: Theory & Practice. Galgotia Publishing Company: New Delhi.
4. Singh, S., & Kaur, R. (2020). Basic Financial Management. Scholor Tech Press: New Delhi.
5. Tripathi, V. (2021). Basic Financial Management. Taxmann Publications.
6. Chandra, P. (2019). Financial Management: Theory and Practice. 10e. Tata McGraw Hill.
7. Khan, M.Y., & Jain, P.K. (2018). Financial Management: Text and Problems. 8e. Tata McGraw Hill.

Web Resource:

1. Investopedia - Provides articles, tutorials, and definitions related to financial management.
2. Financial Times - Offers news, analysis, and resources on financial management and global markets.
3. Harvard Business Review - Features articles and case studies on various aspects of financial management.
4. The Wall Street Journal - Provides news, analysis, and insights on finance and financial management.
5. IMF (International Monetary Fund) - Offers reports, data, and publications on global financial management and economic policies.
6. World Bank - Provides resources, research, and publications on financial management and development economics.
7. Corporate Finance Institute - Offers online courses, articles, and resources on corporate finance and financial management.
8. American Finance Association - Provides research papers, publications, and resources related to finance and financial management.

Journals:

1. Journal of Financial Management
2. Journal of Finance
3. Journal of Financial Economics
4. Journal of Financial and Quantitative Analysis
5. Journal of Financial Planning
6. Journal of International Financial Management & Accounting

M21OE 3.1: FINANCIAL LITERACY

Total Teaching Hours: 45 Hours

No. of Hours / Week: 03

(03 credit)

CObj	Course Objectives
CObj_1	To familiarize non-finance students with the essentials of finance and investments
CObj_2	To enable the students to use financial data in planning, and decision making
CObj_3	To equip students with general knowledge, basic tools, and techniques for managing their personal finance and investment decisions

CO	Course Outcomes
	After completion of this module, students should be able to:
CO1	Understand and interpret the financial statements of a company
CO2	Identifies the role and importance of the finance function in business
CO3	Take investment decisions for their personal portfolio
CO4	Develop an attitude towards investments and be able to assess risk and returns
CO5	Analyze and develop budget control techniques for an organization

CO-PO Mapping

	PO_1	PO_2	PO_3	PO_4	PO_5
CO_1	*	*			
CO_2			*	*	
CO_3		*	*		
CO_4		*	*		
CO_5				*	*

Course Content

S. No	Unit/chapter title	Course Content	Number of hours	Skills Developed
1	Unit- I Basics of Indian Financial System	Indian Financial System, functions of the Indian financial system, a basic understanding of the capital market, money market in India.	08 Hrs	Cognitive Skills
2	Unit- II Investment Decisions	What are investments?- Trading off between Risk & Returns- Golden Principles of Investments- Creating a personal portfolio- Investment in gold, investing in real estate, investment in mutual funds, government bonds, stock etc. advantages and disadvantages- Investing v/s savings- Do's and Don'ts of investments	10 Hrs	Cognitive Skills Analytical Skills
3	Unit- III Reading & Understanding Financial Statements	What are financial statements? - Basic terminologies – Assets, liabilities, current assets, current liabilities, long term assets and liabilities. Income, expenses etc.- How to read and understand financial statements- Differentiate between income statement and balance sheet- Interpreting various items in the financial statements.	10 Hrs	Analytical Skills
4	Unit- IV Loans	Loans – Different types of loans- home loans, vehicle loans, personal loans, jewelry loans, etc. - Calculation of EMIs, Fixed v/s floating- Calculation of rate of interest- Dos and Don'ts of loans- Credit worthiness, CIBIL Scores- Debit & Credit Cards	09 Hrs	Analytical Skills
5	Unit- V Budgetary Control	Budget and Budgetary control – Zero Based Budgeting, Performance budgeting.	08 Hrs	Analytical Skills

Books for Reference:

1. Pandey, I. M. (1995). Financial Management. Vikas Publishing House Pvt. Ltd.
2. Chandra, P. (2007). Financial Management. Tata McGraw Hill.
3. Khan, M.Y. & Jain, P.K. (2017). Financial Management. Tata McGraw Hill.
4. Kishore, R.M. (2020). Financial Management. 8th edition. Taxmann Publications.
5. Shah, P. (2009). Financial Management. 2 ed. biztantra.
6. White, G. I., Sondhi, A. C., & Fried, D. (2002). Financial Statements. Wiley Books.
7. Tripathi, V. (2021). Basic Financial Management. 3e. Taxmann Publications.

Web Resources:

1. www.icaai.org/students/Bos-knowledgeportal.
2. www.icmai.in
3. www.bseindia.com
4. www.capitalmarket.com
5. www.cmie.com
6. www.financeprofessor.com
7. www.moneycontrol.com
8. www.rbi.gov.in
9. www.sebi.gov.in

Journals:

1. Journal of Accounting
2. Indian Journal of Accounting

21SBC 3 .1: DIGITAL FLUENCY II
(Artificial Intelligence-IoT-Cloud Computing-Cyber Security)

Total Teaching Hours: 30 Hours

No. of Hours / Week: 3 Hrs/week

(2 Credits)

CObj	Course Objectives
CObj_1	To provide a basic understanding of Artificial Intelligence and its importance in today's world
CObj_2	To provide an understanding of cyber security and its importance in protecting internet-connected systems against malicious cyber-attacks
CObj_3	To provide a basic understanding of cloud computing and other related services over networks

CO	Course Outcomes
	After completion of this module, students should be able to:
CO1	Understand the machine languages and learning such as visual perception in decision making.
CO2	Apply appropriate tools and techniques to protect systems, networks, programs, worms and malicious cyber-attacks.
CO3	Apply and familiarize with services such as Dropbox, resource pooling, using the storage facilities, etc.
CO4	Demonstrate an understanding of IoT, create information about the connected objects, analyze it and make decisions.
CO5	Interpret and apply strong data storage and privacy of data in storage and transit.

Course Content

S. No	Unit title	Course Content	Number of Hours	Skills Developed
1	Unit- I Artificial Intelligence	Overview of Artificial Intelligence-meaning-definition-concept of AI-scope of AI. Application of Artificial Intelligence-How AI and machine learning are used in Business – Examples of AI in Business. AI in E-Commerce. Advantages and limitations of using AI in business. Meaning of machine learning-deep learning.	10 Hrs	logical Skills
2	Unit- II Internet of Things (IoT)	Introduction-meaning and definition of IoT, IoT devices and examples. Features of IoT, Technologies of IoT, Advantages and disadvantages of using IoT. Major components of IoT, Trusted IoT development companies in India. Applications of IoT.	8 Hrs	Technical & Analytical Skills
3	Unit- III Cloud Computing	Introduction, Meaning & definition of cloud computing. Characteristics of Cloud computing. Models of cloud computing. Cloud computing applications. Advantages & disadvantages of cloud computing.	7 Hrs	Technical & Analytical Skills
4.	Unit- IV Cyber Security	Introduction- Meaning & importance of cyber security. key concepts of cyber security. Types of cybersecurity.	6 Hrs	Cognitive, Logical & Analytical Skills

Books for Reference:

1. Saha, Kantesha, Asif, (2021), “Digital Fluency”, 1st Edition, HimalayaPublishing House, India.
2. Russell and Peter Norvig, (2010), “Artificial Intelligence, A Modern Approach” Third Edition, Prentice-Hall, Pearson Education Inc. Erickson,(2008),” Hacking: The Art of Exploitation”, second edition, Pearson Education Inc.
4. Wang, Ranjan, Chen, Benatallah,(2017), “ Cloud Computing”, first edition, CRC Press

Web Resources:

1. https://cloud.google.com/compute/?utm_source=google&utm_medium=cpc&utm_campaign=japac-IN-all-en-dr-bkwsrmkt-all-all-trial-e-dr-1009882&utm_content=text-ad-none-none-DEV_c-CRE_505012043176-ADGP_Hybrid%20%7C%20BKWS%20%20EXA%20%7C%20Txt%20~%20Compute%20~%20Compute%20Engine_Business%20Services%20-%20google%20cloud%20computing.
2. <https://www.netohq.com/blog/cyber-security-and-ecommerce>
3. <https://www.i-scoop.eu/internet-of-things-iot/internet-of-things-in-manufacturing/>

Journals:

1. Artificial Intelligence Journal (AIJ)
2. Journal of Artificial Intelligence Research (JAIR)
3. Journal of Internet of Things (JIOT)
4. International Journal of Internet of Things and Cyber-Assurance
5. Internet of Things (IoT) Journal
6. IEEE Transactions on Cloud Computing
7. Journal of Cloud Computing: Advances, Systems, and Applications
8. International Journal of Cloud Computing
9. Journal of Cybersecurity
10. Computers & Security

NEP- Curriculum Framework
B.B.A - Matrix for IV Semester (w.e.f. 2021-22 onwards)

IV Semester							
Code	Course Code	Course	Teaching Hours	Course Components			Credits
				L	T	P	
AECC	M21KN 1.1/ M21HN1.1/ M21AE 1.1	Language I (Kannada/Hindi/Additional English)	45	3	1	-	3
AECC	M21GE1.1	Language II (Generic English)	60	3	1	-	3
DSC	M21DC 4.1	International Business	60	4	-	-	4
DSC	M21DC 4.2	Production and Operations Management	60	4	-	-	4
DSC	M21DC 4.3	Management Accounting	60	4	-	-	4
OE-4	M21OE 4.1	Event Management	45	3	-	-	3
SEC	21SBC 4.1	Constitution of India	45	2	1	-	3
SEC-VB	21VBC 4.1	Sports	30	-	-	2	1
SEC-VB	21VBC 4.2	NCC/NSS/R&R/Cultural	30	-	-	2	1
Total							25

Note 1:

AECC- Ability Enhancement Compulsory Course

DSC - Discipline-Specific Course

OE- Open elective (course offered by the department to students of other stream)

SEC - VB Skill Enhancement Course -Value Based

SEC - SB Skill Enhancement Course -Skill Based

Continuous Internal Assessment – Scheme of Evaluation
For Theory Courses

End Semester Examination: 60%

Continuous Internal Assessment: 40%

Activities (CIA: 40 Marks)	Proposed and Approved Scheme		Total Marks (40)
	IA-1	IA-2	
Session Test Maximum Marks	30	30	
1. Weightage (Marks)	10	10	20
2. Assignment (Marks)	20		20
i. Writing	10		
ii. Quiz / Presentation / Creating diagrams /charts / Classwork / Case study / Viva / Field work etc.	05		
iii. Classroom participation	05		
Total			40

M 21 DC 4.1: INTERNATIONAL BUSINESS**Total Teaching Hours: 60****No. of Hours / Week: 4****(04 credit)**

CObj	Course Objectives
CObj_1	To provide an understanding of the importance of international business has on the modern world.
CObj_2	To enable students to identify the factors that must be considered by a multinational corporation before entering a different country.
CObj_3	To provide an understanding of how international trade affects economic growth of a country.

CO	Course Outcomes After completion of this module, students should be able to:
CO1	Understands the stages of internationalization
CO2	Applies concepts to choose the companies strategies on mode of entry into another rcountry
CO3	Analyze the strategies adopted by companies to expand globally
CO4	Apply and adopt the procedures followed in India's import and export trade
CO5	Demonstrate market fluctuations in foreign exchange that affect trade

CO-PO Mapping

	PO_1	PO_2	PO_3	PO_4	PO_5
CO_1	*				
CO_2		*			*
CO_3				*	
CO_4			*	*	
CO_5	*			*	*

Course Content

S. No	Unit/chapter title	Course Content	Number of hours	Skills Developed
1	Unit- I Introduction to International Business	Meaning and Definition of International Business – Nature of International Business, Globalization: Meaning – Features, Advantages and Disadvantages	12 Hrs	Cognitive Skills
2	Unit- II Modes Of Entry into International Business	Mode of Entry – Exporting, Licensing, Franchising, Contract Manufacturing, Turn Key Projects, Foreign Direct Investment, Mergers, Acquisitions, and Joint Ventures. Comparison of different modes of Entry (Case Study)	12 Hrs	Employable Skills; Cognitive Skills
3	Unit- III International Finance	Exchange rate and economic adjustment - Direct and indirect quote, parity theorems – PPP, numerical on exchange rates (Simple problems), international parity relations, International monetary system	12 Hrs	Analytical Skills
4	Unit- IV International Marketing Intelligence	Information required – Source of Information, International Marketing Information System and Marketing Research (Case Study)	10 Hrs	Analytical Skills Research Skills
5	Unit- V EXIM Trade	Export Trade, Procedure, Steps & Documentation, Direction of India's Trade, Export Financing, Documents related to Export Trade, Import Trade, Procedure, Steps, Documentations and Problems. EXIM Policy – Basics of balance of payments, Institutions connected with EXIM Trade, cross country risk analysis	14 Hrs	Employable Skills

Books for Reference:

1. Aswathappa, K. (2022). International Business. 6th ed. McGraw Hill Education.
2. Begum, Z., Paramesh, P. and Sudha, B. (2017). International Business. 1st ed. Himalaya Publishing House.
3. Hill, C. (2021). International Business. 13th ed. Tata McGraw Hill.
4. Peng, M. and Meyer, K. (2011). International Business. Cengage Learning EMEA.
5. Clark, E. (2007). International Finance Management. 2nd ed. Cengage Learning.

Web Resource:

1. World Economic Forum (WEF)
2. The International Trade Centre (ITC)
3. World Trade Organization (WTO)
4. Investopedia

Journals:

1. Journal of International Business Studies (JIBS)
2. International Business Review
3. Global Strategy Journal
4. Management International Review
5. Journal of World Business
6. International Marketing Review
7. International Business Review
8. International Journal of Business and Emerging Markets
9. International Journal of Business Governance and Ethics

M21DC 4.2: PRODUCTION & OPERATIONS MANAGEMENT

Total Teaching Hours: 60

No. of Hours / Week: 04

(04 credit)

CObj	Course Objectives
CObj_1	To analyze the basics of production and operations management and the responsible factors.
CObj_2	To facilitate the various activities relating to scheduling and measuring of production take place and how control can be obtained on both product and quality.
CObj_3	To create supply and logistics, distribution networks, and their management.

CO	Course Outcomes
	After completion of this module, students should be able to:
CO1	Apply the concept of operations management in manufacturing and service sector and will be able to plan and implement production and service-related decisions.
CO2	Plan production schedules and plan resources (material and machine) required for production.
CO3	Explore employment opportunities in sales and operations positions with transportation providers in the region.
CO4	Apply logistics and supply chain strategies can create value generation and utilize it with applications.
CO5	Develop an understanding of the importance of logistics in the formulation of the business strategy.

CO-PO Mapping

	PO_1	PO_2	PO_3	PO_4	PO_5
CO_1			*		
CO_2	*	*			
CO_3			*	*	
CO_4		*		*	*
CO_5			*		*

Course Content

S. No	Unit/chapter title	Course Content	Number of hours	Skills Developed
1	Unit- I Introduction to POM	Introduction to Production and Operations Management: Introduction to Operations Management, its Nature, Scope, Importance and Functions. Types of Production, Mass, Job-Based, Batch and Assembly Line Production System.	12 Hrs	Employability Skills
2	Unit- II Plant Location and Layout	Facilities and Production Planning: Factors Affecting Plant Location, Types of Plant Layouts – Product Layout, Process Layout, Fixed Position Layout, Cellular Layout, Types of Service Layouts. Concept of Production Planning, Definitions of Capacities, Master Production Schedule, Material Planning and Maintenance.	12 Hrs	Cognitive Skills
3	Unit- III Materials Management	Material Management: Scope of Materials Management, Purchase and Stores Functions, Introduction to Warehouse Management, Concept of Lead Time, Re-order Level, Minimum and Maximum Stock, Basic Concepts of Inventory Management, Inventory Costs, Ordering and Carrying Cost.	12 Hrs	Analytical Skills
4	Unit- IV Logistics Management	Basics of Logistics Management-Introduction to physical distribution, Logistics Management-Logistics Management and its elements, Modern Concepts in Logistics, Role of logistics in strategy, Container -types -Different types of cargo, Trends in logistics.	12 Hrs	Employability Skills
5	Unit- V Supply Chain Management	Warehousing and supply chain management-Introduction to supply Chain Management (SCM), Sourcing, Transportation, Indian supply chain architecture, Introduction to warehousing - Warehouse functions, Warehouse types, Inbound and outbound supply chain management, Warehouse providing value added services, Warehouse internal operations, Warehousing equipment, Inventory-Safety and security in warehouses, Future trends in warehousing.	12 Hrs	Employability Skills

Books for Reference:

1. Adam, E., & Ebert, R. (1992). Production and Operations Management. Fifth Edition. Prentice-Hall.
2. Stevenson, W. J. (2017). Operations Management. 13th Edition. McGraw-Hill Education.
3. Pannerselvam, R. (2012). Production and Operations Management. 3e. PHI.
4. Bowersox. (2011). Supply Chain Logistics Management: Mc Graw Hill.
5. Bowersox, (2000). Logistical Management: Mc-Graw Hill,
6. Reguram G, Rangaraj N. (1999). Logistics and Supply Chain Management Cases and Concepts: Macmillan India Ltd., New Delhi.
7. Sahay B.S. (2003). Supply Chain Management for Global Competitiveness: Macmillan India Ltd., New Delhi.

Web Resources:

1. <https://www.investopedia.com/terms/s/scm.asp>
2. <https://www.epa.gov/homeland-security-waste/waste-management-benefits-planning-and-mitigation-activities-homeland>
3. <https://www.linkedin.com/pulse/production-operations-management-plant-layout-patrick-mutabazi>

Journals:

1. Aissani, N., A. Bekrar, D. Trentesaux, and B. Beldjilali. 2012. "Dynamic Scheduling for Multi-Site Companies: a Decisional Approach Based on Reinforcement Multi-Agent Learning." *Journal of Intelligent Manufacturing* 23 (6): 2513–2529.
2. Al-Sayed, R., and J. Yang. 2020. "Towards Chinese Smart Manufacturing Ecosystem in the Context of the One Belt One Road Initiative." *Journal of Science and Technology Policy Management* 11 (3): 291–310.
3. Angizeh, F., H. Montero, A. Vedpathak, and M. Parvania. 2020. "Optimal Production Scheduling for Smart Manufacturers with Application to Food Production Planning." *Computers & Electrical Engineering* 84: 106609.
4. Barenji, A. V., R. V. Barenji, and M. Hashemipour. 2016. "Flexible Testing Platform for Employment of RFID-Enabled Multi-Agent System on Flexible Assembly Line." *Advances in Engineering Software* 91: 1–11.
5. Benotsmane, R., G. Kovács, and L. Dudás. 2019. "Economic, Social Impacts and Operation of Smart Factories in Industry 4.0 Focusing on Simulation and Artificial Intelligence of Collaborating Robots." *Social Sciences* 8 (5): 143.
6. Bortolini, M., E. Ferrari, M. Gamberi, F. Pilati, and M. Faccio. 2017. "Assembly System Design in the Industry 4.0 Era: A General Framework." *IFAC-Papers On Line* 50 (1): 5700–5705.

M21DC 4.3: MANAGEMENT ACCOUNTING**Total Teaching Hours: 60****No. of Hours per Week: 04****(04 credits)**

CObj	Course Objectives
CObj_1	Understand management accounting and various tools of financial analysis
CObj_2	Analyse profitability and financial status of a business based on ratios calculated and Understand the preparation of Cash flow statement
CObj_3	Apply marginal costing technique in managerial decision making problems and evaluate different proposals and Understand and further analyze different types of budgets

CO	Course Outcomes
	After completion of this module, students should be able to:
CO1	Recognize the relationship between Cost, Financial and Management Accounting
CO2	Draw conclusion about the liquidity, solvency and profitability of business entities based on ratio analysis
CO3	Prepare Cash flow statement based on Revised Accounting Standard and make inferences
CO4	Prepare marginal cost statement and calculate breakeven point
CO5	Compare different proposals based on marginal costing technique and draw conclusion Understand the concepts of budgeting and budgetary control and its role in management decision making

CO-PO Mapping

	PO_1	PO_2	PO_3	PO_4	PO_5
CO_1	*				
CO_2		*			
CO_3			*	*	
CO_4				*	
CO_5					*

Course Content

S. No	Unit/chapter title	Course Content	Number of hours	Skills Developed
1	Unit- I Introduction to Management Accounting	Introduction- Meaning and Definition, Objectives, Nature and Scope, Functions, Role of Management Accountant, Relationship between Financial Accounting and Management Accounting, Relationship between Cost Accounting and Management Accounting, advantages and limitations of Management.	08 Hrs	Communication Skills
2	Unit- II Ratio Analysis	Introduction-Meaning and Definition of ratio, Meaning of Accounting ratio, and Ratio Analysis, Uses and Limitations, Classification of ratios- Liquidity ratios, Profitability ratios and Solvency ratios. Problems on conversion of financial statements into ratios and ratios into financial statements.	14 Hrs	Analytical/ Logical/ Research/ Employable Skills
3	Unit- III Cash Flow Analysis	Meaning and Definition of Cash Flow Statement – Concept of Cash and Cash Equivalents, Uses of Cash Flow Statement, Limitations of Cash Flow Statement, Differences between Cash Flow Statement and Fund Flow Statement, Provisions of Ind. AS-7. Procedure for preparation of Cash Flow Statement, Cash Flow from Operating Activities, Cash Flow from Investing Activities and Cash Flow from Financing Activities, Preparation of Cash Flow Statement according to Ind. AS7	12 Hrs	Analytical/ Logical/Cog native Skills
4	Unit- IV Marginal Costing	Introduction-Meaning and definition of marginal cost, marginal costing, features of marginal costing- terms used in marginal costing – P/V ratio, BEP, Margin of Safety, Angle of Incidence and Break-Even Chart. Break Even Analysis- assumption and uses problems.	12 Hrs	Analytical/ Logical/ Cognitive Skills
5	Unit- V Budgetary Control and Management Reporting	Meaning and Definition of Budget and Budgetary Control, objectives of budgetary control, advantages and limitations of budgetary control, essentials of effective budgeting, Types of budget- Functional budgets, Master Budget, Fixed and Flexible Budget, Problems on Flexible budget and Cash Budget. Meaning of Reporting and Reports, Essentials of an ideal report, Designing and Installation of Reporting system, Types of Reports, Drafting of Reports under different situations.	14 Hrs	Communication/ Analytical/ Logical / Cognitive Skills

Book for Reference:

1. Batty J. (1969). Management Accountancy, 3rd Edition, Delhi, Macdonald & Evans Ltd.
2. Foster, G. (1986). Financial statement analysis (2nd ed.). Upper Saddle River, NJ: Prentice Hall.
3. Goyal, S.N., & Manmohan. (2013). Cost and management accounting (1st ed.). New Delhi: Sultan Chand & Sons.
4. Khan, M.Y., & Jain, P.K. (2017). Management accounting (7th ed.). New Delhi: Tata McGraw Hill Publication.
5. Made Gowda. (2010). Management accounting (1st ed.). New Delhi: Himalaya Publishing House.
6. Maheswari, S.N. (2018). Advanced accountancy (11th ed.). New Delhi: Vikas Publishing.
7. Pandey, I.M. (2018). Management accounting (3rd revised ed.). New Delhi: Vikas Publishing House.
8. Jain, & Narang. (2016). Cost and management accounting. New Delhi, India: Kalyani Publisher.

Web Resources:

1. The Economist (economist.com/topics/corporate_accounting)
2. www.icai.org/students/Bos-knowledgeportal.
3. www.icmai.in
4. Indian Journal of Accounting
5. The Chartered Accountant.

Journals:

1. <https://www.sciencedirect.com/journal/management-accounting-research>
2. <https://www.emerald.com/insight/publication/ISSN/1030-9616>
3. <https://www.cribfb.com/journal/index.php/ijafr>
4. <https://journals.indexcopernicus.com/journal/69134>
5. Journal of Accounting

M21OE 4.1: EVENT MANAGEMENT**Total Teaching Hours: 45 Hours****No. of Hours / Week: 03****(03 credit)**

CObj	Course Objectives
CObj_1	To provide the means to compare actual performance in an IT environment against desired performance.
CObj_2	To Provide the entry point for many process and activities of Service Operation
CObj_3	To provide a basis for service assurance, reporting and service improvement.

CO	Course Outcomes
	After completion of this module, students should be able to:
CO1	Identify the key characteristics of an event.
CO2	Recognize the key management competencies required in the events industry and to use interpersonal and communications skills to pursue career in events industry.
CO3	Apply the conceptual framework of Event Management, Event Services, Conducting Event and Managing Public Relations.
CO4	Identify the importance of communication for leadership & decision making.
CO5	Acquire competencies to: Plan a proposal on management of an event

CO-PO Mapping

	PO_1	PO_2	PO_3	PO_4	PO_5
CO_1	*	*			
CO_2			*		
CO_3		*			
CO_4	*			*	
CO_5			*		*

Course Content

S. No	Unit/chapter title	Course Content	Number of hours	Skills Developed
1.	Unit- I Introduction to Event Management	Event- Meaning- Why Event Management- Analysis of Event, Scope of Event, Decision Makers- Event Manager Technical Staff- Establishing of Policies & Procedure- Developing Record Keeping Systems.	10 Hrs	Cognitive Skills
2.	Unit- II Event Management Procedure	Principles for holding an Event, General Details, Permissions- Policies, Government and Local Authorities, - Phonographic Performance License, Utilities- Five Bridge Ambulance Catering, Electricity, Water Taxes Applicable.	10 Hrs	Analytical Skills
3.	Unit- III Conduct of an Event	Preparing a Planning Schedule, Organizing Tables, Assigning Responsibility, Communication and Budget of Event- Checklist, Computer aided Event Management- Roles & Responsibilities of Event Managers for Different Events.	10 Hrs	Cognitive Skills
4.	Unit- IV Public Relations	Introductions to Public Relations- Concept- Nature- Importance- Limitations- Media- Types of Media- Media Management, Public Relation Strategy & Planning. Brain Storming Sessions- Writings for Public Relations.	08 Hrs	Transferrable Skills
5.	Unit- V Corporate Events	Planning of Corporate Event, Job Responsibility of Corporate Events Organizer, Arrangements, Budgeting, Safety of Guests and Participants, Creating Blue Print, Need for Entertainment in Corporate Events And Reporting.	07 Hrs	Employable Skills

Books for Reference:

1. Sonder, M. (2011). Event Entertainment and Production. Hoboken, NJ: Wiley & Sons, Inc. ISBN: 0-471-26306-0. Ghouse Basha – Advertising & Media Mgt
2. Anne Stephen. (2021) Event Management. HPH.
3. Kilkenny, S. (2021). The Complete Guide to Successful Event Planning. 2nd Edition. Atlantic Publishing Co.
4. Van der Wagen, L. (2015). Human Resource Management for Events. Routledge.
5. Hayed, N. (1996). Successful Team Management [Paperback]. Cengage Learning EMEA.
6. Mohan, S. (2012). Event Management & Public Relations. Enkay Publishing House.
7. Goyal, S. K. (2009). Event Management & Public Relations. Adhyayan Publisher.

Web Resources:

1. <https://www.comit.ie/latest-news-from-comit/what-are-the-different-types-of-pr.798.html>
2. <https://www.celebritycorporatekit.com/our-blog/6-types-of-corporate-events-which-is-right-for-your-organization/>
3. <https://www.wildapricot.com/blog/how-to-plan-an-event>

Journals:

1. Camerlengo, Quirino. 2009. Il Cerimoniale, tra Stato e Regioni, e la Correttezza Costituzionale [The Ceremonial, between State and Regions, and the Constitutional Fairness]. In *Le Regioni*, n.3-4, 763- 775.
2. De Lasio, Emiliana, Matthew Hibberd, Michael Higgins and Michele Sorice. 2012. *La Leadership Politica. Media e Costruzione del Consenso* [Political Leadership. Media and Consensus Building]. Roma: Carocci Editore.
3. Maimone, Fabrizio. 2014. *La Comunicazione Organizzativa. Comunicazione, Relazioni e Comportamenti Nelle Imprese, Nella P.A. e nel no Profit* [The Organisational Communication. Communication, Relationships and Behaviors in Business, in P.A. and in the no Profit]. Milano: Angelini.
4. Ricci, Maurizio. 2016. *Più Tecnologia, Meno Produttività* [More Technology, Less Productivity]. Roma: La Repubblica.
5. Sgrelli, Massimo. 2016. *Il Cerimoniale. Il Cerimoniale Moderno ed il Protocollo di Stato: Regole Scritte e non Scritte* [The Ceremonial. The Modern Ceremonial and the State Protocol: Written and Unwritten Rules]. Aquila: Di Felice Editore.

NEP- Curriculum Framework

B.B.A - Matrix for V Semester (w.e.f. 2021-22 onwards)

V Semester							
Code	Course Code	Course	Teaching hours	Course Components			Credits
				L	T	P	
DSC	M21DC 5.1	Banking and Insurance	60	4	-	-	4
DSC	M21DC 5.2	Income Tax	60	4	-	-	4
DSC	M21DC 5.3	Business Policy and Strategy	60	4	-	-	4
DSE	M21DEF 5.4	Finance-Financial Market and Service	45+45	3+3	-	-	3+3
	M21DEH 5.4	Human Resource-Employee Welfare and Industrial Relations					
	M21DEM 5.4	Marketing- Advertising and Sales Promotion					
Vocational -1	21VOC 5.1	Information Technology for Managers	4	4	-	-	4
SEC-SB	21SEC 5.1	Soft Skills for Business	2				2
Total							24

Note 1:

AECC- Ability Enhancement Compulsory Course

DSC - Discipline-Specific Course

OE- Open elective (course offered by the department to students of other stream)

VOC - VB Skill Enhancement Course -Vocational Based

SEC - SB Skill Enhancement Course -Skill Based

Continuous Internal Assessment – Scheme of Evaluation For Theory Courses

End Semester Examination: 60%

Continuous Internal Assessment: 40%

Activities (CIA: 40 Marks)	Proposed and Approved Scheme		Total Marks (40)
	IA-1	IA-2	
Session Test Maximum Marks	30	30	
1. Weightage (Marks)	10	10	20
2. Assignment (Marks)	20		20
i. Writing	10		
ii. Quiz / Presentation / Creating diagrams / charts / Classwork / Case study / Viva / Field work etc.	05		
iii. Classroom participation	05		
Total			40

SEMESTER V**M21DC 5.1: BANKING & INSURANCE****Total Teaching Hours: 60****No. of Hours per Week: 4****(4 credits)**

Cob_j	Course Objectives
CObj_1	Introduce the students to the basic concept of banking as a financial intermediation service and bank as a financial institution.
CObj_2	To Familiarize students with crucial banking operations and fundamentals of bank lending.
CObj_3	To enlighten the students with the Introduction of insurance concepts.

CO	Course Outcomes
	After completion of this module, students should be able to:
CO1	After this course the students would have the fundamental knowledge of banking as a service and bank as an institution.
CO2	Understand the working and functioning of the Insurance Sector and study the inter-relationship between Insurance & Risk Management.
CO3	Students will be updated with the latest technology and innovation that are currently being used in banks.
CO4	Students will be able to express opinions about banking in written and oral form, based on the basic knowledge and skills acquired.
CO5	Obtain an overview of the Regulatory Framework of the Insurance Sector.

CO-PO Mapping

	PO1	PO2	PO3	PO4	PO5
CO1		*			
CO2			*		
CO3	*				
CO4				*	
CO5			*		

Course Content

S. No	Unit title	Course Content	Number of Hours	Skills Developed
1.	Unit- I Origin of Banking	Evolution of Banking-Kinds of banks–primary and secondary Functions of commercial banks – structure of banking system in India- types of deposit-Credit creation of commercial banks-General and special relationship between banker and customer. Reserve Bank of India: Organization, Role And functions, Techniques of credit control.	16 Hrs	Cognitive Skills
2.	Unit- II Operations of Banking	Kinds of Negotiable Instruments – Cheques: types of crossing-Endorsements: Meaning – Essentials – Kinds of Endorsement. Banking innovations: New technology in banking, RTGS, SWIFT, NEFT, MICR, DEMAT, ECS, API, Digital wallets, E-Services, Internet banking. Critical comparison of traditional banking methods and e-banking.	10 Hrs	Employable & Cognitive Skills
3.	Unit- III Principles of Bank Lending	Sound Principles of bank lending- Non-Performing Assets: Introduction, Provision for NPAs, and Management of NPA- Impact of NPAs on Banking Sector-Banker's Lien –Right of set off –garnishee order- income tax attachment order. Insolvency and Bankruptcy Code 2016.	12 Hrs	Cognitive Skills
4.	Unit- IV Risk and Insurance	Defining risk, nature and types of risk, risk management process, Risk and its relation with insurance, Classification of insurance life and non-life, fundamental Principles of Insurance. Salient features of IRDA Act.	10 Hrs	Cognitive & Employable Skills
5.	Unit- V Life & General Insurance	Life insurance: Life - principles, products term insurance endowment, insurance, pensions, Group Insurance. General Insurance: Fire Insurance: Meaning, nature, Policies and conditions of fire insurance. Subrogation and Reinsurance; Marine insurance: Meaning, nature, Principles of marine insurance, Policies and conditions to marine insurance, Accident and motor insurance, Concept of health insurance and Catastrophe insurance	12 Hrs	Cognitive & Employable Skills

Books for Reference:

1. Agarwal, O. P. (2019). Banking and Insurance. HPH.
2. Kumar, S. (2018). Banking and Insurance. Galgotia Publishing Company.
3. Gordon, & Natrajan. (2013). Banking Theory Law and Practice. HPH.
4. Maheshwari, S.N. (1999). Banking Law and Practice. 5th Edition. Kalyani Publishers.
5. Naidu, G., & Poddar, S.K. (2018). Law and Practice of Banking. VBH.
6. Prakash, M. (2016). Banking Regulation & Operations. VBH.
7. Tannan, M.L. (2010). Banking Law and Practice in India. Wadhwa and Company.

Web Resource:

1. Federal Deposit Insurance Corporation (FDIC): <https://www.fdic.gov/>
2. Federal Reserve System: <https://www.federalreserve.gov/>
3. Insurance Information Institute (III): <https://www.iii.org/>
4. National Association of Insurance Commissioners (NAIC): <https://www.naic.org/>
5. Investopedia - Banking and Insurance Section: <https://www.investopedia.com/banking-4689817>

Journals:

1. <https://stmjournals.com/Journal-of-banking-and-Insurance-Laws.html>
2. https://papers.ssrn.com/sol3/papers.cfm?abstract_id=4204338&dgcid=ejournal_html_email_banking:insurance:ejournal_abstractlink
3. https://www.sciencedirect.com/journal/journal-of-banking-and-finance?start_rank=42881

M21DC 5.2: INCOME TAX**Total Teaching Hours: 60****No. of Hours per Week: 4****(4 credits)**

CObj	Course Objectives
CObj_1	To enable the students to identify the basic concepts, definitions and terms related to Income Tax and to determine the residential status of an individual and scope of total income.
CObj_2	To enable the students to compute income under various heads namely income from salaries, house property, business/ profession, and income from other sources and also to discuss the various deductions under the Income tax act, 1961.
CObj_3	To enable the students to compute the net total taxable income of an individual.

CO	Course Outcomes
	After completion of this module, students should be able to:
CO1	Identify the technical terms related to Income Tax.
CO2	Determine the residential status of an individual and scope of total income.
CO3	Compute income from salaries, house property, business/profession, and income from other sources.
CO4	Analyse various benefits/ deductions under the Income Tax Act, 1961.
CO5	Compute the net total income of an individual.

CO-PO Mapping

	PO_1	PO_2	PO_3	PO_4	PO_5
CO_1	*				
CO_2		*	*		
CO_3				*	
CO_4			*	*	
CO_5		*			*

Course Content

Sl. No.	Unit title	Content	No of Hours	Skills Developed
1	Unit- I Introduction to Income Tax and Residential Status	Brief history of Indian Income Tax, legal framework, types of taxes, canons of taxation, definitions, assessment, assessment year, previous year including exception, assessee, person, income, casual income, gross total income, scheme of taxation, meaning and classification of capital and revenue. Residential status of an individual's, Determination of residential status, incidence of tax- problems	14 Hrs	Cognitive Skills
2	Unit- II Income from Salary	Meaning, definitions, basis of charge, advance salary, arrears of salary, allowances, perquisites, profits in lieu of salary, provident fund, gratuity, pension, encashment of earned leave, deductions from salary U/S 16, problems on computation of salary income (excluding retirement benefits).	18 Hrs	Employable Skills
3	Unit- III Income from House Property	Basis of charge, deemed owners, exempted income from house property, composite rent, Annual value, determination of Annual value, treatment of unrealized rent, loss due to vacancy, deductions from Annual value U/S 24, problems on computation of income from house property.	10 Hrs	Technical Skills
4	Unit- IV Profits and Gains from Business or Profession	Meaning and Definition of Business, Profession Vocation, Expenses Expressly Allowed – Allowable Losses, Expenses Expressly Disallowed, Expenses Allowed on payment basis. Problems on Business relating to Sole trader and Problems of Profession relating to Chartered Accountant, Doctor, Advocate and Medical practitioners.	10 Hrs	Interpersonal Skills
5	Unit- V Computation of Total Income	Income from other sources (Theory only) Deductions u/s: 80 C, 80 CCC, 80 CCD, 80 D, 80 DD, 80 E, 80 G, 80 GG, 80 GGA, 80 QQB, 80 U. Simple problems on computation of total income of an individual.	08 Hrs	Cognitive Skills

Books for Reference:

1. Lal, B. (2013). Direct Taxes. Konark Publisher (P) Ltd.
2. Prasad, B. (2009). Direct Taxes – Law and Practice. WishwaPrakashan.
3. Pagre, D. (2021). Law and Practice of Income Tax. Sultan Chand and Sons.
4. Ahuja, G., & Gupta, R. (2021). Income Tax. Commercial Law Publishers.
5. Mehrotra, Dr., & Goyal, Dr. (2020). Direct Taxes – Law and Practice. Sahitya Bhavan Publication.
6. Singhanian, V. K. (1990). Direct Taxes – Law and Practice. Taxmann Publication.
7. Gaur, & Narang. (2021). Income Tax. KALYANI PUBLICATIONS.

Web Resources:

1. Tax Treatment on Income from Salary - <https://taxguru.in/income-tax/tax-treatment-income-salary.html>
2. Deductions from IFHP - <https://cleartax.in/s/deductions-under-section24-income-from-house-property>
3. Profit and Gains of Business and Profession - <https://www.indiafilings.com/learn/profits-gains-business-profession-income-tax/>

Journals:

1. <https://www.studocu.com/in/document/tamil-nadu-dr-ambedkar-law-university/taxation-law/salary-chapter-notes-by-ca-rajat-mogha-sir/9970385>
2. Chromeextension://efaidnbmnnnibpcajpcglclefindmkaj/https://incometaxindia.gov.in/tutorials/12.%20income-from-house-property.pdf
3. chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/https://www.vazecollege.net/wp-content/uploads/2016/08/Unit_6-Business_Income.pdf

M21DC 5.3: BUSINESS POLICY AND STRATEGY**Total Teaching Hours: 60****No. of Hours per Week: 4****(4 credits)**

CObj	Course Objectives
CObj_1	To gain knowledge about the business policy, vision, mission and strategic management
CObj_2	To analyze the environment in which businesses operate and assess their significance for strategic planning and implementation
CObj_3	To foster the understanding levels of strategy, strategy formulation and implementation processes at corporate and business level.

CO	Course Outcomes
	After completion of this module, students should be able to:
CO1	Apply understanding about business policy and strategic management in organizations.
CO2	Analyses the environment in which businesses operate and assess their significance for strategic planning.
CO3	Determine functional level strategies
CO4	Apply strategic alternatives at business and corporate level
CO5	Apply tactics and frameworks for strategic implementation

CO-PO Mapping

	PO_1	PO_2	PO_3	PO_4	PO_5
CO_1	*	*			
CO_2		*			*
CO_3				*	*
CO_4			*		*
CO_5		*			

Course Content

S. No	Unit/chapter title	Course Content	Number of hours	Skills Developed
1	Unit- I Introduction To Business Policy	Nature and Importance of Business Policy - Definitions of Policy, Procedures, Process and Programmes, - Types of Policies - Policy Formulation and Implementation - Company's vision and mission - need for a mission statement, criteria for evaluating a mission statement - Goal, Process & Input formulation of the mission statement - Drucker's Performance Area. Strategic management - need, scope, importance and process	12 Hrs	Conceptual Skills
2	Unit- II Strategic Analysis	External Environment- Appraisal using PESTEL – Competitor Analysis using Porter's 5- Forces model, Environmental Threat and Opportunity Profile (ETOP) - Value chain Analysis, Scanning Functional Resources and Capabilities for building Organization Capability Profile (OCP) SWOT Analysis.	14 Hrs	Analytical Skills
3	Unit- III Functional Level Strategies	Functional level strategy Concept - Types - Marketing strategies, HRM strategies, Financial strategies, Research and development strategies, Production Strategies.	10 Hrs	Cognitive Skills
4	Unit- IV Strategic Analysis	Strategic alternatives at corporate level - concept of grand strategies - Strategic choice models, Strickland's Grand Strategy, Selection Matrix, Model of Grand Strategy Clusters, BCG, GE Nine Cell Matrix, Strategic alternatives at business level.	12 Hrs	Employable Skills
5	Unit- V Strategic Implementation	Strategic Implementation: Developing short-term objectives and policies, functional tactics and rewards, Structural Implementation: an overview of Structural Considerations Behavioral Implementation: an overview of: Leadership and Corporate Culture Mc Kinsey 7-S Framework Establishing Strategic Control	12 Hrs	Cognitive Skills / Analytical Skills

Books for Reference:

1. Kazmi, A. (2014) Strategic Management and Business Policy. McGraw Hill Education
2. Subbarao(2017) Business Policy and Strategic Management, HPH
3. Strickland, A.J. III & Thompson, A.A. (2009) Strategic Management: Concepts and Cases.13th Edition. McGraw Hill Education
4. Pearce, J.A. & Robinson, R.B.(2017) Strategic Management: Formulation Implementation and Control. 12th Edition. McGraw Hill Education
5. Lawrence, (1989) Business Policy and Strategic Management, Tata McGraw Hill.

Web Resources:

1. https://elearn.daffodilvarsity.edu.bd/pluginfile.php/946325/mod_page/intro/Strategic%20management%20and%20business%20policy%20_%20globalization%2C%20innovation%2C%20and%20sustainability-Thomas%20L.%20Wheelen%20-Pearson%20%282018%29.pdf

Journals:

1. Strategic Management Journal
2. Journal of Strategy and Management

M21DEF 5.4 FINANCIAL MARKET & SERVICES

Total Teaching Hours: 45

No. of Hours per Week: 3

(3 credits)

CObj	Course Objectives
CObj_1	To provide students with a solid foundation in understanding the structure, functions, and operations of financial markets such as money markets and capital markets.
CObj_2	To give in-depth understanding of the Indian stock market's trading and settlement procedures, and update the students with various innovations in financial markets.
CObj_3	To familiarize students with various concepts of mutual funds and the roles played by various market participants. Equip them with knowledge and skills necessary to become employable in the financial service industry.

CO	Course Outcomes
	After completion of this module, students should be able to:
CO1	Understand how shares are issued in the primary market and listed in the secondary market. And will have an overall understanding of various functions of the primary and secondary market.
CO2	Gain a thorough understanding of how financial markets operate, including the roles and functions of market participants, the trading mechanisms, and the impact of market forces on asset prices.
CO3	Demonstrate their understanding on various financial instruments traded in financial markets.
CO4	Identify the regulatory framework governing the stock market, including securities laws in India.

CO-PO Mapping

	PO_1	PO_2	PO_3	PO_4	PO_5
CO_1	*	*			
CO_2	*		*		
CO_3			*	*	
CO_4				*	*

Course Content

S. No	Unit title	Course Content	Number of Hours	Skills Developed
1	Unit- I Introductions to Financial markets and Primary market	Nature, Functions, Types of Financial markets, Structure of Financial markets. Primary Market – Meaning, Features, Players of Primary Market, Instruments in Primary Market (Names), Procedure for issuing Equity shares and Debentures, SEBI guidelines towards the issue of Equity Shares and Debentures, Merits and Demerits of Primary Markets.	10 Hrs	Cognitive Skills
2	Unit- II Stock Exchange/ Secondary market	Meaning, Structure, Functions, Trading and Settlement System of Stock Exchange Transactions. DEMAT Account, order types, execution methods, Players in the Stock Market, market orders, limit orders, stop orders, process of matching buyers and sellers. Merits and Demerits of Stock Markets, Reforms in Stock Market, OTCEI and NSE, Origin, Function, Merits, Demerits.	14 Hrs	Cognitive Skills /Life Skills/ Employable Skills
3	Unit- III Non-Banking Financial Intermediaries	Investment & Finance Companies - Merchant Banks, Hire Purchase Finance, Lease Finance, Housing Finance. Concept of Mutual Funds, Mutual Fund Schemes.	10 Hrs	Cognitive Skills
4	Unit- IV Regulatory Body/ SEBI	Objectives of SEBI – Organization - Functions and Functioning of SEBI, Powers of SEBI, Role of SEBI in marketing of Securities and Protection of Investor Interest. Listings: Listing Requirements & Process - Delisting of Corporate Stocks	11 Hrs	Cognitive Skills

Books for Reference:

1. Appannaiah, H. R., Reddy, P. N., N Mukund Sharma, & Ebrary, I. (2010). *Financial markets and services*. Himalaya Pub. House. Auerbach, R. D. (1983). *Financial markets and institutions*. Macmillan
2. GOEL, S. (2018). *FINANCIAL MARKETS INSTITUTIONS AND SERVICES*. PHI Learning Pvt. Ltd
3. Gordon, & Natarajan. (2016). *Financial Markets and Services*. Himalayan Publications.
4. Henning, C. N., Pigott, W., & Robert Haney Scott. (1988). *Financial markets and the economy*. Prentice Hall.
5. Mishkin, F. S. (2019). *The economics of money, banking, and financial markets*. Harlow, England London New York Boston San Francisco Toronto Sydney Dubai Singapore Hong Kong Tokyo Seoul Taipei New Delhi Cape Town Sao Paulo Mexico City Madrid Amsterdam Munich Paris Milan Pearson

Web Resources:

- 1) <https://www.nseindia.com/>
- 2) <https://www.bseindia.com/>
- 3) https://www.moneycontrol.com/promo/mc_interstitial_dfp.php?size=1280x540
- 4) <https://www.putnam.com/advisor/>

Journals:

- 1) Boehme, Rodney, and GönülÇolak. "Primary Market Characteristics and Secondary Market Frictions of Stocks." *Journal of Financial Markets*, vol. 15, no. 2, May 2012, pp. 286–327, <https://doi.org/10.1016/j.finmar.2011.11.001>. Accessed 28 Feb. 2019.
- 2) Boulatov, Alex. *Strategic Trading with Market Closures*. 2006.
- 3) Carhart, Mark M. "On Persistence in Mutual Fund Performance." *The Journal of Finance*, vol. 52, no. 1, Mar. 1997, p. 57, <https://doi.org/10.2307/2329556>. Accessed 28 Apr. 2019.
- 4) CARTER, RICHARD, and STEVEN MANASTER. "Initial Public Offerings and Underwriter Reputation." *The Journal of Finance*, vol. 45, no. 4, Sept. 1990, pp. 1045–1067, <https://doi.org/10.1111/j.1540-6261.1990.tb02426.x>. Accessed 21 Mar. 2019.
- 5) Isaenko, Sergey. "Transaction Costs, Frequent Trading, and Stock Prices." *Journal of Financial Markets*, vol. 64, Aug. 2022, p. 100775, <https://doi.org/10.1016/j.finmar.2022.100775>. Accessed 19 Aug. 2022.
- 6) Jain, Bharat A., and OmeshKini. "The Life Cycle of Initial Public Offering Firms." *Journal of Business Finance Accounting*, vol. 26, no. 9-10, Nov. 1999, pp. 1281–1307, onlinelibrary.wiley.com/doi/abs/10.1111/1468-5957.00298, <https://doi.org/10.1111/1468-5957.00298>. Accessed 5 Sept. 2019.
- 7) Wójcik, Dariusz. "Geography of Stock Markets." *Geography Compass*, vol. 3, no. 4, July 2009, pp. 1499–1514, <https://doi.org/10.1111/j.1749-8198.2009.00255.x>.

M21DEH 5.4: EMPLOYEE WELFARE AND INDUSTRIAL RELATIONS**Total Teaching Hours: 45****No. of Hours per Week: 3****(3 credits)**

CObj	Course Objectives
CObj_1	The course aims at providing fundamental knowledge and exposure to the industrial relations and related aspects prevailing in industries and to familiarize the students with various Labour Legislations applicable to businesses
CObj_2	To learn the salient features of welfare and wage Legislations
CObj_3	To learn the laws relating to Industrial Relations, Social Security and Working conditions

CO	Course Outcomes
	After completion of this module, students should be able to:
CO1	Describe fundamental concepts and nature of Industrial Relations
CO2	Identify the nature and role of trade unions for workers and industries
CO3	Apply collective bargaining concepts and understands its impact on employee-management relations
CO4	Identify ways to resolve industrial disputes
CO5	To apply various industrial legislations in business

CO-PO Mapping

	PO_1	PO_2	PO_3	PO_4	PO_5
CO_1	*				
CO_2		*			
CO_3			*		*
CO_4			*		
CO_5				*	

Course Content

Sl. No.	Unit/Chapter title	Content	Number of Hours	Skills Developed
1	Unit- I Social & Labour Welfare	Social Welfare; Labour Welfare: Concept, Scope; Philosophy and Principles of Labour Welfare; Indian constitution and Labour Welfare; Labour Welfare Policy and Five Year Plans Historical Development of Labour Welfare in India- Emerging Issues	14 Hrs	Analytical Skills/ Logical Skills
2	Unit- II Social Security	Concept and Scope; Social Assistance and Social Insurance, Development of Social Security in India; Social Security measures for Industrial Employees. Case study	11Hrs	Cognitive Skills
3	Unit- III Labour Administration	Evolution of Machinery for Labour Administration; Central Labour Administrative Machinery in India, Labour Administration in India.	8Hrs	Employable Skills
4	Unit- IV Industrial Relations	Concept- Evaluation -Background of industrial Relations in India- Influencing factors of IR in enterprise and the consequences Role of various parties to IR – Govt. – IR strategy – Factors affecting Employee relations strategy – IR Divisions Case study	12 Hrs	Cognitive Skills / Analytical Skills

Books for References:

1. Moorthy, M.V. (1982). Principles of Labour Welfare. 2nd Edition. New Delhi: Oxford & IBH Publishing Co.
2. Vaid, K.N. (2006). Labour Welfare in India. New Delhi: Sree Ram Centre for Industrial Relations and Human Resources.
3. Venkataramana, K. (2014). Employee Welfare & Social Security. Publisher: SHBP.
4. Sharma, A.M. (2015). Aspects of Labour Welfare and Social Security. Mumbai: Himalaya Publishing House.
5. Singh, R. C. P. (1993). Labour Welfare Administration in India. New Delhi: Deep & Deep Pub.
6. Puneekar, S.D., Deodhar, S.B., & Sankaran, Saraswathi. (2011). Labour Welfare, Trade Unionism and Industrial Relations. Mumbai: Himalaya Publishing House.
7. Pant, S.C. (2007). Indian Labour Problems. Allahabad: Chaitanya Publishing House.

Web Resources:

1. Labor Welfare in Five Year Plans.(<https://old.amu.ac.in/emp/studym/99999354.pdf>)
2. Labor Welfare Officer (<http://labourlawshcm.com/home/responsibilities-of-welfare-officers/>)

3. Social Security Measures (<https://www.india-briefing.com/news/introduction-social-security-system-india-6014.html/>)
4. Industrial Relations (<https://www.economicdiscussion.net/industries/industrial-relations/32249>)

Journals:

1. https://www.researchgate.net/publication/283481802_EMPLOYEE_WELFARE_IS_THE_KEY_AN_INSIGHT
2. <https://www.jetir.org/view?paper=JETIR2105754>
3. <https://researchleap.com/impact-welfare-measures-quality-employees-performance-special-reference-construction-industry/>

M21DEM 5.4: ADVERTISING AND SALES PROMOTION

Total Teaching Hours: 45

No. of Hours per Week: 3

(3 credits)

Cob_j	Course Objectives
CObj_1	To familiarize the students about the history, purpose, functions of advertising and ad agencies.
CObj_2	To understand the role of media and functioning of advertising agency
CObj_3	To know the important function and tools of Sales Promotion

CO	Course Outcomes
	After completion of this module, students should be able to:
CO1	Understand the history of advertising and the operations of advertising agencies
CO2	Analyses the role of media, media research and how ratings are conducted and knowing about the cost of media.
CO3	Illustrates the skills about the creative strategies implemented by the advertisers and the advertising budget for future transactions.
CO4	Develop the knowledge about the forms and contents of sales promotion.

CO-PO Mapping

	PO_1	PO_2	PO_3	PO_4	PO_5
CO_1				*	
CO_2		*			
CO_3	*				*
CO_4			*		
CO_5		*			

Course Content

S. No	Unit/chapter title	Course Content	Number of hours	Skills Developed
1.	Unit- I Introduction & Basic Concepts	History of advertising; Advertising purpose and functions; Economic, social & ethical aspects of advertising; Advertising & the marketing mix, Advertising as a communication process; types of advertising	10 Hrs	Analytical Skills
2.	Unit- II Advertising Media Strategy	Role of media; types of media; their advantages and disadvantages; Media research & advertising decisions; media planning, selection & scheduling strategies. Measuring advertising effectiveness. Advertising strategies for rural markets. Advertising Agencies: Profile of major advertising agencies in India, Rural advertising, social advertising, ethics in advertising, advertising standards council of India (ASCI). Case study.	12 Hrs	Cognitive Skills
3.	Unit- III Creative Strategy & Advertising Budget	Advertising Campaign Planning: Setting advertising goals and objectives, The DAGMAR Approach. Message strategies and tactics, Creative approaches, Copywriting and testing, Advertising copy design and communication strategy, Copy-visualization layout, Advertising appeals and themes, Classification of advertisement copies, Essentials of a good copy. Exercises in drafting advertisement copy. Advertising budget process	12 Hrs	Analytical Skills
4.	Unit- IV Tools of Sales Promotion	Major tools of sales promotion: developing a sales promotion programme, pre testing implementing, evaluating the results and making necessary modification Integration of Sales Promotion with advertising [case study]	11 Hrs	Analytical Skills

Books for Reference:

1. Shah, K., & D'Souza, A. (2017). Integrated Advertising, Promotion and Marketing Communications. TMH.
2. Kazmi, S.H., & Batra, Satish. (2008). Advertising & Sales Promotion. Excel.
3. O'Guinn, T. C., Allen, C. T., & Semenik, R. J. (2018). Advertising Management with Integrated Brand Promotion. 8th Edition. Cengage.

4. Chunawalla, S. A. (2022). Advertising, Sales and Promotion Management. Publisher: Himalaya.
5. Belch, G. E., & Belch, M. A. (2004). Advertising and Promotion. Publisher: TMH
6. Batra, R., Myers, J. G., & Aaker, D. (1996). Advertising Management. Prentice Hall.

Web Resources:

1. https://www.google.com/search?q=ADVERTISING+AND+MEDIA+MANAGEMENT&rlz=1C1CHBD_enIN811IN811&ei=mfaGY-Iv8I_j4Q-
2. https://www.google.com/search?q=SALES+PROMOTION+&rlz=1C1CHBD_enIN811IN811&ei=mfaGY-Iv8I_j4Q-13ZhY&ved=0ahUKEwii4KCCotX7AhXwxzgGHbUuBgsQ4dU
3. https://www.google.com/search?q=advertising+and+media+planning&rlz=1C1CHBD_enIN811IN811&ei=zfaGY9Jaw5Dj4Q_274RQ&ved=0ahUKEwiS9YabotX7AhVDyDgGHf
4. https://www.google.com/search?q=advertisng+media+types&rlz=1C1CHBD_enIN811IN811&ei=7PaGY_SqBv7e4-EP8baHWA&ved=0ahUKEwj00PCpotX7AhV-7zgGHXHbA

Journals:

1. Barnes James G. (1975), "Factors Influencing Consumer Reaction to Retail Newspaper 'Sale' Advertising," in Combined Proceedings of the American Marketing Association, Vol. 37, Mazze Edward M., ed. Chicago: American Marketing Association, 471–77.
2. Berkowitz Eric N., and Walton John R. (1980), "Contextual Influences on Consumer Price Responses: An Experimental Analysis," *Journal of Marketing Research*, 17(August), 349–58.
3. Biswas Abhjit, and Blair Edward A. (1991), "Contextual Effects of Reference Prices in Retail Advertisements," *Journal of Marketing*, 55(July), 1–12.
4. Burton Scot, and Lichtenstein Donald R. (1988), "The Effect of Ad Claims and Ad Context on Attitude toward the Advertisement," *Journal of Advertising*, 17(1), 3–11.
5. Bitta Delia, Albert J., Monroe Kent B., and McGinnis John M. (1981), "Consumer Perceptions of Comparative Price Advertisements," *Journal of Marketing Research*, 18(November), 416– 27.

21 SBC 5.1: SOFT SKILLS FOR BUSINESS

Total Teaching Hours: 30

No. of Hours per Week: 2

(2 credits)

CObj	Course Objectives
CObj_1	Become familiar with the types and forms of communication skills
CObj_2	To understand the importance of public speaking
CObj_3	To identify the business communication skills required in the workplace

CO	Course Outcomes
	After completion of this module, students should be able to:
CO1	understand and develop communication skills
CO2	deliver lectures publicly
CO3	Can make effective business communication oral and written

CO-PO Mapping

	PO_1	PO_2	PO_3	PO_4	PO_5
CO_1	*	*			
CO_2			*		
CO_3		*			
CO_4			*	*	*

Course Content

S. No	Unit/chapter title	Course Content	Number of hours	Skills Developed
1	Unit- I Elements of Communication	Meaning, Importance, Objectives & Principles of Communication, Process, impediments of effective communication, Strategies for effective communication. Types and forms of communication Nonverbal Communication- Body Language, Gestures, Postures, Facial Expressions, Dress codes, The Cross Cultural Dimensions of Business Communication, Listening & Speaking, –Case Study.	10 Hrs	Cognitive Skills
2	Unit- II Presentation Skills	Importance of Presentations, Speech Composition - Principles of Effective Speaking & Presentations. Technical speeches & Non- technical presentations. Speech for introduction of a speaker - Speech for vote of thanks - Occasional speech - Theme speech. Moderating programs - Use of Technology	10 Hrs	Employable Skills
3	Unit- III Business Communication	Business Letters: Inquiries, Circulars, Quotations, Orders, Acknowledgments Executions, Complaints, Claims & Adjustments, Collection letter, Banking correspondence, Agency correspondence, Bad news and persuading letters, Sales letters, Job application letters - Bio-data, Covering Letter, Interview Letters, Letter of Reference. Memos, Minutes, Circulars & Notices- case study	10 Hrs	Analytical and Employable Skills

Books for Reference:

1. Rai, R. & Rai, S. (2018). Soft Skill for Business. HPH.
2. Kumar, S. (Year). Soft Skill for Business. VBH.
3. Krishnamacharyulu, C.G.G., & Lalitha. (Year). Soft Skills of Personality Development. HPH.
4. Lesikar, R.V. & Flatley, M.E. (2005). Basic Business Communication Skills for Empowering the Internet Generation. Tata McGraw Hill Publishing Company Ltd., New Delhi.
5. Rajkumar. (Year). Basics of Business Communication. Publisher.
6. Ludlow, R. & Panton, F. (1998). The Essence of Effective Communications. Prentice Hall of India Pvt. Ltd.

Web Resources:

1. Harvard Business Review (HBR) - Provides articles, case studies, and resources on various soft skills topics.
2. Mind Tools - Offers a wide range of resources, including articles, videos, and worksheets, covering soft skills development.

3. LinkedIn Learning - Offers online courses on soft skills topics such as communication, leadership, and emotional intelligence.
4. TED Talks - Features inspirational talks by experts in various fields, including soft skills and business communication.
5. Coursera - Provides online courses and specializations on soft skills topics offered by universities and institutions worldwide.

Journals:

1. Journal of Business Communication (JBC) - Publishes research articles, case studies, and reviews on various aspects of business communication, including soft skills.
2. International Journal of Business Communication (IJBC) - Publishes research articles, case studies, and reviews on various aspects of business communication, including intercultural communication and communication skills development.
3. Journal of Leadership & Organizational Studies (JLOS) - Focuses on research related to leadership, organizational behavior, and management, including studies on leadership development and soft skills training.
4. Human Resource Management Review - Publishes research articles and reviews on topics related to human resource management, including employee development, training, and skills assessment.
5. Communication Research - Focuses on research related to communication theory and practice, including studies on interpersonal communication skills and communication in organizational settings.
6. Training and Development Journal - Focuses on research and practical articles related to training and development in organizations, including soft skills training programs and strategies.

21 VOC 5.1: IT FOR MANAGERS

Total Teaching Hours: 60

No. of Hours per Week: 4

(4 credits)

CObj	Course Objectives
CObj_1	To understand the concept of Information Systems used in Business
CObj_2	To understand the basic concepts of ERP Systems and steps in the ERP Life Cycle.
CObj_3	To know E-Governance as an effective tool to manage citizen and resources.

CO	Course Outcomes
	After completion of this module, students should be able to:
CO1	Gains understanding of Information System and its types
CO2	Apply the Business Modules of ERP in business organization
CO3	Analyze the E-Commerce applications and methodologies.
CO4	Explore the E-Governance and it's technologies for application
CO5	Demonstrates the requirement of the latest technology and its advantages.

CO-PO Mapping

	PO_1	PO_2	PO_3	PO_4	PO_5
CO_1	*		*		
CO_2		*		*	*
CO_3	*		*		
CO_4					*
CO_5			*		

Course Content

S. No	Unit/chapter title	Course Content	Number of hours	Skills Developed
1	Unit- I Introduction To Information System and Types	Meaning and definition of system, information and information system- business information system-Features of information system-Uses of Business Information Systems, Users of Information Systems-Components of Business Information Systems. SDLC and Models, Management Support Systems (MSS), Management Information Systems, Transaction Processing Systems, Decision Support Systems (DSS), Group Decision Support Systems (GDSS), Office Automation System, Executive Information Systems	12 Hrs	Cognitive Skills
2	Unit- II ERP	Introduction to ERP: Origin, Evolution, Structure and Benefits, Various Modules of ERP, ERP Implementation Life Cycle, Practical Session on Tally ERP	10 Hrs	Cognitive and Employable
3	Unit- III E-Commerce Systems	Introduction to E-Commerce and M-Commerce, Advantages and Disadvantages of each. Emergence of the Internet and World Wide Web-Types of E-Commerce,E- Business Model, Concept of B2B, B2C, C2C with examples. Concept of Internet Banking and Online Shopping, Electronic Payment Systems, development of e- commerce store. E-Commerce Opportunities for Industries, Transition challenges for Indian Corporates	14 Hrs	Employable Skills
4	Unit- IV E-Governance	Concept of e-governance, World Perspective, Indian Perspective, Technologies for e-governance, e- governance as an effective tool to manage the country's citizens and resources, Advantages and Disadvantages of E-governance, E-governance perspective in India. Discussion on e-chaupal, Bhoomi etc.	12 Hrs	Cognitive Skills
5	Unit- V Data Security and Payment Systems	Information System Security-Internet Security - E-Business Risk Management Issues-Information Security Environment in India-Payment Gateway-Concerns of Internet Banking-Requirement of E- Payment Systems-Functioning of Debit and Credit Cards-Classification of New Payment Systems-Cryptography- Digital Signature	12 Hrs	Life Skills

Books for Reference:

1. Norton, P. (2010). Introduction to Computers. Tata McGraw-Hill
2. Jawadekar, W.S. (2009). Management Information System; Tata Mc Graw Hill.
3. Sheikh, K. (2002). Manufacturing Resource Planning (MRP II) with Introduction to ERP; SCM. McGraw-Hill.
4. Loshin, P., & Vacca, J. (2004). E-Commerce. 4th Edition. Firewall/Laxmi Publications (P) Ltd., New Delhi.
5. Laudon, K. C., & Traver, C. G. (2017). E-Commerce: Business, Technology, Society. Thirteenth Edition. Pearson Publications.
6. Deitel, H. M., & Deitel, P. J. (1994). E-Business & E-Commerce for Managers. Pearson Publication.
7. Dubey, R.K. (2012). E-Governance. R.K. Publishers & Distributors

Web Resource:

1. <https://www.techrepublic.com/topic/tech-industry/it-management/>
2. <https://hbr.org/topic/information-technology>
3. <https://sloanreview.mit.edu/topic/it-management/>
4. <https://www.cio.com/it-leadership/>
5. <https://www.gartner.com/en/information-technology/leadership-strategy>

Journals:

1. <https://www.jmis-web.org/>
2. <https://pubsonline.informs.org/journal/isre>
3. <https://www.springer.com/journal/41265>
4. <https://onlinelibrary.wiley.com/journal/13652575>
5. <https://www.palgrave.com/gp/journal/41303>

NEP- Curriculum Framework

B.B.A - Matrix for VI Semester (w.e.f. 2021-22 onwards)

VI Semester							
Code	Course Code	Course	Teaching hours	Course Components			Credits
				L	T	P	
DSC	M21DC 6.1	Entrepreneurship & Start-up Management	60	4	-	-	4
DSC	M21DC 6.2	Business Analytics	60	4	-	-	4
DSC	M21DC 6.3	Corporate Accounting	60	4	-	-	4
DSE	M21DEF 6.4	Finance -International Finance	45+45	3+3	-	-	3+3
	M21DEH 6.4	Human Resource- Human Resource Development					
	M21DEM 6.4	Marketing -Consumer Behaviour					
Vocational-2	21VOC 6.1	Digital Marketing	60	3	-	2	4
I-1	21SEC 6.1	Internship	4 weeks	-	-	-	2
Total							24

Note 1:

AECC- Ability Enhancement Compulsory Course

DSC - Discipline-Specific Course

OE- Open elective (course offered by the department to students of other stream)

VOC - VB Skill Enhancement Course -Vocational Based

SEC - SB Skill Enhancement Course -Skill Based

Continuous Internal Assessment – Scheme of Evaluation

For Theory Courses

End Semester Examination: 60%

Continuous Internal Assessment: 40%

Activities (CIA: 40 Marks)	Proposed and Approved Scheme		Total Marks (40)
	IA-1	IA-2	
Session Test Maximum Marks	30	30	
1. Weightage (Marks)	10	10	20
2. Assignment (Marks)	20		20
i. Writing	10		
ii. Quiz / Presentation / Creating diagrams / charts / Classwork / Case study / Viva / Field work etc.	05		
iii. Classroom participation	05		
Total			40

VI SEMESTER**M21DC 6.1 – ENTREPRENEURSHIP & START-UP MANAGEMENT****Total Teaching Hours: 60****No. of Hours per Week: 4****(4 credits)**

CObj	Course Objectives
CObj_1	To familiarize the students with the prerequisites to become an entrepreneur and start a business enterprise.
CObj_2	To understand the concepts related to Start up and to know the support extended by the Government of India.
CObj_3	To make the students understand the significance of business plans and to bring awareness regarding financial aspects of new ventures.

CO	Course Outcomes
	After completion of this module, students should be able to:
CO1	Understands the importance of entrepreneurial culture.
CO2	Develop a start-up business plan and examine the elements.
CO3	Analyze various funding opportunities for new ventures.
CO4	Develop a business plan and conduct feasibility study.
CO5	Explore the support of central level institutions.

CO-PO Mapping

	PO_1	PO_2	PO_3	PO_4	PO_5
CO_1	*				
CO_2		*	*		
CO_3					*
CO_4			*	*	
CO_5					*

Course Content

Sl. No.	Unit/chapter title	Content	Number of Hours	Skills Developed
1	Unit- I Entrepreneurship	Introduction to Entrepreneur & Entrepreneurship: Meaning of entrepreneur - Evolution of the concept - Functions of an Entrepreneur - Types of Entrepreneurs - Intrapreneurs- an emerging class - Concept of Entrepreneurship -Entrepreneurial Culture (Definition and Levels) - Stages in entrepreneurial process.	10 Hrs	Cognitive Skills
2	Unit- II Start-Up Management	The new model of Entrepreneurship-Business incubators and startups, Start up's- Concepts, models, characteristics, startup communities, startup terminologies and funding options of start-up's. Startups in India: Profile, Causes, Effects, Process of becoming a startup, Current trends, Regulatory environment, Budget, Plans and Policies. Disruptions for Startups. Startup Karnataka: Profile. Make in India - Introduction	12 Hrs	Cognitive Skills
3	Unit- III Financial Aspects of New Ventures	Preparing for the new venture launch - early management decisions, managing growth of the new venture- new venture expansion strategies and issues. Getting Financing or Funding for the New Venture: Estimating the financial needs of a new venture and preparation of a financial plan, Sources of Personal Financing, Preparing to Raise Debt or Equity Financing, Business Angels, Venture Capital, Initial Public Offering, Commercial Banks, Other Sources of Debt Financing, Leasing, Aatmanirbhar Bharat and Mudra Yojana Scheme.	14 Hrs	Cognitive Skills and Information Processing Skills
4	Unit- IV Business Plan	Meaning of business plan - Business plan process - Advantages of business planning - Final Project Report - Preparation of Business Plan / Project, Project Appraisal. Feasibility Study.	10 Hrs	Cognitive Skills

5	Unit- V Govt. support for entrepreneurs	Schemes and functions of Directorate of Industries, District Industries Centers (DICs), Industrial Development Corporation (IDC), State Financial Corporation (SFCs), Small Scale Industries Development Corporations (SSIDCs). Khadi and Village Industries Commission (KVIC), Technical Consultancy Organization (TCO), Small Industries Service Institute (SISI), National Small Industries Corporation (NSIC), Small Industries Development Bank of India (SIDBI). Recent Initiatives from MUDRA.	14 Hrs	Cognitive Skills

Books for Reference:

1. Vasant Desai, (2016) Small-Scale Enterprises and Entrepreneurship Ecosystem, 6th Edition, Himalaya Publishing House.
2. Robert Hisrich, Michael Peters, and Dean Shepherd, (2019) Entrepreneurship, 11th Edition, McGraw Hill Education.
3. Poornima M. Charantimath, (2018) Entrepreneurship Development and Small Business Enterprises, 3rd Edition, Pearson Education,
4. Andrew Zacharakis, William Bygrave, and Andrew Corbett, (2016) Entrepreneurship, 4th Edition, Wiley.
5. Marc J. Dollinger, (2008) Entrepreneurship: Strategies and Resources, 4th Edition, Marsh Publications, USA,.
6. Steven Fisher, Ja-nae' Duane, (2016) The Startup Equation -A Visual Guidebook for Building Your Startup, Indian Edition, Mc Graw Hill Education India Pvt. Ltd.
7. Donald F Kuratko, Jeffrey S. Hornsby, (2017) New Venture Management: The Entrepreneur's Road Map, 2e, Routledge.
8. Barringer, Bruce R. (2015) Preparing Effective Business Plans: An Entrepreneurial Approach. Second edition, Pearson Education.
9. Blank, Steven G., and Dorf, Bob (2012). The Startup Owner's Manual: The Step-by-Step Guide for Building a Great Company. KetS Ranch, Inc.
10. Kuratko, D. F. (2016). Entrepreneurship: Theory, Process, and Practice. Cengage Learning.
10. Blank, S., & Dorf, B. (2012). The Startup Owner's Manual: The step-by-step guide for building a great company; BookBaby.

Web Resource:

1. <http://www.businessmodelgeneration.com/canvas/bmc>
2. <https://www.startupindia.gov.in/>
3. <https://www.missionstartupkarnataka.org/?en>
4. <https://www.mudra.org.in/>
5. <https://www.myscheme.gov.in/schemes/pmmmy>

Journals:

1. Saxena, Kavita (2018). World Entrepreneurs's Day 2018: Entrepreneurs India – Gains & Misses. New Delhi: The Associated Chambers of Commerce and Industry of India.
2. Bhave, M. P. (1994). A process model of entrepreneurial venture creation. *Journal of business venturing*, 9(3), 223-242
3. Watson, K., Hogarth-Scott, S. and Wilson, N. (1998), "Small business start-ups: success factors and support implications."

M21DC 6.2: BUSINESS ANALYTICS**Total Teaching Hours: 60****No. of Hours per Week: 4****(4 credits)**

CObj	Course Objectives
CObj_1	To use Analytics to Solve Different Business Problems.
CObj_2	To investigate data to establish new relationship and patterns.
CObj_3	To exhibit knowledge of data analysis techniques and to apply principles of data sciences in integrating enterprise reporting

CO	Course Outcomes
	After completion of this module, students should be able to:
CO1	On successful completion of the course, the students will be able to Understand types of analytics and data models.
CO2	Understand the role of data in decision making, sources and types of Data
CO3	Apply knowledge using different data analytics tools and draw inferences.
CO4	Analyze and apply statistics for business problems.
CO5	Demonstrate visualization of data.

CO-PO Mapping

	PO_1	PO_2	PO_3	PO_4	PO_5
CO_1		*	*		
CO_2		*		*	*
CO_3	*				
CO_4					*
CO_5				*	

Course Content

S. No	Unit/chapter title	Course Content	Number of Hours	Skills Developed
1	Unit- I Introduction to Business Analytics	Business Analytics, Terminologies used in Analytics: Business Analytics-Business Intelligence- Meaning-Importance-Scope-Uses of Business Analytics-Architecture of Business Analytics-Types of Analytics: Descriptive - Predictive, Prescriptive-Application of Business Analytics - Concept of OLAP and OLTP.	12 Hrs	Cognitive Skills
2	Unit- II Role of Data in the Organization	Sources of Data - Use of Data in Decision Making-Importance of data quality- Dealing with missing or incomplete data-Types of Digital Data-Structures - Semi Structures, Unstructured Data - Difference Between Structured data and Unstructured Data	10 Hrs	Cognitive and Employable
3	Unit- III Data Integration	Data Warehouse – Goals - Data Sources-Extract, Transform, Load-Data Integration-Technologies-Data Quality Maintenance-Data profiling. Data Modelling -Basics-Types-Techniques-Fact Table -Dimension Table-Typical Dimensional Models-Dimensional modeling life cycle-Designing the Dimensional Model-Introduction to SQL- SQL Statements - Imp SQL Commands-SELECT, UPDATE, DELETE, INSERT INTO, CREATE DATABASE, ALTER DATABASE, CREATE TABLE, ALTER TABLE, DROP TABLE-CREATE INDEX, DROP INDEX(only the basics)	13 Hrs	Cognitive Skills, Technical Skills
4	Unit- IV Data Analytics Using Excel	Entering Data-Exploring data in Excel (Using Excel's Data Analysis Tool)-Include Variable-Format the Variables-Sample or Population-Mean-Mode -Median-Standard Error-Standard Deviation-Sample Variance-Kurtosis-Skewness-Range-One Way ANOVA-Sources of Variation-Sum of Square Deviations-Degree of Freedom-Mean Square of Deviations-P-Value-Linear Optimization Models-Solving Linear Programs with Excel Solver	13Hrs	Employable Skills, Cognitive Skills, Technical Skills
5	Unit- V Data Visualization Using Tableau (Public Version)	Introduction to Dimensions and Measures-Types of Charts-(Pie Chart,-Column chart-Line Chart, Bar chart- Area Chart-Scatter Chart, Bubble Chart- Stock Chart-Basic understanding in dashboard and storyboard.(Explain using practical examples and students execute the examples using Tableau.)	12 Hrs	Cognitive, Analytical and Employable Skills

Practical:

1. Prepare tree map chart using Tableau.
2. Data Analysis using Excel.

Books for Reference:

1. Banerjee, T., & Banerjee, A. (2020). Business Analytics: Text and Cases. Sage Publication.
2. Kumar, U. D. (2021, ed 2). Business Analytics. Wiley.
3. Evans, J. R. (2020). Business Analytics. Pearson.
4. Acharya, S., & Prasad, R. N. (2011). Fundamentals of Business Analytics. Wiley.
5. Albright, S., & Winston, W. (2014). Business Analytics: Data Analysis and Decision Making. Cengage Learning.
6. Schepers, S. (2008). Business Intelligence for Dummies.
7. Sherman, R. (2014). Business Intelligence Guidebook: From Data Integration to Analytics.

Web Resource:

1. <https://www.kaggle.com/>
2. <https://www.analyticsvidhya.com/>
3. <https://towardsdatascience.com/>
4. Tableau Public
5. Google Analytics Academy

Journals:

1. Journal of Business Analytics
2. Harvard Business Review – Analytics
3. International Journal of Data Science and Analytics
4. Decision Support Systems

M21DC 6.3: CORPORATE ACCOUNTING

Total Teaching Hours: 60

No. of Hours per Week: 4

(4 credits)

CObj_ID	Course Objectives
CObj_1	To understand the concept of underwriting under the regulation of SEBI and assess underwriting commissions, differentiate between marked and unmarked applications, determine underwriters' liability.
CObj_2	To provide a foundational understanding of goodwill and share valuation, emphasizing the essential concepts and practical applications.
CObj_3	To provide comprehensive understanding of mergers and acquisitions, covering types of amalgamations, determining purchase considerations, preparation of post amalgamation balance sheet. Also to update students on recent developments in corporate accounting.

CO_ID	Course Outcomes
	After completion of this module, students should be able to:
CO1	An understanding of the fundamental concepts, regulations, and practices associated with underwriting in financial markets.
CO2	Able to apply various methods for valuation of shares, goodwill.
CO3	Analyzes the factors affecting valuation goodwill and shares.
CO4	Acquires the skills to understand the concepts of mergers and acquisitions and prepare post-merger balance sheets in accordance with Schedule III to the Companies Act 2013.
CO5	Gains insight of recent developments in accounting including Human Resource Accounting and Social Responsibility Accounting.

CO-PO Mapping

	PO_1	PO_2	PO_3	PO_4	PO_5
CO_1	*		*		
CO_2	*		*		
CO_3		*	*		
CO_4	*	*		*	*
CO_5	*	*	*	*	

Course Content

Sl. No	Unit/chapter title	Content	Number of hours	Skills Developed
1.	Unit- I Underwriting of Shares	Underwriting: Introduction, Meaning, Advantages, Types; SEBI Regulations; Underwriting Commission; Underwriters' Functions; Marked and Unmarked Applications; Determination of Underwriters' Liability; Firm & Pure Underwriting; Full & Partial Underwriting	12 Hrs	Cognitive skill
2.	Unit- II Valuation of Goodwill	Introduction & Meaning; Factors influencing Valuation of Goodwill; Circumstances of Valuation of Goodwill; Methods of Valuation of Goodwill: Average Profit Method, Super Profit Method, Capitalization of Average Profit & Super Profit Method and Annuity Method	12 Hrs	Analytical Skill and Cognitive skill
3.	Unit- III Valuation of Shares	Meaning – Need for Valuation – Factors affecting Valuation– Methods of Valuation: Intrinsic Value Method, Yield Method, Earning Capacity Method and Fair Value of shares.	12 Hrs	Analytical Skill
4.	Unit- IV Mergers And Acquisition of Companies	Meaning, Types & Objectives of merger and acquisition; Types of Amalgamation, Accounting for Amalgamation - Purchase Method (only); Purchase Consideration: Meaning, Methods – Lump sum Method, Net Assets Method, and Net Payment Method. Preparation of Balance Sheet after Merger as per Schedule III to Companies Act 2013	16 Hrs	Analytical Skill and Cognitive skill
5.	Unit- V Recent Trends in Accounting	Human Resource Accounting: Meaning, Need, Valuation of Human Resources – Historical Cost Approach – Replacement Cost Approach (Theory Only) Social Responsibility Accounting: Social Responsibility of Business – Meaning of social accounting – Approaches to social accounting (Theory Only)	08 Hrs	Analytical Skill and Cognitive skill

Books for Reference:

1. Anil Kumar, V. Rajesh Kumar, B. Mariyappa, Corporate Accounting, 2017 Himalaya Publishing House, New Delhi
2. Anil Kumar, V. Rajesh Kumar, B. Mariyappa, .Advanced Corporate Accounting, 2018. Himalaya Publishing House, ,New Delhi
3. Arulanandam & Raman Corporate Accounting-II, 2017, Himalaya Publishing House, , New Delhi
4. CA Shibarama Tripath, Roadmap to IFRS and Indian Accounting Standards,2016 Edition
5. S.N. Maheswari , Financial Accounting, 2018, Vision Publishing House.
6. Soundarajan A & K. Venkataramana, Advanced Corporate Accounting, 2019, SHBP.
7. RL Gupta , Advanced Accountancy, 2017 Sultan Chand
8. Shukla and Grewal , Advanced Accountancy , 2017,Sultan Chand
9. Srinivas Putty, Advanced Corporate Accounting, 2019, Himalaya Publishing House, New Delhi

Web Resources:

1. The Economist(economist.com/topics/corporate-accounting)
2. Accounting Coach (accountingcoach.com)
3. <https://testbook.com/learn/corporate-accounting/>
4. <https://onlinemasters.ohio.edu/blog/corporate-accounting/>
5. https://wikieducator.org/Corporate_Accounting <https://www.oreilly.com/library/view/corporate-accounting/>
6. https://www.drnishikantjha.com/booksCollection/advanced_corporate_accounting_.pdf
7. <https://web.thisisbeast.com/advanced-corporate-accounting-problems-and-solutions-pdf>

Journals:

1. Journal of Accounting and Economics
2. The Accounting Review
3. Journal of Accounting Research
4. Journal of Corporate Finance
5. Journal of Business Finance & Accounting
6. Journal of Financial Reporting and Accounting
7. Journal of International Accounting Research

M21DEF 6.4: INTERNATIONAL FINANCE**Total Teaching Hours: 45****No. of Hours per Week: 3****(3 credits)**

CObj	Course Objectives
CObj_1	Aims to knowledge of global financial markets, including foreign exchange markets
CObj_2	To analyze the factors that influence foreign exchange rates and know about foreign exchange risks
CObj_3	To identify the operations of International Financial operations

CO	Course Outcomes
	After completion of this module, students should be able to:
CO1	Understands about the global financial markets, including foreign exchange markets, including the international monetary system, methods of payment, and exchange rates.
CO2	Apply theoretical knowledge to identify the instruments of International Financial markets.
CO3	Analyze the functioning of Foreign exchange.
CO4	Contrast and compare the foreign exchange risks
CO5	Demonstrates an understanding about International Financial Institutions and Liquidity

CO-PO Mapping

	PO_1	PO_2	PO_3	PO_4	PO_5
CO_1	*	*			
CO_2		*	*		
CO_3		*		*	
CO_4		*			*
CO_5				*	*

Course Content

S. No	Unit/chapter title	Course Content	Number of Hours	Skills Developed
1	Unit- I Introduction to International Finance	Issues involved in International Business and Finance, methods of payment, International Monetary system – Fundamental terms and concepts – Home currency – foreign currency – direct quote – indirect quote – bid and ask, spot and forward rate - appreciation and depreciation – cross currency rates.	12 Hrs	Cognitive skill
2	Unit- II Instruments In International Financial Markets	Meaning-Definition-International Financial Markets-Globalization of Capital markets, Innovation in foreign securities and International Portfolio Management. FII – Regulations governing FII in India, FDI-Meaning, Advantages & Disadvantages –Concept of ADR & GDR - Foreign Trade Finance.	08 Hrs	Cognitive skill
3	Unit- III Introduction To Foreign Exchange	Meaning, Need of foreignexchange–relationship among inflation, interest rate & exchange rate - parity concept (PPP, IRP) - - international portfolio - currency basket.	08 Hrs	Cognitive skill
4	Unit- IV Foreign Exchange Risk	Exchange risks, Hedging techniques, managing risk, speculation & arbitrage process.	08 Hrs	Employability Skill
5	Unit- V International Financial Institutions and Liquidity	The IMF, International liquidity and SDR's (special drawing rights) – International bank for reconstruction and development (World Bank), International development association, International investment guarantee agency.	09 Hrs	Cognitive skill

Books for Reference:

1. Apte, P. G. (2021). International Financial Management. Tata McGraw-Hill Education.
2. Sharan, V. (2020). International Financial Management. Pearson Education[DA1] .
3. Krugman, P. R., Obstfeld, M., & Melitz, M. (2018). International Finance: Theory and Policy. Pearson.
4. Eun, C. S., & Resnick, B. G. (2018). International Financial Management. McGraw-Hill Education.
5. Liedtka, J., King, A., & Bennett, K. (2018). Solving Problems with Design Thinking: Ten Stories of What Works. Columbia University Press.

Web Resources:

1. <https://www.imf.org/>
2. <https://www.worldbank.org/>
3. <https://www.investopedia.com/>

Journals:

1. Journal of International Money and Finance: <https://www.journals.elsevier.com/journal-of-international-money-and-finance>.
2. Review of International Economics: <https://onlinelibrary.wiley.com/journal/14679396>
3. Journal of International Financial Markets, Institutions & Money: [https://www.journals.elsevier.com/journal-of-international-financial-markets-\[DA2\]institutions-and-money](https://www.journals.elsevier.com/journal-of-international-financial-markets-[DA2]institutions-and-money)
4. International Journal of Finance and Economics: <https://onlinelibrary.wiley.com/journal/10991158>
5. Journal of International Financial Management and Accounting:
<https://onlinelibrary.wiley.com/journal/14679941>

M21DEH 6.4: HUMAN RESOURCE DEVELOPMENT**Total Teaching Hours: 45****No. of Hours per Week: 3****(3 credits)**

CObj	Course Objectives
CObj_1	To understand the human resource development process, outcomes interventions in improving the knowledge, skills, and competencies of employees
CObj_2	To know the concepts related to organizational development and change process
CObj_3	To learn about the HRD application and trends in improving productivity in workplaces in businesses.

CO	Course Outcomes
	After completion of this module, students should be able to:
CO1	Learn about the HRD process, skills and competencies required to perform a task.
CO2	Understand the HRD programs, such as training and development initiatives that can enhance the knowledge, skills, and abilities of employees.
CO3	Apply the HRD activities in developing training and development programs.
CO4	Analyse HRD role in the organization development and change.
CO5	Demonstrate knowledge on HRD trends in the business place for improved performance.

CO-PO Mapping

	PO_1	PO_2	PO_3	PO_4	PO_5
CO_1	*		*		
CO_2		*			
CO_3	*				
CO_4			*		*
CO_5				*	*

Course Content

Sl. No.	Unit/Chapter title	Content	Number of hours	Skills Developed
1	Unit- I Introduction to Human Resource Development	Introduction to HRD – Meaning-Relationship between HRD AND HRM-HRD Processes and Outcomes-HRD Matrix-HRD Interventions- Personality quotient – Emotional quotient/ Intelligence – Changing view of Global HRD and the use of computer and the internet (HRIS) –Role and competencies of HRD Professionals.	10 Hrs	Cognitive Skills
2	Unit- II HRD Process	HRD Process -Assessing need for HRD-Designing and developing effective HRD Programs-Implementing HRD Programs-Evaluating the effectiveness of HRD Programs.	07 Hrs	Cognitive Skills
3	Unit- III HRD Activities	HRD Activities - Orientation and training – Orienting employees – Training process – Evaluating training efforts –Development: Nature and purpose of management development– Managerial on-the-job training – Job rotation and management – Off the job management development techniques – Computerized managerial assessment and Development program.	07 Hrs	Analytical Skills
4	Unit- IV Organizational Development	Introduction – Definition and concept – Characteristics-Growth and relevance of OD – Operational goals of OD – Conditions for OD success – Phases of OD –Group level and Individual Level Diagnosis- Techniques of OD – Interventions: Meaning and types – Benefits and limitations of OD – Change Process: Meaning -Types of change – Managing resistance to change at work Institutionalizing Organizational Changes.	11 Hrs	Cognitive Skills
5	Unit- V HR Applications and Trends	Competency Mapping, People Capability Maturity Model (PCMM), Balanced Score Card, Appreciative Enquiry, Employer Branding, Employee Branding, Cross Cultural Training, HRD Audit, Challenges in HR.	10 Hrs	Cognitive Skills /Employable Skills

Books for Reference:

1. Beanchamp Tom L. Ethical Theory and Business, Prentice Hall. TM Jean Marleen. Performance Oriented HRD.
2. Mahesh V S. Thresholds of Motivation. Tata McGraw Hill.
3. Pandey. (2019). HRD.Wizard Publisher
4. Rao,T. V. (2010) HUMAN RESOURCE DEVELOPMENT. Oxford & IBH Publishing Co Pvt.Ltd
5. Rao M G, Mintty B. S. & Rao K. K. Personnel Management –Text & Cases.
6. Singh B P & Chhabra TN. Personnel Management & Industrial Relations.
7. Subba Rao P & Rao V S P: Personnel / HRM: Text, Cases & Games.

Web Resources:

1. HRD Process (<https://egyankosh.ac.in/bitstream/123456789/89340/1/Unit-3.pdf>)
2. Techniques of Training (<https://whatfix.com/blog/employee-training-methods/>)
3. OD Techniques (<https://www.yourarticlelibrary.com/hrm/organisation/top-9-techniques-of-organisation-development/60275>)
4. Cross Cultural Training (<https://www.simonandsimon.co.uk/blog/what-is-cross-cultural-training-and-why-is-it-important>)
5. HRD Audit (<https://www.economicsdiscussion.net/human-resource-development/hrd-audit/32223>)

Journals:

1. Ahmad, S. (2007). Human resource Development in Universities APH Publishing.
2. Ahmad, S.M. & Mir, A.A. (2011). Need for Human Resource Development (HRD) Practices in Indian Universities: A key for Educational Excellence. Journal of Human Values, 18(2), 113-132.
3. Basu, C.R., “Human Resource Development”, Vol. XI (Jan-June 1987), Indian Journal of Commerce, P. 150-151
4. Billimoria, R.P. & Singh, N.K.: Human Resource Development, Vikas Publishing House Pvt. Ltd, New Delhi, 1985, p.3
5. Chowdhury, I. G (2003).“Human Resource Development: A competitive Perspective”, Journal of Business Administration, IBA, University of Dhaka,p. 127.
6. Chowdhury, M.A (2003). “Human Resource Development and Economic Growth: A Critical Analysis with Special Reference to Bangladesh”, Insurance Journal, Bangladesh insurance Academy, p.149.

M21DEM 6.4: CONSUMER BEHAVIOUR**Total Teaching Hours: 45****No. of Hours per Week: 3****(3 credits)**

CObj	Course Objectives
CObj_1	To understand the basic concepts related to consumer behaviour, consumer decision making process and its applications in the marketing function of firms.
CObj_2	To familiarise the students about the theories and factors influencing consumer behaviour
CObj_3	To acquaint students with the consumer models, customer satisfaction and consumerism

CO	Course Outcomes
	After completion of this module, students should be able to:
CO1	Able to understand the basic concepts related to consumer behavior
CO2	Understands the theories that determine consumer behaviour
CO3	Able to analyze the influence of psychological, socio-cultural and demographic factors on the consumer decision process
CO4	Able to develop consumer decision making ability to apply in business
CO5	Demonstrate the knowledge on identifying customer satisfaction and gains knowledge about consumerism

CO-PO Mapping

	PO_1	PO_2	PO_3	PO_4	PO_5
CO_1		*			
CO_2					*
CO_3	*				
CO_4				*	
CO_5			*		

Course Content

Sl. No.	Unit/Chapter title	Content	Number of Hours	Skills Developed
1	Unit- I Introduction To Consumer Behaviour	Introduction to Consumer Behaviour - A managerial & consumer perspective; Need to study Consumer Behaviour; Applications of consumer behaviour knowledge; current trends in Consumer Behaviour; Market segmentation & consumer behaviour.	10 Hrs	Cognitive Skills
2	Unit- II Individual- Determinants of Consumer Behavior	Consumer needs & motivation; personality and self-concept; consumer perception; learning & memory; nature of consumer attitudes; consumer attitude formation and change.	10 Hrs	Analytical Skills
3	Unit- III Environmental Determinants of Consumer Behavior	Family influences; Influence of culture; subculture & cross cultural influences; group dynamics and consumer reference groups; social class & consumer behaviour.	10 Hrs	Cognitive Skills
4	Unit- IV Consumer Decision Making Process	Problem recognition; Search & Evaluation; Purchase processes; Post-purchase behaviour; personal influence & opinion leadership process; Diffusion of innovations; Researching Consumer behaviour; Consumer research process.	6 Hrs	Analytical Skills
5	Unit- V Consumer Satisfaction & Consumerism	Concept of Consumer Satisfaction; Working towards enhancing consumer satisfaction; Sources of consumer dissatisfaction; dealing with consumer complaints. Concept of consumerism; consumerism in India; the Indian consumer; Reasons for growth of consumerism in India; Consumer protection Act 2022.	9 Hrs	Cognitive Skills

Books for Reference:

1. Schiffman, L.G., Kanuk, L.L., & Kumar, S.R. (2011). Consumer Behaviour. (10th ed.). Pearson.
2. Solomon, M.R. (2009). Consumer Behaviour – Buying, Having, and Being. (8th ed.) New Delhi: Pearson .
3. Blackwell, R.D., Miniard, P.W., & Engel, J. F. (2009). Consumer Behaviour. New Delhi: Cengage Learning.
4. Hawkins, D.I., Best, R. J., Coney, K.A., & Mookerjee, A. (2007). Consumer Behaviour – Building Marketing Strategy. (9th ed.). Tata McGraw Hill.
5. Loudan, David L and Bitta, A.J. Della Consumer Behaviour
6. Kotler, P. & Keller, K. L. (2012). Marketing Management (Global Edition) (14th ed.). Pearson
7. Nair, Suja R- Consumer Behaviour in Indian Perspective

Web Resources:

1. Consumer protection Act 2022.(http://ncdrc.nic.in/bare_acts/consumer%20protection%20act-1986.html)
2. CDM (<https://www.lucidchart.com/blog/consumer-decision-making-process>)
3. Theories of Personality (<https://www.wisdomjobs.com/e-university/consumer-behaviour-tutorial-94/trait-theory-in-personality-10532.html>)
4. Models in CB ([https://nscpolteksby.ac.id/ebook/files/Ebook/Business%20Administration/Consumer%20Behaviour%20and%20Advertising%20Management%20\(2006\)/21.%20Chapter%2020%20-%20Models%20of%20Consumer%20Behaviour.pdf](https://nscpolteksby.ac.id/ebook/files/Ebook/Business%20Administration/Consumer%20Behaviour%20and%20Advertising%20Management%20(2006)/21.%20Chapter%2020%20-%20Models%20of%20Consumer%20Behaviour.pdf))

Journals:

1. https://www.researchgate.net/publication/256412209_Journal_of_Consumer_Behaviour6
2. <https://journals.sagepub.com/doi/pdf/10.1177/2158244016645638>
3. https://www.jois.eu/files/Vol_6_1_Makarewicz.pdf

21VOC 6.1: DIGITAL MARKETING

Total Teaching Hours: 60

No. of Hours per Week: 4

(4 credits)

CObj	Course Objectives
CObj_1	To understand the important concepts related to digital marketing and SEO
CObj_2	To learn the use of display advertising
CObj_3	To be aware of social media marketing and mobile marketing.

CO	Course Outcomes
	After completion of this module, students should be able to:
CO1	Gain insights to digital marketing
CO2	Learns about the application of display advertising
CO3	Can apply search engine optimization for business
CO4	Apply social media strategies to solve business problems
CO5	Ability to develop Mobile Marketing in business

CO-PO Mapping

	PO_1	PO_2	PO_3	PO_4	PO_5
CO_1	*				
CO_2	*	*			
CO_3			*		
CO_4			*	*	
CO_5					*

Course Content

S. No	Unit/chapter title	Course Content	Number of hours	Skills Developed
1	Unit- I Introduction to Digital Marketing	Introduction to Digital Marketing, Concept of Digital Marketing, Origin, traditional versus Digital Marketing, Digital Marketing Strategy- The P-O-E-M Framework, Segmenting and customizing Messages, Digital Landscape, Digital advertising Market in India, Skills required in Digital Marketing, Digital Marketing Plan.	14 Hrs	Cognitive Skills
2	Unit- II Display Advertisement	Display Advertising: Concept of Display Advertising, Types of display ads, Buying models, Display plan Targeting, Contextual targeting, Placement targeting, Remarketing, Interest categories, Geographic and language tagging, Demographics, Mobile and other targeting methods, Programmatic digital advertising.	12 Hrs	Cognitive Skills, Employable Skills
3	Unit- III Search Engine Optimization	Search Engine Advertising- Understanding Ad Placement, Understanding Ad Ranks, Creating First Ad Campaign, Performance Reports. Search Engine Optimization: How search engines work, concept of search engine optimization (SEO), On Page Optimization, Off Page Optimization, social media outreach, Maintenance- SEO tactics, Google Search Engine, Web Analytics- Key Metrics- concepts only.	14 Hrs	Cognitive skills
4	Unit- IV Social Media Marketing	Social Media Marketing: Building a successful Strategy, Facebook Marketing: Facebook for business & Facebook insights; LinkedIn Marketing: LinkedIn Strategy, LinkedIn Analytics; Twitter Marketing: Building Content Strategy, Twitter usage, Twitter Analytics Instagram and Snapchat: Objectives of Instagram, Hashtags, Digital Public Relations. YouTube Advertising. Podcasts- Introduction, types and uses.	8 Hrs	Cognitive skills Analytical Skills
5	Unit- V Mobile Marketing	Mobile Marketing, Mobile Usage, Mobile Advertising, Mobile Advertising Models, Advantages of Mobile advertising, Mobile Marketing Toolkit, Mobile Marketing features, Location based services, social marketing on mobile, QR Codes, Augmented Reality, Gamification, Tracking mobile campaigns.	12 Hrs	Cognitive skills, Employable Skills

Books for Reference:

1. Seema Gupta. (2017). Digital Marketing. McGraw Hill.
2. Philip Kotler, Hermawan Kartajaya, Setiawan Iwan. (2017). Marketing 4.0: Moving from Traditional to Digital. Wiley.
3. Puneet Bhatia. Fundamentals of Digital Marketing. (Second Edition). Pearson
4. Swaminathan, T.N. Karthik Kumar (2019). Digital Marketing. Cengage Learning India Pvt. Ltd.
5. Tracy L Tuten, Michael. Solomon, R. Social Media Marketing. (Second Edition). SAGE
6. Ian Dodson. (2016). Digital Marketing. Wiley

Web Resource:

1. <https://testbook.com/digital-marketing/digital-marketing-course-syllabus-and-content-for-beginners>
2. Google Digital Garage
3. HubSpot Academy
4. Moz
5. Social Media Examiner
6. Search Engine Land
7. Neil Patel's Blog
8. DigitalMarketer

Journals:

1. Journal of Interactive Marketing
2. Journal of Digital Marketing
3. Journal of Research in Interactive Marketing
4. International Journal of Internet Marketing and Advertising
5. Journal of Marketing Communications
6. Journal of Digital & Social Media Marketing

21SEC 6.1: INTERNSHIP

Total Teaching Hours: 30

No. of Hours per Week: 2

(2 credits)

Internship project is an opportunity for students to learn the real-time structure, operations and practices of an organization by undertaking training in a business organization for a month and half period of time. During this period students spend in various functional departments of organization and report their learnings to their guides.

CObj	Course Objectives
CObj_1	To analyse whether the companies' visions, missions, core values and strategies are in proper alignment
CObj_2	To understand various processes and systems within the company and their related area of operations such as Marketing, Finance, H.R
CObj_3	To learn and familiarize of organizational structure, product and services

CO	Course Outcomes
	After completion of this module, students should be able to:
CO1	Understands the companies Visions, missions, core values and strategies. Infer the organization size, structure, product and service and their current state.
CO2	Identifies the various processes and systems within the company and their related area of operations.
CO3	Learns about the core functions of the organizations and develops executive networks by performing the assigned tasks in the organization.
CO4	Analyses the SWOC related to an organization
CO5	Develops interpersonal skills, softskills and leadership skills

Course Content

Sl. No	Unit/Chapter title	Content	Number of Hours	Skills Developed
1	Introduction	Industry overview, Company profile, Vision, mission, goals and objectives	03 Hrs	Cognitive Skills
2	Organizational structure/Chart	Organizational chart, board of directors, top leaders	02 Hrs	Employable Skills
3	Functional areas	Details about various functional areas, Finance department, marketing department, HR departments.	05 Hrs	Analytical and Employable Skills
4	Financial Analysis	Liquidity ratios, Profitability ratios, Leverage ratios, Per-share ratios	05 Hrs	Analytical Skills
5	SWOC Analysis	Strength, Weakness, opportunities and Challenges analysis with diagram/matrix	05 Hrs	Analytical Skills
6	Learning experience	Record the tasks assignment and write about the learning experience	05 Hrs	Employable Skills
7	Suggestions, recommendations and Conclusion	Suggestions based on findings, recommendations, and Conclusion of the study, references	05 Hrs	Analytical Skills

Text Books and Reference Books: NA

Essential Reading / Recommended Reading

- Kothari, C. R. (2019). Research Methodology Methods & Techniques (2 ed.). New Delhi: VishwaPrakashan.

Grading of the Internship

The internship will be graded based on weekly report, final report and viva and the grade is awarded on the following pattern

Guidelines

1. Each student will have to work in a Business Organization for at least 4 weeks after their Fifth Semester Examination.
2. The entire batch of students is to be divided equally among the department faculty members. The faculty members should be the mentors and guide the students in the internship process.
3. The students must submit the Certificate for completion of internship by the organization to the college along with a brief report of not less than 25 pages. The report contains details of the organization, nature of business, and a write up on the learning outcome from the internship carried out by them.

Marks Allocation:

- 30 Marks for the Internship Report and 20 Marks for Presentation and Viva-Voce examination.
- Viva-Voce shall be conducted at the end of the semester, by the external faculty, from among the panel of examiners and identified by the College.
- The Institution should send the marks to the University along with IA Marks scored by them in the VI Semester.



MATRIX AND SYLLABUS

For the Programme

Bachelor of Business Administration (Business Analytics)

NEP Based Curriculum (2021 onwards)

PEOs	Programme Educational Objectives
PEO1	Provide students with an overview of business analytics and its applications in various industries. The role of data analytics in decision-making processes and the importance of data-driven insights in driving business success.
PEO2	To provide an understanding of organising information efficiently and analyse using appropriate software.
PEO3	To Introduce students to descriptive analytics techniques used to summarize and interpret data. This includes concepts such as data visualization, exploratory data analysis, data profiling, and summary statistics.
PEO4	To instil professional ethics, human values, and social responsibility for the growth of organisations and societies.
PEO5	To educate future business professionals who are able to apply theoretical understanding toward the development of viable solutions to challenges that exist in the actual world.

PO	Programme Outcomes
PO1	Students will be able to perform forecasting and predictive analytics.
PO2	Students will be conversant with basic data visualisation techniques and will be capable of learning advanced techniques.
PO3	Students will be able to work on business applications of emerging technologies.
PO4	This programme brings out reflective, scientific and creative thinking in the students to get deeper insights into the business world and tackle complex situations with the help of skills and knowledge acquired.
PO5	Imbibe ethical practices in profession and appreciate sustainability and evince a sense of social responsibility in their respective environments, by becoming citizens working for the welfare and benefit of the society, at large. Achieve higher levels of proficiency and self-actualization through the pursuit of life-long learning.

At the end of year	Exit Award	Outcomes Achieved	Credits
1 st Year	Certificate in Business Administration	PO1	50
2 nd Year	Diploma in Business Administration	PO1, PO2, PO3	100
3 rd Year	Bachelor's Degree in Business Administration	PO1, PO2, PO3, PO4	148
4 th Year	Honours Degree in Business Administration	PO1, PO2, PO3, PO4, PO5	190

NEP- Curriculum Framework

B.B.A (Business Analytics)- Matrix for I Semester (w.e.f. 2023-24 onwards)

I Semester							
Code	Course Code	Course	Teaching Hours	Course Components			Credits
				L	T	P	
AECC	M21KN 1.1/ M21HN 1.1/ M21AE 1.1	Language I (Kannada/Hindi/Additional English)	45	3	1	-	3
AECC	M21GE 1.1	Language II (Generic English)	60	3	1	-	3
DSC	T23DC 1.1	Management Theory & Practices	60	4	-	-	4
DSC	T23DC 1.2	Fundamentals of Business Accounting	60	4	-	-	4
DSC	T23DC 1.3	Fundamentals Business Analytics	60	4	-	-	4
OE-1	M21OE 1.1	Business Organisation	45	3	-	-	3
SEC- SB	21SBC 1.1	Digital Fluency - I	30	1	-	2	2
SEC-VB	21VBC 1.1	Health and Well-being	30	-	-	2	1
SEC-VB	21VBC 1.2	Yoga	30	-	-	2	1
Total							25

Note 1:

AECC- Ability Enhancement Compulsory Course

DSC - Discipline-Specific Course

OE- Open elective (course offered by the department to students of other stream)

SEC - VB Skill Enhancement Course -Value Based

SEC - SB Skill Enhancement Course -Skill Based

Continuous Internal Assessment – Scheme of Evaluation For Theory Courses

End Semester Examination: 60%

Continuous Internal Assessment: 40%

Activities (CIA: 40 Marks)	Proposed and Approved Scheme		Total Marks (40)
	IA-1	IA-2	
Session Test Maximum Marks	30	30	
1. Weightage (Marks)	10	10	20
2. Assignment (Marks)	20		20
i. Writing	10		
ii. Quiz / Presentation / Creating diagrams /charts / Classwork / Case study / Viva / Field work etc.	05		
iii. Classroom participation	05		
Total			40

T23DC 1.1: MANAGEMENT PRINCIPLES AND PRACTICE**Total Teaching Hours: 60****No. of Hours per Week: 4****(4 credits)**

CObj	Course Objectives
CObj_1	To provide an understanding of the functions and responsibilities of managers.
CObj_2	To familiarize students with the tools and techniques to be used in the performance of the managerial job.
CObj_3	To enhance students understanding to develop cognizance of the importance of management principles.

CO	Course Outcomes
	After completion of this module, students should be able to:
CO1	Able to demonstrate their understanding of various concepts, principles, and functions of business management.
CO2	Able to Demonstrate the roles, skills and functions of management
CO3	The ability to create organization structures based on authority, task and responsibilities.
CO4	The ability to understand the complexities associated with management of human resources in the organizations and integrate the learning in handling these complexities.
CO5	The ability to understand the requirement of good control system and control techniques

CO-PO Mapping

	PO_1	PO_2	PO_3	PO_4	PO_5
CO_1	*				
CO_2		*		*	*
CO_3	*				
CO_4			*		
CO_5			*		

Course Content

S. No	Unit title	Course Content	Number of Hours	Skills Developed
1	Unit- I Introduction To Management	Introduction –Meaning, Evolution of management thought, Pre-Scientific Management Era, Classical Management Era, Neo-Classical Management Era, Modern Management Era; Nature and Characteristics of Management - Scope and Functional areas of Management; Management as a Science, Art or Profession; Management and Administration; Principles of Management.	14 Hrs	Cognitive Skills
2	Unit- II Planning And Decision Making	Nature, Importance and Purpose of Planning - Planning Process; Objectives; Types of plans (Meaning only); Decision making- Importance and steps; MBO and MBE (Meaning only)	10 Hrs	Life Skills
3	Unit- III Organizing And Staffing	Nature and purpose of Organization; Principles of Organizing; Delegation of Authority; Types of Organization - Departmentation, Committees; Centralization vs Decentralization of Authority and Responsibility, Span of Control; Nature and importance of Staffing (Case Study)	12 Hrs	Employable Skills
4	Unit- IV Directing And Communicating	Meaning and Nature of Direction, Principles of Direction; Communication - Meaning and Importance, Communication Process, Barriers to Communication, Steps to overcome Communication Barriers, Types of Communication; Leadership – Meaning, Formal and Informal Leadership, Characteristics of Leadership; Leadership Styles – Autocratic Style, Democratic Style, Participative Style, Laissez Faire Leadership Styles, Transition Leadership, Charismatic Leadership Style. (Case Study)	14 Hrs	Life Skills

5	Unit- V Coordinating And Controlling	Coordination–Meaning, Importance and Principles. Controlling-Meaning and steps in controlling, Essentials of Effective Control system, Techniques of Control (in brief).	10 Hrs	Life Skills

Books for Reference:

1. Robbins, S. P. (2021). Management. Pearson.
2. Koontz, H., & O'Donnell, C. (2005). Management. McGraw Hill.
3. Prasad, L. M. (2019). Principles of Management. Sultan Chand and Sons.
4. Rao, V. S. P., & Bajaj, P. (2009). Management Process and Organization. Excel Books.
5. Appanniah, H. R., & Reddy, P. N. (2017). Management. HPH.
6. Ramaswamy, T. (2017). Principles of Management. HPH.

Web Resources:

1. <https://courses.lumenlearning.com/boundless-management/>
2. <https://www.managementstudyguide.com/principles-of-management.htm>
3. https://www.tutorialspoint.com/management_concepts/index.htm
4. <https://www.investopedia.com/terms/p/principles-of-management.asp>
5. <https://study.com/academy/course/business-101-principles-of-management.html>

Journals:

1. Academy of Management Journal
2. Journal of Management Studies
3. Harvard Business Review
4. Administrative Science Quarterly
5. Journal of Business Ethics

T23DC 1.2: FUNDAMENTALS OF BUSINESS ACCOUNTING**Total Teaching Hours: 60****No. of Hours / Week: 04****(04 Credit)**

CObj	Course Objectives
CObj_1	To acquaint students with the accounting concepts, tools and techniques influencing business organizations.
CObj_2	To make the students understand the basic accounting concepts and conventions
CObj_3	To familiarize the students to work with ratio analysis and bank reconciliation statement

CO	Course Outcomes
	After completion of this module, students should be able to:
CO1	Acquires the knowledge in accounting, system of maintenance of accounts, journal, ledger, bill of exchange, and account current, average due date and bank reconciliation statement. The Ability to pass journal entries and prepare ledger accounts.
CO2	Understand the basic accounting concepts and conventions, preparation of subsidiary books and final accounts, account of Consignment, Joint venture and non-trading concerns.
CO3	Develops the analytical skills in accounting equation, preparation of trial balance and suspense account, normal loss in consignment. Analysing the reasons for differences between pass book and cash book transactions in the Bank Reconciliation Statement.
CO4	Prepare the vertical and Horizontal Analysis and Ratio Analysis.
CO5	Analyse and interpret published financial information.

CO-PO Mapping

	PO_1	PO_2	PO_3	PO_4	PO_5
CO_1	*				
CO_2	*		*		
CO_3		*			*
CO_4	*			*	
CO_5			*		*

Course Content

S. No	Unit/chapter title	Course Content	Number of hours	Skills Developed
1.	Unit- I Introduction to Fundamentals of Accounting	Introduction – Meaning and Definition, Objectives of Accounting, Functions of Accounting, Users of Accounting Information, Limitations of Accounting, Accounting Cycle, Accounting Principles, Accounting Concepts and Conventions. Basics of Accounting Standards, Accounting Equations.	08 Hrs	Cognitive Skills
2.	Unit- II Accounting Process	Meaning of Double entry system, Process of Accounting, Types of Accounts, Rules -Transaction Analysis, Journal – Ledger –Balancing of Accounts, Trial Balance – Numerical	13Hrs	Cognitive Skills
3.	Unit- III Subsidiary Books	Meaning – Significance – Types of Subsidiary Books –Preparation of Purchases Book, Sales Book, Purchase Returns Book, Sales Return Book, Bills Receivable Book, Bills Payable Book. Types of Cash Book- Simple Cash Book , Double Column Cash Book , Three Column Cash Book and Petty Cash Book (Numericals only on Three Column Cash Book and Petty Cash Book) Preparation of Bank Reconciliation Statement.	15 Hrs	Cognitive Skills& Analytical Skills
4.	Unit- IV Final Accounts Of Proprietary Concern	Preparation of Statement of comprehensive income and financial position of a proprietary concern with special adjustments like depreciation, outstanding and prepaid expenses, provision for doubtful debts, drawings and interest on capital etc.(Case Study)	12 Hrs	Analytical Skills
5.	Unit- V Financial Statements Analysis	Meaning - Users of Financial statement - Analysis of financial statements – Vertical and Horizontal Analysis (Numericals) – Basics of Ratio analysis and Interpretation.	12 Hrs	Analytical Skills

Books for Reference:

1. Hanif and Mukherjee (2015). *Financial Accounting*. McGraw Hill Publishers
2. Arulanandam & Raman (2013). *Advanced Accountancy*, Himalaya Publishing House
3. S.Anil Kumar, V.Rajesh Kumar and B.Mariyappa. (2014). *Fundamentals of Accounting*,Himalaya Publishing House.
4. Maheswari, S. N. (2018). *Financial Accounting*. (6/e),Vikas Publication.
5. Jain, S. P., & Narang, K. L. (2016). *Financial Accounting*. Kalyani Publication.
6. Radhaswamy, & Gupta, R. L. (2015). *Advanced Accounting*. Sultan Chand.
7. Shukla, M.C., & Goyel. (2017). *Advanced Accounting*. (19e), S Chand.

Web Resources:

1. <https://www.accountancyknowledge.com/journal-entry-problems-and-solutions/>
2. <https://www.toppr.com/guides/fundamentals-of-accounting/books-of-prime-entry/what-are-subsidiary-books/>
3. https://www.brainkart.com/article/Final-accounts-with-adjustments_34241/
4. <https://www.accountingtools.com/articles/financial-statement-analysis>

Journals:

1. Duff, A., Hancock, P. and Marriott, N., 2020. The role and impact of professional accountancy associations on accounting education research: An international study. *The British Accounting Review*, 52(5), p.100829.
2. Jenkins, J., Popova, V. and Sheldon, M., 2020. Monitoring the accounting profession under the AICPA code of professional conduct: An analysis of state board of accountancy participation. *Journal of Accounting and Public Policy*, 39(3), p.106742.
3. Power, S., Cleary, P. and Donnelly, R., 2017. Accounting in the London Stock Exchange's extractive industry: The effect of policy diversity on the value relevance of exploration-related disclosures. *The British Accounting Review*, 49(6), pp.545-559.

T23DC 1.3: FUNDAMENTALS OF BUSINESS ANALYTICS

Total Teaching Hours: 60

No. of Hours per week: 4

(4 credits)

CObj	Course Objectives
CObj_1	To achieve and establish vital understanding of big data application in business intelligence.
CObj_2	To institute the concept of systematic transformation of process-oriented data into information of the underlying business process.
CObj_3	To exhibit knowledge of data analysis techniques and to apply principles of data sciences integrating enterprise reporting.

CO	Course Outcomes
	After completion of this module, students should be able to:
CO1	Outline the business analytics role
CO2	Examine the business view of information technology application
CO3	Explain the concepts of OLTP, OLAP and BI
CO4	Demonstrate the data integration and data modelling concepts
CO5	Analyze the concepts of Enterprise reporting and BI in real world also learn to use excel

CO-PO Mapping

	PO_1	PO_2	PO_3	PO_4	PO_5
CO_1		*	*		
CO_2		*		*	*
CO_3	*				
CO_4					*
CO_5				*	

Course Content

S. No	Unit/chapter title	Course Content	Number of hours	Skills Developed
1	Unit- I Introduction to the Business Analytics	Business Analysis-Business Analyst, The evolving role of the Business Analyst, The BA roadmap: different levels of business analysis, The basic rules of Business and Business Analysis-Classical Requirements and Tasks performed by Business Analysts. Project Definition and Scoping: Aspects-Projects phases -Project approaches (Waterfall, Agile, Iterative, Incremental) – The role of the BA across the project lifecycle.	15 hrs	Cognitive Skills
2	Unit- II Business View of Information Technology Applications	Core Business Process – Baldrige Business Excellence Framework -Key purpose of using IT in business-Enterprise Applications-Information users and their requirements. Data Definition: Types of Data -Attributes and Measurement-Types of Data Sets-Data Quality-Types of Digital Data.	10 hrs	Cognitive and Employable Skills
3	Unit- III Introduction to OLTP and OLAP	OLTP-OLAP-Different OLAP Architectures-OLTP and OLAP-Data models for OLTP and OLAP-Role of OLAP Tools in BI Architecture. Business Intelligence -Business Intelligence defines-Evolution of BI and Role of DSS, EIS,MIS and Digital Dashboards-Need for BI -BI value chain – Introduction to Business Analytics.BI Definitions and Concepts-BI Component Framework-Need for BI-BI Users-Business Intelligence applications-BI roles and responsibilities.	13hrs	Employable Skills
4	Unit- IV Data Integration	Data Warehouse - Goals-Data sources-Extract-Transform, Load-Data Integration-Technologies-Data Quality maintenance-Data profiling. Data Modelling –Basics, Types-Techniques, Fact Table, Dimension Table-Typical Dimensional Models-Dimensional modeling life cycle-Designing the Dimensional Model	12 hrs	Cognitive Skills, Technical Skills

5	Unit- V Data Analytics Using Excel	Entering Data, Exploring data in excel, Descriptive Statistics(Using Excel's Data Analysis tool)-Include Variable, Format the variables – Sample or Population, Mean, Mode, Median, Standard error, Standard Deviation, Sample Variance, Kurtosis-Skewness, Range, Minimum, Maximum, Sum, Count, One way ANOVA, Sources of Variation, Sum of Square Deviations, Degrees of Freedom, Mean Square of Deviations, P -Value	10 hrs	Technical Skills

Books for Reference:

1. Prasad, R. N., & Acharya, S. (2016). Fundamentals of Business Analytics (Revised ed). Wiley.
2. Tan, P.-N., Steinbach, M., & Kumar, V. (2015). Introduction to Data Mining (Revised ed). Pearson Education.
3. Thomas, H. (2016). Business Analysis Fundamentals (Revised ed.). Pearson Education.

Web Resource:

1. Kaggle
2. DataCamp
3. Analytics Vidhya
4. Towards Data Science
5. Stack Overflow

Journals:

1. Journal of Business Analytics, Volume 6, Issue 2 (2023)
2. Business Analyst Journal

M21OE 1.1: BUSINESS ORGANISATION**Total Teaching Hours: 45****No. of Hours / Week: 03****(3 Credit)**

CObj	Course Objectives
CObj_1	To impart the fundamentals of Business Organisation with an objective to develop the basic knowledge of operations and functions of organisation
CObj_2	To enable the use of basic concepts of management in business organization
CObj_3	To have a proper understanding of social responsibility towards business and principles of management

CO	Course Outcomes
	After completion of this module, students should be able to:
CO1	An understanding of the nature, objectives and social responsibilities of business
CO2	An ability to describe the different forms of organisations
CO3	An understanding of the basic concepts of management
CO4	An understanding of functions of management
CO5	An understanding of different types of business combinations

CO-PO Mapping

	PO_1	PO_2	PO_3	PO_4	PO_5
CO_1	*	*			
CO_2		*		*	*
CO_3	*				
CO_4			*	*	
CO_5			*		

Course Content

S. No	Unit/chapter title	Course Content	Number of hours	Skills Developed
1	Unit- I Introduction to Business	Business: Meaning, Nature, Scope and Social responsibility of Business, Objectives, Essentials of successful business; Functional areas of business. Concept of Business Organisation.	10 Hrs	Cognitive Skills
2	Unit- II Forms of Business Organization	Sole proprietorship: Definitions, Features, Merits and Demerits. Partnership: Definitions, partnership deed, Features, Merits and Demerits. Joint Stock Company: Definitions, Features, Merits and Demerits. Co-operatives: Definitions, Features, Merits and Demerits.	12 Hrs	Cognitive Skills
3	Unit- III Public Enterprises	Departmental Undertaking: Definitions, Features, Merits and Demerits. Public Corporations: Definitions, Features, Merits and Demerits. Government Companies: Definitions, Features, Merits and Demerits	08 Hrs	Evaluation and Synthesis
4	Unit- IV Business Combinations	Meaning Definitions, Causes, Types, Forms, merits and demerits of Business Combinations, Recent Trends in Business Combinations.	08 Hrs	Cognitive Skills
5	Unit- V Management of Organizations	Management- Meaning, Definitions, Difference between Management and Administration, Levels of Management, Objectives of Management, Functions of management- planning, organizing, staffing, directing, coordinating, controlling, Principles of Management.	07 Hrs	Analytical Skills

Books for Reference:

1. C B. Gupta. (2020). Business Organisation and Management, Sultan Chand & Sons.
2. Saxena, S. C. (2021). Business Administration & Management. Sahitya Bhawan.
3. Shukla, M. C. (2010). Business Organisation and Management. S Chand & Company Pvt. Ltd.S.A Sherlekar - Business Organization, Himalaya Publishing House.
4. Bhushan, Y.K. (2016). Fundamentals of Business Organisation and Management. Sultan Chand & Sons.
5. Sharma, R.K. (2018). Business Organisation & Management. Kalyani Publishers.
6. Sahai, I.M., & Asthana, P. (2021). Business Organisation & Administration. Sahitya Bhawan Publications.

Web Resource:

1. U.S. Small Business Administration (SBA)
2. Entrepreneur
3. Investopedia
4. SCORE
5. Harvard Business Review (HBR)
6. The Wall Street Journal (WSJ)
7. Forbes

Journals:

1. Journal of Business Research
2. Harvard Business Review
3. Academy of Management Journal
4. Journal of Management Studies
5. Strategic Management Journal
6. Organization Science
7. Journal of Organizational Behavior
8. Administrative Science Quarterly
9. Journal of Business Ethics
10. Organization Studies

21SBC 1 .1: DIGITAL FLUENCY

Total Teaching Hours: 30

No. of Hours 2

(2 Credits)

CObj_ID	Course Objectives
CObj_1	To learn about advanced formulas for business administration
CObj_2	To equip participants with the knowledge to debug and audit the advanced formulas
CObj_3	To explore and analyze data using advanced excel.

CO_ID	Course Outcomes
	After completion of this module, students should be able to:
CO_1	Understands to apply basic principles of laying out excel models for decision making..
CO_2	Examines spread sheet concepts and explore the Microsoft office Excel environment
CO_3	Use excel functions to summarize quantitative data graphically, including pivot table and charts.
CO_4	Gains ability to apply formulas to lay data in readiness for analysis.
CO_5	Explores the best practices by troubleshooting complex models.

CO-PO Mapping

	PO_1	PO_2	PO_3	PO_4	PO_5
CO_1	*	*			
CO_2	*	*			
CO_3		*	*		
CO_4		*	*	*	
CO_5		*			*

Course Content

S. No	Unit/chapter title	Course Content	Number of hours	Skills Developed
1	Create Worksheets & Workbook	Create of Workbook, Navigation within the Workbook (Clipboard), Import Data from De Limited Text Files, Add the Worksheet for the Existing workbook. Navigating using GOTO Special.	2 Hrs	Employable Skills
2	References & Table Format	Type of References: Absolute Reference, Mixed References, Relative References, Apply the Different Table Format. (Working with 2 Case Studies)	2 Hrs	Employable Skills
3	Summarize data by using Functions / Statistical Functions.	Define Name, Perform Calculations by using the SUM, SUMIF, SUMIFS, COUNT, COUNTA, COUNTIF, COUNTIFS, COUNT BLANK, AVERAGE, AVERAGEIF, MAX, MIN RANK FUNCTIONS ETC (Working with 2 Case Studies)	2 Hrs	Employable Skills
4	Lookup & Reference Section.	VLOOKUP, HLOOKUP, Index, Match, & If error. (Working with 2 Case Studies)	2 Hrs	Employable Skills
5	Create & Format Charts	New Chart, Data Series, Switch b/w Rows & Columns, Analyses data by using Quick Analysis, Resize Charts & Add & Modify The Chart Elements, Layouts & Styles, Move Chart to Chart Sheets (Working with 1 Case Studies)	2 Hrs	Employable Skills
6	Format & Modify Text by using Functions.	Format Text by using RIGHT, LEFT, MID, UPPER, LOWER, PROPER, Concatenate, TRIM, Clean, Char, TEXT JOIN, LEN, FIND, Search, Replace & Substitute. (Working with 1 Case Studies)	2 Hrs	Employable Skills
7	Create Advanced Tables & Charts	Create & Manage Pivot Tables, Create & Manage Pivot Charts , Working Slices , Timeline Filters , Sorting Options, Designing the PIVOT Tables ETC. (Working with 2 Case Studies)	2 Hrs	Employable Skills
8	DATE Functions	Working the Date Formats, Working the Various Date Functions Like DATE, TODAY, NOW, EOMONTH, WORKDAY, WORKDAY.INTL, NETWORKDAY, and NETWORKDAY.INTL. ETC. . (Working with 1 Case Studies)	2 Hrs	Employable Skills
9	Functions	Working the Various Logical Functions	2 Hrs	Employable

		like IF, IFS, AND, OR, SWITCH , TRUE or False . (Working with 1 Case Studies)		Skills
10	Financial Functions	PMT, IPMT, CUMIPMT,RATE, NPER,FV. (Working with 1 Case Studies)	2 Hrs	Employable Skills
11	Data Analytics Tools	Working with Custom Sort & Advanced Filter, Text to Columns, Remove Duplicates, Data Validation, Consolidation, what if Analysis (Scenario Manager, Goal Seek, FORECAST, FORECAST.ETS, FORECAST.CONFIN, FRCAST.ETS.SESONALITY, FORECAST.ETS.STAT, FORECAST & Data Table), FORECASTING.LINEAR) (Working with 1 Case Studies)	3 Hrs	Employable Skills
12	Creating for Dynamic Charts using Functions.	An Excel Dashboard provides insight, analysis and alerts. They're fully interactive and dynamic and can help with project management, customer service, retail management, financial forecasting and much more. (Working with 1 Case Studies)	3 Hrs	Employable Skills
13	Power Pivot Table	Advanced Pivot Table, Working with Relationship, Introduction of DAX Functions, Data Modelling, Queries & Connections, Designing Pivot Chart & Table. (Working with 1 Case Studies)	2 Hrs	Employable Skills
14	Working with Addons	Working Various Addons Analytics Tool Pack, Power Maps, Solver Add in.	2 Hrs	Employable Skills

Books for Reference:

1. Microsoft Excel 2019 Bible: The Comprehensive Tutorial Resource Excel: Quickstart Guide from Beginner to Expert
2. Excel 2019: All-In-One for Dummies Microsoft Excel Dashboards and Reports
3. Ctrl+Shift+Enter Mastering Excel Array Formulas Excel for Beginners
4. Microsoft Excel 2019 Formulas and Functions

Web Resources:

1. www.google.com
2. <https://youtube.com/c/edurekaIN>
3. <https://openoregon.pressbooks.pub/beginningexcel19/>
4. <https://corporatefinanceinstitute.com/resources/ebooks/excel-book-pdf/>
5. <https://doc.lagout.org/operating%20system%20/Windows/Excel/Microsoft%20Excel%202010%20Step%20by%20Step.pdf>
6. <https://www.linkedin.com/learning/excel>
7. <https://www.youtube.com/channel/UCVLbzhxVTiTliVKeGV7WEBg>

Journals:

1. Journal of Financial Planning
2. Journal of Business and Economic Statistics
3. Journal of Applied Business Research
4. Journal of Financial Education
5. Journal of Accounting Education

NEP- Curriculum Framework

B.B.A (Business Analytics)- Matrix for II Semester (w.e.f. 2023-24 onwards)

II Semester							
Code	Course Code	Course	Teaching Hours	Course Components			Credits
				L	T	P	
AECC	M21KN 2.1/ M21HN 2.1/ M21AE 2.1	Language I (Kannada/Hindi/Additional English)	45	3	1	-	3
AECC	M21GE 2.1	Language II (Generic English)	60	3	1	-	3
DSC	T23DC 2.1	Business Environment	60	4	-	-	4
DSC	T23DC 2.2	Power Business Intelligence	60	3	-	2	4
DSC	T23DC 2.3	Business Mathematics	60	4	-	-	4
OE-2	M21OE 2.1	People Management	45	3	-	-	3
AECC	21SBC 2.1	Environmental Studies	30	2	-	-	2
SEC-VB	21VBC 2.1	NCC/NSS/Cultural	30	-	-	2	1
SEC-VB	21VBC 2.2	Sports	30	-	-	2	1
Total							25

Note 1:

AECC- Ability Enhancement Compulsory Course

DSC - Discipline-Specific Course

OE- Open elective (course offered by the department to students of other stream)

SEC - VB Skill Enhancement Course -Value Based

SEC - SB Skill Enhancement Course -Skill Based

Continuous Internal Assessment – Scheme of EvaluationFor

Theory Courses

End Semester Examination: 60%

Continuous Internal Assessment: 40%

Activities (CIA: 40 Marks)	Proposed and Approved Scheme		Total Marks (40)
	IA-1	IA-2	
Session Test Maximum Marks	30	30	
1. Weightage (Marks)	10	10	20
2. Assignment (Marks)	20		20
i. Writing	10		
ii. Quiz / Presentation / Creating diagrams /charts / Classwork / Case study / Viva / Field work etc.	05		
iii. Classroom participation	05		
Total			40

T23DC 2.1: BUSINESS ENVIRONMENT

Total Teaching Hours: 60

No. of Hours per Week: 4

(4 credits)

CObj	Course Objectives
CObj_1	To familiarise the students with aspects of Business Organization and its Environment.
CObj_2	To identify the definable aspects of business environment within which a business organisation
CObj_3	To develop an insight so as to adapt to the changing trends of the business environment.

CO	Course Outcomes
	After completion of this module, students should be able to:
CO1	Understand the nature, objectives and forms of business
CO2	Acquire the ability to describe the government and legal environment
CO3	Analyze and Understand the economic and globalisation concepts
CO4	Analyze and understand the technological and natural environment
CO5	Identify the trends in business

CO-PO Mapping

	PO_1	PO_2	PO_3	PO_4	PO_5
CO_1	*			*	*
CO_2			*	*	*
CO_3		*			
CO_4				*	
CO_5			*		

Course Content

S. No	Unit/chapter title	Course Content	Number of hours	Skills Developed
1	Unit- I Introduction to Business	Business: Meaning, Nature, Scope and Social responsibility of Business, Objectives, Essentials of successful business; Functional areas of business. Forms of Business organization: Sole proprietorship, Partnership, Joint Stock Company & Co-operatives – Definitions, Features, Merits and Demerits.	8 Hrs	Cognitive Skills
2	Unit- II Government and Legal Environment in India	Role of Central and State Governments in business. Causes for State intervention in business - Benefits and limitations. Role of legal environment in business. Need and objectives of Environmental Protection Act 1986. Need and objectives Consumer Protection Act 2019. Rights of consumers under Consumer Protection Act, 2019. Need and objectives of National Competition Policy in India. Meaning of Intellectual Property Right. Types of Intellectual Properties.	14 Hrs	Technical Skills
3	Unit- III Economic Environment and Global Environment	An overview of economic environment, nature of the economy, structure of economy, factors affecting economic environment. Globalization of business; meaning and dimensions, stages, essential conditions of globalization, foreign market entry strategies, merits and demerits of globalization of business, Impact of Globalization on Indian businesses, Forms of globalization of businesses - MNCs, TNCs etc.	14 Hrs	Cognitive Skills
4	Unit- IV Technological Environment and Natural Environment	Meaning and features; types of innovation, Impact of Technological changes on business, Technology and Society, Technological Acquisition modes, IT revolution and business, Management of Technology. Meaning and nature of physical environment. Impact of Natural environment on business.	14 Hrs	Technical Skills
5	Unit- V Emerging Modes of Business	E-business - scope and benefits, resources required for successful e-business implementation, online transactions, payment mechanism, security and safety of business transactions; Outsourcing concept, need and scope of BPO (business process outsourcing) and KPO (knowledge process outsourcing); Smart cards and ATMs- meaning and utility.	10 Hrs	Cognitive Skills Technical Skills

Books for Reference:

1. Aswathappa, K. (2015). Essentials of Business Environment. Himalaya Publishing House.
2. Rangarajan, C.A. (1998). Perspective in Economics. S. Chand & Sons.
3. Cherunilam, F. (2019). Business Environment - Text and Cases (27th Revised Edition). Himalaya Publishing House.
4. Gupta, C.B. (2023). Business Organisation and Management. Sultan Chand & Sons.
5. Shukla, M.C. (2010). Business Organisation and Management. S Chand & Company Pvt. Ltd.
6. Sharma, R.K. (2011). Business Organisation & Management. Kalyani Publishers.

Web Resource:

1. World Economic Forum (WEF): <https://www.weforum.org/>
2. Harvard Business Review (HBR): <https://hbr.org/>
3. Forbes: <https://www.forbes.com/>
4. The Economist: <https://www.economist.com/>
5. Business Insider: <https://www.businessinsider.com/>

Journals:

1. International Journal of Business Environment
2. Business Strategy and the Environment

T23DC 2.2: POWER BUSINESS INTELLIGENCE

Total Teaching Hours: 60

No. of Hours per Week: 4

(4 credits)

CObj	Course Objectives
CObj_1	To become familiar with the Power BI workspace
CObj_2	To import, transform and cleanse data using Power Query Editor
CObj_3	To identify the primary components of the Power BI interface: reports, data, and model views

CO	Course Outcomes
	After completion of this module, students should be able to:
CO1	Create and share compelling data visualizations.
CO2	Find and integrate data from multiple data sources.
CO3	Enrich data with calculations and other features available in Power BI.
CO4	Review Data Analysis Expressions (DAX) business logic and calculations.
CO5	Explore data acquisition and modeling.

CO-PO Mapping

	PO_1	PO_2	PO_3	PO_4	PO_5
CO_1	*				
CO_2			*		
CO_3		*			
CO_4				*	
CO_5				*	*

Course Content

S. No	Unit/chapter title	Course Content	Number of hours	Skills Developed
1	Unit- I Introduction to Power BI & Data Preparation	Introduction to Business Intelligence and Power BI -Uses of Power BI-The Flow of Work in Power BI-Basic Components and Building Blocks of Power BI. Connecting to data sources, Basic Data Prep and Model on Power Query-Drill Down and Tooltip	12 Hrs	Cognitive Skills
2	Unit- II Power BI Desktop and Data Transformation	Data Sources in Power BI Desktop-Loading Data in Power BI Desktop-Views in Power BI Desktop-Query Editor in Power BI-Transform, Clean, Shape, and Model Data-Manage Data Relationship-Editing a Relationship-Cross Filter Direction-Saving Work file	14 Hrs	Technical Skills
3	Unit- III Performing Computations	Combine multiple files and folders-Merge and append-Custom calculations Conditional Columns-Column from examples-Advanced Editor	8 Hrs	Technical and Employable
4	Unit- IV Data Analysis Expression (DAX)	Introduction to DAX, -Importance of DAX-Data Types in DAX-DAX Calculation Types-Steps to Create Calculated Columns-Introduction to Measures - Measures in DAX-DAX Syntax-DAX Functions-DAX Operators-DAX Tables and Filtering. Time intelligence functions	14 Hrs	Analytical and Employable
5	Unit- V Data Visualisation	Introduction to Visuals In Power BI-Inbuilt visuals-custom visuals-Visualization Charts in Power BI-Matrixes and Tables-Slicers and MapVisualizations-Gauges and Single Number Cards-Modifying Colors in Charts And Visuals-Shapes, Text Boxes, and Images- Custom Visuals-Page Layout and Formatting-Bookmarks and Selection Pane-KPI Visuals-Z-order-Grouping and Binning-Power BI Dashboards	12 Hrs	Employable

Books for Reference:

1. Sinha, P., & Chandrish, R. (2021). Mastering Power BI. BPB Publications.
2. Powell, B. (2018). Mastering Microsoft Power BI. Packt.
3. Russo, M., & Ferrari, A. (2019). The Definitive Guide to DAX (2nd ed.). Microsoft Press.

Web Resources:

1. <https://docs.microsoft.com/en-us/power-bi>
2. <https://powerbi.microsoft.com/en-us/customer-showcase/>
3. <https://www.sqlbi.com/>
4. <https://iterationinsights.com/uploads>

Journals:

1. M If for (Data)Monkey: A Guide to the M Language in Excel Power Query Ken Puls & Miguel Escobar
2. Cole Nussabaumer Knaflitz: Storytelling with data- a data visualization guide for business professionals; Wiley

T23DC 2.3: BUSINESS MATHEMATICS**Total Teaching Hours: 60****No. of Hours / Week: 04****(04 credit)**

CObj	Course Objectives
CObj_1	To provide basic knowledge of mathematics and their application to Commercial situations.
CObj_2	To make students equipped with the concepts of interest, rate of interest, annuity and instalments
CObj_3	To make students familiar with the concepts of ratio, proportion, variation and percentage.

CO	Course Outcomes
	After completion of this module, students should be able to:
CO1	Understands the basic concepts of business maths and apply them to create solve and interpret application problems in business
CO2	Solves problems on various types of equation.
CO3	Solves problems on Matrices and execute the laws of indices, law of logarithm and evaluate them.
CO4	Apply the concept of simple interest and compound interest bills discounted etc. and apply them in day-to-day life.
CO5	Solves problems on Arithmetic progression, Geometric progression and construct logical application of these concepts.

CO-PO Mapping

	PO_1	PO_2	PO_3	PO_4	PO_5
CO_1	*				
CO_2		*	*		
CO_3			*		
CO_4			*	*	
CO_5				*	*

Course Content

S. No	Unit/chapter title	Course Content	Number of hours	Skills Developed
1	Unit- I Number System	Introduction: Natural Numbers - Even Numbers, Odd Numbers, Integers, Prime Numbers, Rational and Irrational numbers, Real Numbers, HCF and LCM (Simple problems).	6 Hrs	Cognitive Skills
2	Unit- II Theory Of Equations	Introduction – Meaning - Types of Equations – Simple/ Linear Equations and Simultaneous Equations (only two variables), Elimination and Substitution Methods only. Quadratic Equation - Factorization and Formula Method ($ax^2 + bx + c = 0$ form only). Simple problems.	12 Hrs	Analytical Skills
3	Unit- III Indices, Matrices and Logarithms	Meaning, types, operation on matrices, additions, subtractions and multiplication of two matrices, transpose, determinants, minor of an element, co-factor of an element, inverse, crammers' rule in two variables, problems. Indices and Logarithms: Meaning- Basic Laws of Indices and their application for simplification. Laws of Logarithms – Common Logarithm, Application of Log Table for Simplification.	16 Hrs	Analytical Skills, Cognitive Skills
4	Unit- IV Commercial Arithmetic	Simple Interest, Compound Interest including yearly and half yearly calculations, Annuities, Percentages, Bills Discounting, Ratios and proportions, duplicate-triplicate and sub-duplicate of a ratio. Proportions: third, fourth and inverse proportion - problems.	16 Hrs	Analytical Skills Employable Skills
5	Unit- V Progressions	PROGRESSIONS: Arithmetic Progression - Finding the 'nth' term of AP and Sum to nth term of AP. Insertion of Arithmetic Mean Geometric Progression – Finding the 'nth' term of GP and sum to 'nth' term of GP and insertion 10 Hrs of Geometric Mean.	10 Hrs	Analytical Skills, Cognitive Skills

Books for Reference:

1. Saha. Mathematics for Cost Accountants. Central Publishers.
2. Saha, R.G., & Others. (2017). Methods and Techniques for Business Decisions. VBH.
3. Sancheti., & Kapoor. (2011). Business Mathematics and Statistics. Sultan Chand.
4. Zameerudin, Q., Bhambri, S.K., & Khanna, V.K. (1986). Business Mathematics. 2nd Edition. Vikas Publishing House.
5. Madappa, Hassan, M.H., & Taiyab, M.I. Business Mathematics. Subhash.
6. Veena, G.R., & Seema. (2019). Business Mathematics and Statistics. I.K. International Publishers.

Web Resource:

1. Khan Academy Business and Finance
2. MathIsFun Business Math
3. MIT OCW Mathematics for Business and Personal Finance
4. Investopedia Financial Mathematics
5. Coursera Business Mathematics Courses

Journals:

1. Journal of Business Mathematics and Statistics
2. International Journal of Business and Management Studies (IJBMS)
3. Journal of Mathematics and Statistics
4. Journal of Applied Quantitative Methods (JAQM)
5. International Journal of Business Quantitative Economics and Applied Management Research (IJBEMR)

M21OE 2.1: PEOPLE MANAGEMENT**Total Teaching Hours: 45****No. of Hours / Week: 03(3
Credit)**

CObj	Course Objectives
CObj_1	Examine individuals' personality and behaviours to resulting in better management of people in the organisation
CObj_2	Resolve and manage conflicts quickly.
CObj_3	Understand the process of goal setting.

CO	Course Outcomes
	After completion of this module, students should be able to:
CO1	Understands diversity at the workplace.
CO2	Apply personal effectiveness through goal setting and time management.
CO3	Design the process of performance appraisal
CO4	Develop the interpersonal relationship and networking.
CO5	Develop the functions and importance of communication.

CO-PO Mapping

	PO_1	PO_2	PO_3	PO_4	PO_5
CO_1	*				
CO_2	*		*		*
CO_3	*				
CO_4		*		*	
CO_5			*		

Course Content

S. No	Unit/chapter title	Course Content	Number of hours	Skills Developed
1	Unit- I Introduction to People Management	Diversity in organization: age, gender, ethnicity, race and ability. People management: meaning, features, significance of people, difference between people management and human resource management, impact of individual and organizational factors on people management.	06 Hrs	Analytical Skills
2	Unit- II Getting work done and Assessment and Evaluation	Getting work done: Challenges of getting work done, significance of prioritization and assigning work to team members. Performance management: meaning, role of a manager in the different stages of the performance management process. Types of performance assessment, Assessment and Evaluation process of evaluation of tasks in the organization. Modern tools of assessment and Evaluation of tasks and performance.	12 Hrs	Cognitive Skills
3	Unit- III Building peer networks and essentials of communication	Building peer Networks: Understanding the importance of peer networks in an organization, being able to influence those on whom you have no authority, challenges peer networking and different types of people networking in the workplace. Essentials of communication: concept of communication process with reflection on various barriers to effective communication and ways to overcome, types of communication and channels of communication	12 Hrs	Analytical Skills
4	Unit- IV Motivation	Meaning, importance and need for motivation, team motivation-meaning, importance of team motivation, types of motivators and modern methods of motivation.	08 Hrs	Cognitive Skills
5	Unit- V Managing self	Reflection on what does it mean to be a people manager, building a personal development plan for oneself, self-stress management: causes for stress, work life balance, importance of work life balance, factors influencing work life balance.	07 Hrs	Cognitive Skills

Books for Reference:

1. DeSimone, R. L., & Werner, J. M. (2012). Human Resource Development. 6th ed. Cengage Learning.
2. Kumar, V. (2022). *People Management* . Kalyani Publishers.
3. Nirmala, K., Jyothi, A., & Tabassum, S. (2017). Human Resource Management. Himalaya Publishing House.
4. Thomson, R. (2015.). *People Management*. University Press.

Web Resources:

1. <https://courses.lumenlearning.com/suny-oneonta-education106/chapter/6-1-assessment-and-evaluation/>
2. <https://granite.pressbooks.pub/organizationalcommunication/chapter/chapter-6-communication-networks-and-leadership/>
3. <https://www.verywellmind.com/what-is-motivation-2795378>
4. <https://www.mayoclinic.org/tests-procedures/stress-management/about/pac-20384898#:~:text=Stress%20management%20offers%20a%20range,response%20to%20a%20challengin>

Journals:

1. West P. Making sense of epilepsy. In: Osborne DJ , Grunneberg M , Eisner J , eds. Research in psychology and medicine, Volume 2. London: Academic Press, 1979: 162—9.
2. Bury M. Chronic illness as biographical disruption. *Sociol Health Illness* 1982; 4: 167—82.
3. Charmaz K. Experiencing chronic illness. In: Albrecht G, Fitzpatrick R, Scrimshaw S, eds. *The handbook of social studies in health and medicine*. London: Sage, 2000: 277—92.
4. Achterberg, J., Kenner, C., & Lawlis, G. F. (1988). Severe burn injury: A comparison of relaxation, imagery, and biofeedback for pain management. *Journal of Mental Imagery*, 12, 71–87.
5. Agras, S., & Jacob, R. (1979). Hypertension. In O. F. Pomerleau & J. P. Brady. *Behavioral medicine: Theory and practice*. Baltimore: Williams and Wilkins.

DEPARTMENT OF BUSINESS ADMINISTRATION

Blue Print for Question Paper (UG 2023 Batch onwards)

T23DC 3.1 Organisational Behaviour

Maximum : 60

Duration : 2 Hrs 30 Minutes

Course Code : T23DC 3.1

Course Title : Organisational Behaviour

Section A : 5 Questions of 7, each carrying 2 marks ($5 \times 2 = 10$)

Section B : 04 Questions of 06, each carrying 4 marks ($4 \times 4 = 16$)

Section C : 2 Questions of 3, each carrying 12 marks ($2 \times 12 = 24$)

Section D : 1 Compulsory Question 10 marks ($10 \times 1 = 10$)

Distribution of Marks

Unit	Hours Allotted in the Syllabus	No. of Questions & Marks Distribution								
		Section A (No. of Questions)	Total Marks	Section B (No. of Questions)	Total Marks	Section C (No. of Questions)	Total Marks	Section -D	Total marks	Total Marks
I	8	1	2	1	4					6
II	16	2	4	2	8	1	12			24
III	12	1	2	1	4	1	12			18
IV	14	2	4	1	4			1	10	18
V	10	1	2	1	4	1	12			18
Total	60 Hours	7	14	6	24	3	36	1	10	84

DEPARTMENT OF BUSINESS ADMINISTRATION
Blue Print for Question Paper (UG 2023 Batch onwards)
T23DC 3.2 Business Statistics

Maximum : 60

Duration : 2 Hrs 30 Minutes

Course Code : T23DC 3.2

Course Title : Business Statistics

Section A : 5 Questions of 7, each carrying 2 marks ($5 \times 2 = 10$)

Section B : 04 Questions of 06, each carrying 4 marks ($4 \times 4 = 16$)

Section C : 2 Questions of 3, each carrying 12 marks ($2 \times 12 = 24$)

Section D : 1 Compulsory Question 10 marks ($10 \times 1 = 10$)

Distribution of Marks

Unit	Hours Allotted in the Syllabus	No. of Questions & Marks Distribution								
		Section A (No. of Questions)	Total Marks	Section B (No. of Questions)	Total Marks	Section C (No. of Questions)	Total Marks	Section -D	Total marks	Total Marks
I	4	1	2	1	4					6
II	14	2	4	2	8	1	12			24
III	12	1	2	1	4	1	12			18
IV	15	1	2	1	4					6
V	15	2	4	1	4	1	12	1	10	30
Total	60 Hours	7	14	6	24	3	36	1	10	84

DEPARTMENT OF BUSINESS ADMINISTRATION

Blue Print for Question Paper (UG 2023 Batch onwards)

T23DC 3.3 PYTHON FOR MANAGERS

Maximum Marks	: 60
Duration	: 2.5 hours
Course Code	: T23DC 3.3
Course Title	PYTHON FOR MANAGERS
Section A	: 5 Questions of 7, each carrying 2 marks (5 x 2 = 10)
Section B	: 04 Questions of 06, each carrying 4 marks (4 x 4= 16)
Section C	: 2 Questions of 3, each carrying 12 marks (2 x 12 = 24)
Section D	:1 Compulsory Question 10 marks (10 x 1 = 10)

Distribution of Marks

Unit	Hours Allotted in the Syllabus	No. of Questions & Marks Distribution								
		Section A (No. of Questions)	Total Marks	Section B (No. of Questions)	Total Marks	Section C (No. of Questions)	Total Marks	Section -D	Total marks	Total Marks
I	14	2	4	2	8	1	12			24
II	12	1	2	1	4	1	12			18
III	12	1	2	1	4		0	1	10	16
IV	10	1	2	1	4	-	0			6
V	12	2	4	1	4	1	12			20
Total	60	7	14	6	24	3	36	1	10	84

DEPARTMENT OF BUSINESS ADMINISTRATION

Blue Print for Question Paper (UG 2021 Batch onwards)

M210E 3.1 Financial Literacy

Maximum Marks : 45
 Duration : 2.5 hours
 Course Code : M210E 3.1
 Course Title : Financial Literacy
 Section A : 5 Questions of 7, each carrying 2 marks ($5 \times 2 = 10$)
 Section B : 04 Questions of 06, each carrying 4 marks ($4 \times 4 = 16$)
 Section C : 2 Questions of 3, each carrying 12 marks ($2 \times 12 = 24$)
 Section D : 1 Compulsory Question 10 marks ($10 \times 1 = 10$)

Distribution of Marks

Unit	Hours Allotted in the Syllabus	No. of Questions & Marks Distribution								
		Section A	Total Marks	Section B	Total Marks	Section C	Section -D	Total marks	Total Marks	
		(No. of		(No. of		(No. of				
		Question s)		Questions)		Questions)				Total Marks
I	8	1	2	1	4	0	0	1	10	16
II	10	1	2	2	8	0	0	0	0	10
III	10	1	2	1	4	1	12	0	0	18
IV	9	2	4	1	4	1	12	0	0	20
V	8	2	4	1	4	1	12	0	0	20
Total	45	7	14	6	24	3	36	1	10	84

DEPARTMENT OF BUSINESS ADMINISTRATION

Blue Print for Question Paper (UG 2021 Batch onwards)

21SBC 3.1 Digital Fluency

Maximum Marks	30
Duration	1.5 Hrs
Course Code	21SBC 3.1
Course Title	Digital Fluency
Section A	: 4 Questions out of 5, each carrying 2 marks (4 x 2= 8)
Section B	: 4 Questions out of 05, each carrying 4 marks (4 x 3= 12)
Section C	: 2 Questions of 3, each carrying 5 marks (2 x 5 = 10)

Distribution of Marks

Unit	Hours Allotted in the Syllabus	No. of Questions & Marks Distribution								
		Section A (No. of Questions)	Total Marks	Section B (No. of Questions)	Total Marks	Section C (No. of Questions)	Total Marks	Section D	Total marks	Total Marks
I	10	2	4	2	6	1	5			15
II	8	1	2	1	3	0	0			5
III	7	1	2	1	3	1	5			10
IV	6	1	2	1	3	1	5			10
Total	31	5	10	5	15	3	15			40

DEPARTMENT OF BUSINESS ADMINISTRATION

Blue Print for Question Paper (UG 2023 Batch onwards)

T23DC 4.1 International Business

Maximum Marks 60

Duration 2.5 hours

Course Code T23DC 4.1

Course Title International Business

Section A 5 Questions of 7, each carrying 2 marks (5 x 2 = 10)

Section B 04 Questions of 06, each carrying 4 marks (4 x 4= 16)

Section C 2 Questions of 3, each carrying 12 marks (2 x 12 = 24)

Section D 1 Compulsory Question 10 marks (10 x 1 = 10)

Distribution of Marks

Unit	No. of Questions & Marks Distribution									
	Section A	Total Marks	Section B	Total Marks	Section C		Section -D	Total marks	Total Marks	
	(No. of		(No. of		(No. of					
	Questions)		Questions)		Questions)					Total Marks
I	1	2	1	4	1	12			18	
II	2	4	1	4	-	0	1	10	18	
III	1	2	1	4	1	12			18	
IV	2	4	1	4	-	0			8	
V	1	2	2	8	1	12			22	
Total	7	14	6	24	3	36	1	10	84	

DEPARTMENT OF BUSINESS ADMINISTRATION

Blue Print for Question Paper (UG 2023 Batch onwards)

T23DC 4.2 Corporate accounting

Maximum Marks	60
Duration	2.5 Hrs
Course Code	T23DC 4.2
Course Title	Corporate accounting
Section A	5 Questions of 7, each carrying 2 marks (5 x 2 = 10)
Section B	04 Questions of 06, each carrying 4 marks (4 x 4= 16)
Section C	2 Questions of 3, each carrying 12 marks (2 x 12 = 24)
Section D	1 Compulsory Question 10 marks (10 x 1 = 10)

Distribution of Marks

Unit	Hours Allotted in the Syllabus	No. of Questions & Marks Distribution									
		Section A	Total Marks	Section B	Total Marks	Section n C		Section n -D	Total marks	Total Marks	
		(No. of		(No. of		(No. of					
		Questions)		Questions)		Questi ons)					Total Marks
I	12	1	2	1	4	1	12			18	
II	12	2	4	2	8	1	12			24	
III	12	1	2	1	4			1	10	16	
IV	16	2	4	1	4	1	12			20	
V	8	1	2	1	4					6	
Total	60	7	14	6	24	3	36		10	84	

DEPARTMENT OF BUSINESS ADMINISTRATION

Blue Print for Question Paper (UG 2023 Batch onwards)

T23DC 4.3 SQL for Business

Maximum Marks 60

Duration 2.5 hours

Course Code T23DC 4.3

Course Title SQL for Business

Section A 5 Questions of 7, each carrying 2 marks (5 x 2 = 10)

Section B 04 Questions of 06, each carrying 4 marks (4 x 4= 16)

Section C 2 Questions of 3, each carrying 12 marks (2 x 12 = 24)

Section D 1 Compulsory Question 10 marks (10 x 1 = 10)

Distribution of Marks

Unit	No. of Questions & Marks Distribution								
	Section A	Total Marks	Section B	Total Marks	Section C		Section –D	Total marks	Total Marks
	(No. of		(No. of		(No. of				
	Questions)		Questions)		Questions)				
I	1	2	1	4	1	12			18
II	2	4	1	4	-	0	1	10	18
III	1	2	1	4	1	12			18
IV	2	4	1	4	-	0			8
V	1	2	2	8	1	12			22
Total	7	14	6	24	3	36	1	10	84

Department of Business Administration

M21 OE 4.1 Event Management

Maximum Marks : 45

Duration : 2.5 hours

Course Code : M21OE 4.1

Course Title : Event Management

Section A : 5 Questions of 7, each carrying 2 marks (5 x 2 = 10)

Section B : 04 Questions of 06, each carrying 4 marks (4 x 4= 16)

Section C : 2 Questions of 3, each carrying 12 marks (2 x 12 = 24)

Section D : 1 Compulsory Question 10 marks (10 x 1 = 10)

Distribution of Marks

Unit	Hours Allotted in the Syllabus	No. of Questions & Marks Distribution								
		Section A	Total Marks	Section B	Total Marks	Section C	Section n –D	Total marks	Total Marks	
		(No. of		(No. of		(No. of				
		Questions)		Questions)		Questions)				Total Marks
I	10	0	0	0	0	1	12	1	10	22
II	10	2	4	1	4	1	12	0	0	20
III	10	2	4	1	4	1	12	0	0	20
IV	8	2	4	2	8	0	0	0	0	12
V	7	1	2	2	8	0	0	0	0	10
Total	45	7	14	6	24	3	36	1	10	84

M21 OE 4.1: Event Management**Total Teaching Hours: 45 Hours****No. of Hours / Week: 03****[03 credit]**

CObj	Course Objectives
CObj_1	To provide the means to compare actual performance in an IT environment against desired performance.
CObj_2	To Provide the entry point for many process and activities of Service Operation
CObj_3	To provide a basis for service assurance, reporting and service improvement.

CO	Course Outcomes
CO1	Students will have the Capability to identify the key characteristics of an event.
CO2	Students can learn to recognize the key management competencies required in the events industry and to use interpersonal and communications skills to pursue career in events industry.
CO3	Students can learn the conceptual framework of Event Management, Event Services, Conducting Event and Managing Public Relations.
CO4	The students will understand: The importance of communication for leadership & decision making.
CO5	The students will acquire competencies to: Plan a proposal on management of an event

CO-PO Mapping

	PO1	PO2	PO3	PO4	PO5
CO1		*			
CO2			*		
CO3		*			
CO4	*			*	
CO5			*		

Course Content

S. No	Unit title	Course Content	Number of Hours	Skills Developed
1.	Introduction to Event Management	Event- Meaning- Why Event Management- Analysis of Event, Scope of Event, Decision Makers- Event Manager Technical Staff- Establishing of Policies & Procedure- Developing Record Keeping Systems.	10	Evaluation and Synthesis
2.	Event Management Procedure	Principles for holding an Event, General Details, Permissions- Policies, Government and Local Authorities, - Phonographic Performance License, Utilities- Five Bridge Ambulance Catering, Electricity, Water Taxes Applicable.	10	Analytical Skills
3.	Conduct Of An Event	Preparing a Planning Schedule, Organizing Tables, Assigning Responsibility, Communication and Budget of Event- Checklist, Computer aided Event Management– Roles & Responsibilities of Event Managers for Different Events.	10	Cognitive Skills
4.	Public Relations	Introductions to Public Relations- Concept- Nature- Importance- Limitations- Media- Types of Media- Media Management, Public Relation Strategy & Planning. Brain Storming Sessions- Writings for Public Relations.	08	Transferrable Skills
5.	Corporate Events	Planning of Corporate Event, Job Responsibility of Corporate Events Organizer, Arrangements, Budgeting, Safety of Guests and Participants, Creating Blue Print, Need for Entertainment in Corporate Events And Reporting.	07	Employable Skills

Books for Reference:

- Event Entertainment and Production – Author: Mark Sonderm CSEP Publisher: Wiley & Sons, Inc.ISBN: 0-471-26306-0
- Ghouse Basha – Advertising & Media Mgt
- Anne Stephen – Event Management
- Special Event Production – Doug Matthews – ISBN 978-0-7506-8523-8
- The Complete Guide to successful Event Planning – Shannon Kilkenny
- Human Resource Management for Events – Lynn Van der Wagen (Author)
- Successful Team Manageemnt (Paperback) – Nick Hayed (Author)
- Event Management & Public Relations by Savita Mohan – Enkay Publishing House
- Event Management & Public Relations By Swarup K. Goyal – Adhyayan Publisher - 2009

Web Resources:

- <https://www.comit.ie/latest-news-from-comit/what-are-the-different-types-of-pr.798.html>
- <https://www.celebritycorporatekit.com/our-blog/6-types-of-corporate-events-which-is-right-for-your-organization/>
- <https://www.wildapricot.com/blog/how-to-plan-an-event>

Journals:

- Camerlengo, Quirino. 2009. Il Cerimoniale, tra Stato e Regioni, e la Correttezza Costituzionale [The Ceremonial, between State and Regions, and the Constitutional Fairness]. In Le Regioni, n.3-4, 763- 775.
- De Lasio, Emiliana, Matthew Hibberd, Michael Higgins and Michele Sorice. 2012. La Leadership Politica. Media e Costruzione del Consenso [Political Leadership. Media and Consensus Building]. Roma: Carocci Editore.
- Maimone, Fabrizio. 2014. La Comunicazione Organizzativa. Comunicazione, Relazioni e Comportamenti Nelle Imprese, Nella P.A. e nel no Profit [The Organisational Communication. Communication, Relationships and Behaviors in Business, in P.A. and in the no Profit]. Milano: Angelini.
- Ricci, Maurizio. 2016. Più Tecnologia, Meno Produttività [More Technology, Less Productivity]. Roma: La Repubblica.
- Sgrelli, Massimo. 2016. Il Cerimoniale. Il Cerimoniale Moderno ed il Protocollo di Stato: Regole Scritte e non Scritte [The Ceremonial. The Modern Ceremonial and the State Protocol: Written and Unwritten Rules]. Aquila: Di Felice Editore.

M21OE 3.1: Financial Literacy**Total Teaching Hours: 45 Hours****No. of Hours / Week:03****[03 credit]**

CObj	Course Objectives
CObj_1	To familiarize non finance students with the essentials of finance and investments.
CObj_2	To enable the students to use financial data in planning, and decision making
CObj_3	To equip students with general knowledge, basic tools, and techniques for managing their personal finance and investment decisions.

CO	Course Outcomes
CO1	Be able to read, understand and interpret the financial statements of a company.
CO2	Demonstrate an understanding of role and importance of the finance function in business.
CO3	Be able to take investment decisions for their personal portfolio.
CO4	Develop an attitude towards investments and be able to assess risk and returns.
CO5	Be able to apply basic skills in understanding and interpreting....

CO-PO Mapping

	PO1	PO2	PO3	PO4	PO5
CO1	*				
CO2			*		
CO3			*		
CO4			*		
CO5					*

Course Content

S. No	Unit title	Course Content	No of Hours	Skills Developed
1	Basics of Indian Financial System	Indian Financial System, functions of the Indian financial system, a basic understanding of the capital market, money market in India.	08 Hrs	Transferrable Skills
2	Investment Decisions	What are investments?- Trading off between Risk & Returns- Golden Principles of Investments- Creating a personal portfolio- Investment in gold, investing in real estate, investment in mutual funds, government bonds, stock etc. advantages and disadvantages- Investing v/s savings- Do's and Don'ts of investments	10 Hrs	Cognitive Skills Analytical Skills
3	Reading & Understanding Financial Statements	What are financial statements? - Basic terminologies – Assets, liabilities, current assets, current liabilities, long term assets and liabilities. Income, expenses etc.- How to read and understand financial statements- Differentiate between income statement and balance sheet- Interpreting various items in the financial statements.	10 Hrs	Analytical Skills Evaluation and Synthesis
4	Loans	Loans – Different types of loans- home loans, vehicle loans, personal loans, jewelry loans, etc. - Calculation of EMIs, Fixed v/s floating- Calculation of rate of interest- Dos and Don'ts of loans- Credit worthiness, CIBIL Scores- Debit & Credit Cards	09 Hrs	Analytical Skills
5	Budgetary Control	Budget and Budgetary control – Zero Based Budgeting – Performance budgeting.	08 Hrs	Analytical Skills Evaluation and Synthesis

Books for Reference:

1. Financial Management by I.M.Pandey, Vikas Publishing House Pvt. Ltd.
2. Financial Management by Prasanna Chandra, Tata McGraw Hill
3. Financial Management by M.Y.Khan & P.K.Jain, Tata McGraw Hill
4. Financial Management by Ravi M. Kishore, Taxmann Publications
5. Financial Management by Paresh Shah, biztantra
6. Financial Statements by White, Sondhi & Fried, Willey Books
7. Bhargav, B, K, Finance For Non Finance Managers. Jaiko Publishing House.
8. Chandra, P. Finance Sense: Finance For Non Finance executives. Tata McGraw Hill.
9. Gabriel Hawawini, Claude Viallet, Finance For Non Finance Managers, Cengage Delmar Learning India Pvt Ltd.
10. Gene Siciliano ,Finance for Nonfinancial Managers, (Briefcase Books Series), Tata McGraw Hill
11. Tripathi, Vanita, Basic Financial Management” Taxmann Publication.
12. Dash A.P., “Financial Wisdom – Finance for Non-Finance Executives”, Biztantra
13. Palat, Raghu, “How to Read Annual Reports and Balance Sheets”, JAICO Publishing House
14. Chandra, Prasanna, “Finance Sense – Finance for Non-finance Executives”, Tata McGraw Hill
15. HBR Guide to Finance Basics for Managers (HBR Guide Series)
16. The Psychology of Money by Morgan Housel

Note: Latest edition of books may be used.

Web Resources:

- www.icai.org/students/Bos-knowledgeportal.
- www.icmai.in
- www.bseindia.com
- www.capitalmarket.com
- www.cmie.com
- www.financeprofessor.com
- www.moneycontrol.com
- www.rbi.gov.in
- www.sebi.gov.in
- www.learnvest.com
- www.thebirdy.com
- www.dailyworth.com

Journals:

- Journal of Accounting
- Indian Journal of Accounting

➤ The Chartered Accountant.

Further Reference:

- S.K. Bhattacharyya John Dearden “Accounting for Management Text and Cases”, Vikas publication – Reprint 2011
- Rajiv Srivastava, Anil Misra “Financial Management”, Oxford University Press – 2nd ed. 2011.
- Maheshwari.S.K, Sharad K Maheshwari, “Accounting for Management”, Vikas publication – 2011.
- Study guide for Personal Finance, Kapoor, Cram101
- Your Everyday Guide to Personal Finance and Insurance, Prakash Praharaj, CNBC

M21OE 2.1: People Management

Total Teaching Hours: 45 Hours

No. of Hours / Week: 03

CObj	Course Objectives
CObj_1	Examine individuals' personality and behaviours to resulting in better management of people in the organisation
CObj_2	Resolve and manage conflicts quickly.
CObj_3	Understand the process of goal setting.

CO	Course Outcomes
CO1	The students will understand diversity at the workplace.
CO2	Develop personal effectiveness through goal setting and time management.
CO3	Understand the process of performance appraisal
CO4	Develop the interpersonal relationship and networking.
CO5	Understand the functions and importance of communication.

CO-PO Mapping

	PO1	PO2	PO3	PO4	PO5
CO1	*				
CO2			*		*
CO3	*				
CO4		*			
CO5			*		

Course Content

S. No	Unit title	Course Content	Number of Hours	Skills Developed
1.	Introduction to People Management	Diversity in organization: age, gender, ethnicity, race and ability. People management: meaning, features, significance of people, difference between people management and human resource management, impact of individual and organizational factors on people management.	06	Analytical Skills
2.	Getting work done and Assessment and Evaluation	Getting work done: Challenges of getting work done, significance of prioritization and assigning work to team members. Performance management: meaning, role of a manager in the different stages of the performance management process. Types of performance assessment, Assessment and Evaluation process of evaluation of tasks in the organization. Modern tools of assessment and Evaluation of tasks and performance.	12	Evaluation
3.	Building peer networks essentials and of communication	Building peer Networks: Understanding the importance of peer networks in an organization, being able to influence those on whom you have no authority, challenges peer networking and different types of people networking in the workplace. Essentials of communication: concept of communication process with reflection on various barriers to effective communication and ways to overcome, types of communication and channels of communication	12	Analytical Skills
4.	Motivation	Meaning, importance and need for motivation, team motivation-meaning, importance of team motivation, types of motivators and modern methods of motivation.	08	Cognitive Skills
5.	Managing self	Reflection on what does it mean to be a people manager, building a personal development plan for oneself, self-stress management: causes for stress, work life balance, importance of work life balance, factors influencing work life balance.	07	Evaluation

Books for Reference:

1. DeSimone, R. L., & Werner, J. M. (n.d.). *Human Resource Development*. Cengage Learning.
2. Kumar, V. (2022). *People Management* . Kalyani Publishers.
3. Nirmala, K., Jyothi, A., & Tabassum, S. (n.d.). *Human Resource Management*. Himalaya Publishing House.
4. Thomson, R. (n.d.). *People Management* . University Press.

Web Resources:

- <https://courses.lumenlearning.com/suny-oneonta-education106/chapter/6-1-assessment-and-evaluation/>
- <https://granite.pressbooks.pub/organizationalcommunication/chapter/chapter-6-communication-networks-and-leadership/>
- <https://www.verywellmind.com/what-is-motivation-2795378>
- <https://www.mayoclinic.org/tests-procedures/stress-management/about/pac-20384898#:~:text=Stress%20management%20offers%20a%20range,response%20to%20a%20challengin>

Journals:

1. West P. Making sense of epilepsy. In: Osborne DJ , Grunneberg M , Eisner J , eds. Research in psychology and medicine, Volume 2. London: Academic Press, 1979: 162—9.
2. Bury M. Chronic illness as biographical disruption. *Sociol Health Illness* 1982; 4: 167—82.
3. Charmaz K. Experiencing chronic illness. In: Albrecht G , Fitzpatrick R , Scrimshaw S , eds. The handbook of social studies in health and medicine. London: Sage, 2000: 277—92.
4. Achterberg, J., Kenner, C., & Lawlis, G. F. (1988). Severe burn injury: A comparison of relaxation, imagery, and biofeedback for pain management .*Journal of Mental Imagery*, 12, 71–87.
5. Agras, S., & Jacob, R. (1979). Hypertension. In O. F. Pomerleau & J. P. Brady.*Behavioral medicine: Theory and practice*. Baltimore: Williams and Wilkins.

M21OE 1.1: Business Organisation

Total Teaching Hours: 45

No. of Hours / Week: 03

[03 Credit]

CObj	Course Objectives
CObj_1	To impart the fundamentals of Business Organisation with an objective to develop the basic knowledge of operations and functions of organisation
CObj_2	To enable the use of basic concepts of management in business organization
CObj_3	To have a proper understanding of social responsibility towards business and principles of management

CO	Course Outcomes
CO1	An understanding of the nature, objectives and social responsibilities of business
CO2	An ability to describe the different forms of organisations
CO3	An understanding of the basic concepts of management
CO4	An understanding of functions of management.
CO5	An understanding of different types of business combinations

CO-PO Mapping

	PO1	PO2	PO3	PO4	PO5
CO1					
CO2		*		*	*
CO3	*				
CO4					
CO5			*		

Course Content

S. No	Unit title	Course Content	Number of Hours	Skills Developed
1	Introduction To Business	Business: Meaning, Nature, Scope and Social responsibility of Business, Objectives, Essentials of successful business; Functional areas of business. Concept of Business Organisation.	10 Hrs	Cognitive Skills
2	Forms Of Business Organization	Sole proprietorship: Definitions, Features, Merits and Demerits. Partnership: Definitions, partnership deed, Features, Merits and Demerits. Joint Stock Company: Definitions, Features, Merits and Demerits. Co-operatives: Definitions, Features, Merits and Demerits.	12 Hrs	Cognitive Skills
3	Public Enterprises	Departmental Undertaking: Definitions, Features, Merits and Demerits. Public Corporations: Definitions, Features, Merits and Demerits. Government Companies: Definitions, Features, Merits and Demerits	08 Hrs	Evaluation and Synthesis
4	Business Combinations	Meaning Definitions, Causes, Types, Forms, merits and demerits of Business Combinations, Recent Trends in Business Combinations.	08 Hrs	Cognitive Skills
5	Management Of Organizations	Management- Meaning, Definitions, Difference between Management and Administration, Levels of Management, Objectives of Management, Functions of management- planning, organizing, staffing, directing, coordinating, controlling, Principles of Management.	07 Hrs	Analytical Skills

Books for Reference:

1. C B. Guptha - Business Organisation and Management, Sultan Chand & Sons.
2. Dr. S. C. Saxena - Business Administration & Management, Sahitya Bhawan.
3. M. C. Shukla - Business Organisation and Management. S Chand & Company Pvt. Ltd.
4. S.A Sherlekar - Business Organization, Himalaya Publishing House.
5. Y.K. Bhushan. Fundamentals of Business Organisation and Management, Sultan Chand & Sons.
6. R.K. Sharma, Business Organisation & Management Kalyani Publishers
7. Dr. I.M. Sahai, Dr. Padmakar Asthana,“ Business Organisation & Administration’, Sahitya Bhawan Publications Agra.

Note: Latest edition of text books may be used.

Department of Commerce

MATRIX AND SYLLABUS

For the Programme B. Com

NEP Based Curriculum (2021 onwards)

I to VI Semester

NEP- Curriculum Framework

B. Com Matrix for I Semester

I Semester							
Code	Course Code	Course	Teaching Hours	Course Components			Credits
				L	T	P	
AECC	S21KN 1.1/ S21HN 1.1/ S21AE 1.1	Language – 1 (Kannada, Hindi, Additional English)	45	2	1	0	3
AECC	S21GE 1.1	Language – 2 (Generic English)	60	2	1	0	3
DSC-1	C21 DC 1.1	Financial Accounting	60	4	0	0	4
DSC-1	C21 DC 1.2	Corporate Administration	60	4	0	0	4
DSC-1	C21 DC 1.3	Principles of Management	60	4	0	0	4
OE-1	C21 OE 1.1	Financial Literacy	45	3	0	0	3
SEC-1	21SBC 1.1	Digital Fluency-I	30	1	0	2	2
SEC-VB	VBC 1.1	Health and Well-Being	30	0	0	2	1
SEC-VB	VBC 1.2	Yoga	30	0	0	2	1
Total							25

Note 1:

AECC – Ability Enhancement Compulsory Course

DSC - Discipline-Specific Course

DSE – Discipline-Specific Elective

SEC - VB Skill Enhancement Course -Value Based

SEC - SB Skill Enhancement Course -Skill Based

NEP- Curriculum Framework

B. Com Matrix for II Semester

II Semester							
Code	Course Code	Course	Teaching hours	Course Components			Credits
				L	T	P	
AECC	S21KN 2.1/ S21HN 2.1/ S21AE 121	Language – 1 (Kannada, Hindi and Additional English)	45	2	1	0	3
AECC	S21GE 2.1	Language – 2 (Generic English)	60	2	1	0	3
AECC	21SBC 2.1	Environmental Studies	45	3	0	0	3
DSC-2	C21 DC 2.1	Advance Financial Accounting	60	4	0	0	4
DSC-2	C21 DC 2.2	Quantitative Analysis for Business Decisions-I	60	4	0	0	4
DSC-2	C21 DC 2.3	Cost Accounting	60	4	0	0	4
OE-2	C21 OE 2.1	Investing in Stock Market	45	3	0	0	3
SEC-VB	21VBC 2.1	NCC/NSS/Cultural	30	0	0	2	1
SEC-VB	21VBC 2.2	Sports	30	0	0	2	1
Total							26

Note 1:

AECC – Ability Enhancement Compulsory Course

DSC - Discipline-Specific Course

DSE – Discipline-Specific Elective

SEC - VB Skill Enhancement Course -Value Based

SEC - SB Skill Enhancement Course -Skill Based

NEP- Curriculum Framework

B.Com Matrix for III Semester

III Semester							
Code	Course Code	Course	Teaching Hours	Course Components			Credits
				L	T	P	
AECC	S21KN 3.1/ S21HN 3.1/ S21AE 3.1	Language – I (Kannada, Hindi, additional English)	45	2	1	0	3
AECC	S21GE 3.1	Language – II (Generic English)	45	2	1	0	3
DSC-3	C21 DC 3.1	Corporate Accounting	60	4	0	0	4
DSC-3	C21 DC 3.2	Quantitative Analysis for Business Decisions II	60	4	0	0	4
DSC-3	C21 DC 3.3	E- Commerce and Digital Marketing	60	4	0	0	4
OE-3	C21 OE 3.1	Managing Personal Finance	45	3	0	0	3
SEC-SB	SBC 3 .1	Digital Fluency -II	30	1	0	2	2
SEC-VB	SEC - VB 3.1	NCC/NSS/Cultural	15	0	0	2	1
SEC-VB	SEC - VB 3.2	Sports	15	0	0	2	1
Total							25

Note 1:

AECC – Ability Enhancement Compulsory Course

DSC - Discipline-Specific Course

DSE – Discipline-Specific Elective

SEC - VB Skill Enhancement Course -Value Based

SEC - SB Skill Enhancement Course -Skill Base

NEP- Curriculum Framework

B.Com Matrix for IV Semester

IV Semester							
Code	Course Code	Course	Teaching Hours	Course Components			Credits
				L	T	P	
AECC	S21KN 4.1/ S21HN4.1/ S21AE 4.1	Language – I (Kannada, Hindi and Additional English)	45	2	1	0	3
AECC	S21GE1.1	Language – II (Generic English)	60	2	1	0	3
AECC	21SBC 4.1	Constitution of India	45	3	0	-	3
DSC-4	C21 DC 4.1	Financial Statement Analysis	60	4	0	0	4
DSC-4	C21 DC 4.2	Financial Management	60	4	0	0	4
DSC-4	C21 DC 4.3	Financial Systems and Services	60	4	0	0	4
OE-4	C21 OE 4.1	Business Entrepreneurship	45	3	0	0	3
SEC-VB	SEC - VB 4.1	NCC/NSS/Cultural	30	0	0	2	1
SEC-VB	SEC-VB 4.2	Sports	30	0	0	2	1
Total							26

Note 1:

AECC – Ability Enhancement Compulsory Course

DSC - Discipline-Specific Course

DSE – Discipline-Specific Elective

SEC - VB Skill Enhancement Course -Value Based

SEC - SB Skill Enhancement Course -Skill Based

NEP- Curriculum Framework

B. Com Matrix for V Semester

V Semester							
Code	Course Code	Course	Teaching Hours	Course Components			Credits
				L	T	P	
DSC-5	C21 DC 5.1	Entrepreneurship Development and Small Business Management	60	4	0	0	4
DSC-5	C21 DC 5.2	Management Accounting	60	4	0	0	4
DSC-5	C21 DC 5.3	Income Tax Law & Practice - I	60	4	0	0	4
DSE-1	C21 DCA 5.4	Elective -1 (Accounting) Cost Management	45	3	0	0	3
DSE-1	C21 DCF 5.4	Elective -1 (Finance) Security Analysis & Portfolio Management	45	3	0	0	3
SEC-VB	21VOC 5.1	Goods and Services Tax	45	2	0	2	3
SEC – SB	21SBC 5.1	Tally Prime	30	1	0	2	2
Total							23

Note 1:

AECC – Ability Enhancement Compulsory Course

DSC - Discipline-Specific Course

DSE – Discipline-Specific Elective

SEC - VB Skill Enhancement Course -Value Based

SEC - SB Skill Enhancement Course -Skill Based

NEP- Curriculum Framework

B. Com Matrix for VI Semester

VI Semester							
Code	Course Code	Course	Teaching Hours	Course Component			Credits
				L	T	P	
DSC-6	C21 DC 6.1	Advanced Management Accounting	60	4	0	0	4
DSC-6	C21 DC 6.2	Principles and Practices of Auditing	60	4	0	0	4
DSC-6	C21 DC 6.3	Income Tax Law & Practice - II	60	4	0	0	4
DSE-2	C21 DCA 6.4	Elective-2 (Accounts) Indian Accounting Standards-I	60	3	0	0	3
DSE-2	C21 DCF 6.4	Elective-2 (Finance) Investment Management	45	3	0	0	3
SEC-SB	C21 SBC 6.1	Cyber Security	45	2	0	2	3
SEC-VB	C21 VOC 6.1	Internship	90Hours				3
Total							24

Note 1:

AECC – Ability Enhancement Compulsory Course

DSC - Discipline-Specific Course

DSE – Discipline-Specific Elective

SEC - VB Skill Enhancement Course -Value Based

SEC - SB Skill Enhancement Course -Skill Based

C21DC 1.1: FINANCIAL ACCOUNTING

THEORY

Total Teaching Hours: 60

No. of Hours per Week: 4

(4 credits)

CObj	Course Objectives
CObj_1	To acquaint students with the accounting concepts, tools, and techniques influencing Business Organizations.
CObj_2	To Prepare organization's financial accounts (statements) for a specific period of time.
CObj_3	To improve clarity, consistency, and comparability of the communication of financial information.

CO	Course Outcomes
	After completion of this course, students should be able to:
CO1	Develop the skill of recording financial transactions and preparation of reports in accordance with Ind AS.
CO2	Understand and prepare the financial statements required for today's business.
CO3	Understand the concepts and theoretical knowledge of Financial Accounting
CO4	Understand the accounting treatment required for converting a Partnership firm into a Limited company.
CO5	Apply the concept of accounting to find out the profitability at different activity/departmental levels and analyse the same for decision making in business.

CO-PO Mapping

	PO_1	PO_2	PO_3	PO_4	PO_5
CO_1	*				
CO_2					*
CO_3	*				
CO_4	*				*
CO_5		*			*

Course Content

Sl. No.	Unit/chapter title	Content	Number of hours	Skills developed
1	Unit- I Introduction to Financial Accounting	Introduction – Meaning and Definition – Objectives of Accounting – Functions of Accounting –Users of Accounting Information – Limitations of Accounting – Accounting Principles – Accounting Concepts and Accounting Conventions - Social accounting & green accounting concepts-Accounting Standards: List of Indian Accounting Standards	10 Hrs	Transferrable Skills
2	Unit- II Conversion of Single Entry into Double Entry System	Single entry system- Meaning – Features – Merits – Demerits – Types. Conversion into Double Entry system – Need for Conversion – Preparation of Statement of Affairs – Cashbook – Memorandum Trading Account – Total Debtors Account – Total Creditors Account – Bills Receivable Account – Bills Payable Account – Trading, Profit & Loss Account , Balance Sheet	14 Hrs	Cognitive Skills
3	Unit- III Hire Purchase System	Meaning of Hire Purchase and Instalment Purchase System- the difference between Hire Purchase and Instalments Purchase – Important Definitions – Hire Purchase Agreement – Hire Purchase Price – Cash Price – Hire Purchase Charges – Net Hire Purchase Price – Net Cash Price – Calculation of Interest – Calculation of Cash Price – Journal Entry and Ledger Accounts in the books Hire purchaser and Hire Vendor (Asset Accrual Method only) .	14 Hrs	Employable Skills
4	Unit- IV Departmental Accounts	Meaning, Objectives, basis of allocation of expenses, Trading, and Profit and Loss Account in Columnar	10 Hrs	Analytical Skills

		form – (Excluding Inter-Departmental Transfers at invoice price)- Loss of profit in consequential loss , Inter-Departmental transfer at invoice price.		
5	Unit- V Conversion of Partnership Firm into A Ltd Company	Consideration – Methods of calculation of Purchase Consideration – Net Payment Method – Net Assets Method – Journal Entries and Ledger Accounts in the books of Vendor – Treatment of items: Dissolution Expenses, Unrecorded Assets and Liabilities, Assets and Liabilities not taken over by the Purchasing Company, Contingent liabilities, Incorporation entries and preparation of balance sheet of the purchasing company under vertical format.	12 Hrs	Evaluation/ Synthesis Skills

Books for Reference:

1. Arulanandam, & Raman. (2018). Financial accounting – I. HPH.
2. Jawaharlal, & Srivastava, S. (2017). Financial accounting. HPH.
3. Maheshwari, S. N. (2017). Financial accounting. Vikas Publications.
4. Jain, S. P., & Narang, K. L. (2017). Financial accounting - I . Kalyani Publishers.
5. Pandian, S. J. (2016). Financial accounting from zero. Excel Books
6. Radhaswamy, & Gupta, R. L. (2017). Advanced accounting (Revised ed.). Sultan Chand.
7. Murthy, G. (2017). Financial accounting. HPH.
8. Soundararajan, & Venkataramana, K. (2015). Financial accounting. SHBP.
9. Venkataraman, & Others (7 lecturers). (2019). Financial accounting. VBH.
10. Mani, A. (2019). Financial accounting. SBH.
11. Maheshwari, S. N. (2017). Advanced accounting, Vol-I. Vikas Publishing House.

Web Resource:

1. <https://libguides.utt Tyler.edu/>
2. <https://www.zoho.com/>

Journals:

1. International Journal of Accounting and Finance
2. Journal of Finance and Accounting
3. The Journal of Accounting, Auditing, and Finance (JAAF)
4. Journal of Business Finance and Accounting.

C21 DC 1.2 CORPORATE ADMINISTRATION

THEORY

Total Teaching Hours: 60

No. of Hours per Week: 4

(4 credits)

CObj	Course Objectives
CObj_1	To enable students to get familiarized with the existing Company Law and Secretarial Procedure.
CObj_2	To understand the various roles played by top executives.
CObj_3	To familiarize students about the different types of meetings conducted by the company.

CO	Course Outcomes
	After completion of this course, students should be able to:
CO1	Be able to understand the framework of Companies Act of 2013 and different types of companies.
CO2	Be able to identify the stages and documents involved in the formation of companies in India.
CO3	Be able discuss the role, responsibilities and functions of key Management Personnel in Corporate Administration.
CO4	Be able to recognize the procedure involved in the corporate meetings and the role of company secretary in the meeting.
CO5	Be able to draw the role of liquidator in the process of winding up of the company.

CO-PO Mapping

	PO_1	PO_2	PO_3	PO_4	PO_5
CO_1	*				
CO_2		*			
CO_3			*		
CO_4					*
CO_5					*

Course Content

Sl. No.	Unit/chapter title	Content	Number of hours	Skills developed
1	Unit-I Introduction to Company	Meaning and Definition – Features of Joint Stock Company, Highlights of Companies Act 2013 – Types of Companies – One Person Company, Private Company, Public Company, Company limited by Guarantee, Company limited by Shares, Holding Company, Subsidiary Company, Government Company, Associate Company, Small Company, Foreign Company, Global Company, Body Corporate, Listed Company	12 Hrs	Employable Skills
2	Unit-II Formation of a Company	Promotion Stage: Meaning of Promoter, Position of Promoter & Functions of Promoter Incorporation Stage – Meaning & contents of Memorandum of Association & Articles of Association , Distinction between Memorandum of Association and Articles of Association , Certificate of Incorporation , Subscription Stage – Meaning & contents of Prospectus , Statement in lieu of Prospectus and Book Building , Commencement Stage – Document to be filed, e- filing, Register of Companies , Certificate of Commencement of Business .	16 Hrs	Employable Skills
3	Unit-III Company Administration	Key Managerial Personnel – Managing Director , Whole time Directors , the Companies Secretary , Chief Financial Officer , Resident Director , Independent Director , Auditors – Appointment – Powers - Duties & Responsibilities . Managing Director – Appointment – Powers – Duties & Responsibilities . Audit	18 Hrs	Employable Skills/Entrepreneurship skills

		Committee, CSR Committee. Company Secretary - Meaning, Types, Qualification, Appointment, Position, Rights, Duties, Liabilities & Removal or dismissal.		
4	Unit-IV Corporate Meetings	Corporate Meetings - Types of Meetings – Annual General Meeting -Extraordinary General Meetings – Board Meetings and Resolutions - Requisites of a valid meeting.	08 Hrs	Employable Skills
5	Unit-V Winding up of Companies	Winding up – meaning, modes of winding up -compulsory winding up, voluntary winding up, winding up subject to supervision of court; Liquidators -duties and powers of liquidator.	06 Hrs	Employable Skills

Books for Reference:

1. S.N Maheshwari; 2014 Elements of Corporate Law, HPH.
2. Balchandran – Revised 2017, Business Law for Management HPH
3. Dr. B.G. Bhaskar, K.R. Mahesh Kumar, Revised 2015– Corporate Administration, VBH
4. Dr. P.N. Reddy and H.R. Appanaiah: Revised 2019 Essentials of Company Law and Secretarial Practice, HPH.
5. K. Venkataramana, Revised 2019 Corporate Administration, SHBP.
6. N.D. Kapoor: Revised 2015 Company Law and Secretarial Practice, Sultan Chand.
7. C.L Bansal: Revised 2019 Business and Corporate Law
8. M.C. Bhandari: Revised 2017 Guide to Company Law Procedures, Wadhwa Publication.
9. S.C. Kuchal: Revised 2017 Company Law and Secretarial Practice.
10. S.C. Sharma: Revised 2017 Business Law, I.K. International Publishers
11. S.N Maheshwari; Revised 2017 Elements of Corporate Law, Vikas Publisher

Web Resource:

1. Google.com
2. mca.in

Journals:

1. Academy of Management Journal
2. Academy of Management Learning & Education
3. Academy of Management Perspectives
4. Academy of Management Review

C21 DC 1.3: PRINCIPLES OF MANAGEMENT

THEORY

Total Teaching Hours: 60

No. of Hours per Week: 4

(4 credits)

CObj	Course Objectives
CObj_1	To familiarize the students to the concepts and principles of organization management.
CObj_2	To create awareness of the principles to be followed in an organisation
CObj_3	To study the system and process of effective controlling in the organization

CO	Course Outcomes After completion of this course, students should be able to:
CO1	Be able to understand the framework of Companies Act of 2013 and different types of companies.
CO2	Be able to identify the stages and documents involved in the formation of companies in India.
CO3	Be able discuss the role, responsibilities and functions of key Management Personnel in Corporate Administration.
CO4	Be able to recognize the procedure involved in the corporate meetings and the role of company secretary in the meeting.
CO5	Be able to draw the role of liquidator in the process of winding up of the company.

CO-PO Mapping

	PO_ 1	PO_ 2	PO_ 3	PO_ 4	PO_ 5
CO_ 1		*		*	
CO_ 2			*	*	
CO_ 3				*	
CO_ 4	*		*	*	*
CO_ 5	*	*			*

Course Content

S. No	Module title	Module Content	Number of Hours	Skills Developed
1	Unit-I Fundamentals of Management	Management: Introduction, Evolution of management, Meaning, Nature and Characteristics of management, Schools of Management, Scope and functional areas of management, Management as a science art or profession, Management & administration, Principles of management, social responsibility of management and ethics. Branches of management-FM, CM, HRM.	14 Hrs	Employable Skills/Cognitive skills
2	Unit-II Planning and Decision making	Management Process: Introduction; Planning –Nature, Importance and Purpose of planning, planning process, Objectives, Types of plans (meaning only); Decision making steps and process, MBO– Meaning and Importance	12 Hrs	Analytical skills/Skill Development
3	Unit-3 Organizing	Organization: Purpose of organization, Principles of organization, Types of organization. Line and staff authority-departmentalisation, Delegation of Authority- Centralisation Vs Decentralisation, Span of control. TQM, Kaizen – Meaning, Objectives and Importance in Management	9 Hrs	Transferable Skills
4	Unit-4 Communication and control	Communication: Meaning and Importance, Barriers to communication, Types of communication; Controlling-Meaning and Steps in controlling, Essentials of a sound control system.	8 Hrs	Employable Skills

5	Unit-5 Management Of Change	Concept, nature, process of planned change, Reasons for change, Resistance to change, Factors affecting resistance to change, overcoming resistance to change, Emerging horizons of management in a changing environment – Green management – Meaning, Importance, Stress management – Meaning, Types, Causes.	10 Hrs	Cognitive/Employable Skills
6	Unit-6 Motivation and Leadership	Motivation Theories: Maslow's Need Hierarchy Theory, Herzberg's Two Factor Theory, McGregor's X & Y theory; Leadership Styles – Autocratic Style, Democratic Style, Bureaucratic Style, Laissez Faire Leadership Style, Transactional Leadership, Transformational Leadership and Charismatic Leadership	7 Hrs	Entrepreneurship/Transferable Skills

Books for Reference:

1. Appaniah, A., & Reddy, S. (1998). Essentials of management. Himalaya Publishing House.
2. Aswathappa, K. (2011). Human resource management. Tata McGraw Hill Education Pvt Ltd.
3. Rao, S. (2013). Human resource management. Himalaya Publishing House.
4. Srinivasan, V., & Chunawalla, S. (1995). Management principles and practice. Himalaya Publishing House.
5. Tripathi, P. C., & Reddy, P. N. (2011). Principles of management. Tata McGraw Hill Education Pvt Ltd.

Web Resource:

1. <https://hbr.org/>
2. <https://www.mindtools.com/>
3. <https://www.managementstudyguide.com/>
4. <https://www.open.edu/openlearn/>

Journals:

1. Academy of Management Journal (AMJ)
2. Journal of Management (JM)
3. Journal of Business Research (JBR)
4. Management Science
5. International Journal of Management Reviews (IJMR)

21SBC 1 .1: DIGITAL FLUENCY

THEORY

Total Teaching Hours: 30

No. of Hours per Week: 2

(2 credits)

CObj	Course Objectives
CObj_1	To teach participants the advanced formulas as well as how to use which formula for which occasion.
CObj_2	To equip participants with the knowledge on how to debug and audit the advanced formulas
CObj_3	To explore the magic of analyzing data using Advanced Excel.

CO	Course Outcomes
	After completion of this course, students should be able to:
CO1	Examine spread sheet concepts and explore the Microsoft office Excel environment.
CO2	Understand and apply basic principles of laying out excel models for decision making.
CO3	Use excels functions to summarize quantitative data graphically, including pivot table and charts.
CO4	Apply formulas to lay data in readiness for analysis.
CO5	Apply the best practices by troubleshooting complex models.

CO-PO Mapping

	PO_1	PO_2	PO_3	PO_4	PO_5
CO_1	*				*
CO_2	*				
CO_3				*	
CO_4			*		
CO_5			*		

Course Content

Sl. No.	Unit/chapter title	Content	Number of hours	Skills developed
1	Unit- I Create worksheets & workbook	Create of Workbook, Navigation within the Workbook (Clipboard), Import Data from De Limited Text Files, Add the Worksheet for the Existing workbook. Navigating using GOTO Special.	02 Hrs	Employable Skills
2	Unit- II References & table format	Type of References: Absolute Reference, Mixed References, Relative References, Apply the Different Table Format. (Working with 2 Case Studies)	02 Hrs	Employable Skills
3	Unit- III Summarize data by using functions /statistical functions.	Define Name, Perform Calculations by Using The Sum, Sumif, Sumifs, Count, Counta, Countif, Countifs, Count Blank, Average, Averageif, Max, Min Rank Functions (Working With 2 Case Studies)	02 Hrs	Employable Skills
4	Unit- IV Lookup & reference section.	VLOOKUP, HLOOKUP, Index, Match, & If error. (Working with 2 Case Studies)	02 Hrs	Employable Skills
5	Unit- V Create & format charts	New Chart, Data Series, Switch b/w Rows & Columns, Analyses data by using Quick Analysis, Resize Charts & Add & Modify the Chart Elements, Layouts & Styles, Move Chart to Chart Sheets (Working with 1 Case Studies)	02 Hrs	Employable Skills
6	Unit- VI Format & Modify Text by using Functions.	Format Text by using RIGHT, LEFT, MID, UPPER, LOWER, PROPER, Concatenate, TRIM, Clean, Char, TEXT JOIN, LEN, FIND, Search, Replace & Substitute. (Working with 1 Case Studies)	02 Hrs	Employable Skills
7	Unit -VII Create advanced tables & charts	Create & Manage Pivot Tables, Create & Manage Pivot Charts, Working Slices, Timeline Filters, Sorting Options, Designing the PIVOT Tables ETC. (Working with 2 Case Studies)	02 Hrs	Employable Skills

8	Unit -VIII Date functions	Working The Date Formats, Working the Various Date Functions Like DATE, TODAY, NOW, EOMONTH, WORKDAY, WORKDAY. INTL, NETWORKDAY And NETWORKDAY.INTL.(Working With 1 Case Studies)	02 Hrs	Employable Skills
9	Unit -IX Functions	Working the Various Logical Functions like IF, IFS, AND, OR, SWITCH TRUE or False. (Working with 1 Case Studies)	02 Hrs	Employable Skills
10	Unit -X Financial functions	PMT, IPMT, CUMIPMT, RATE, NPER, FV. (Working with 1 Case Studies)	02 Hrs	Employable Skills
11	Unit -XI Data analytics tools	Working with Custom Sort & Advanced Filter, Text to Columns, Remove Duplicates, Data Validation, Consolidation, what if Analysis (Scenario Manager, Goal Seek FORCAST, FORCAST.FORCAST.CONFINT, FRCAST.ETS.SESONALITY, FORCAST.ETS.STAT, FORCAST & Data Table), (Working with 1 Case Studies)	03 Hrs	Employable Skills
12	Unit -XII Creating for Dynamic Charts using Functions.	An Excel Dashboard provides insight, analysis and alerts. They're fully interactive and dynamic and can help with project management, customer service, retail management, financial forecasting and much more. (Working with 1 Case Studies)	03 Hrs	Employable Skills
13	Unit -XIII Power Pivot Table	Advanced Pivot Table, Working with Relationship, Introduction of DAX Functions, Data Modelling, Queries & Connections, Designing Pivot Chart & Table. (Working with 1 Case Studies)	02 Hrs	Employable Skills
14	Unit -XIV Working with Addons	Working Various Addons Analytics Tool Pack, Power Maps, Solver Add in.	02 Hrs	Employable Skills

Books for Reference:

1. Alexander, M., Jelen, B., & Walkenbach, J. (2019). Excel 2019 Bible: The comprehensive tutorial resource. Wiley.
2. Richards, J. (2018). Excel: QuickStart guide from beginner to expert. CreateSpace Independent Publishing Platform.
3. Harvey, G., & Wempen, F. (2018). Excel 2019 all-in-one for dummies. For Dummies.
4. Alexander, M., & Walkenbach, J. (2019). Microsoft Excel dashboards and reports. Wiley.
5. Williams, M. G. (2019). Ctrl+Shift+Enter: Mastering Excel array formulas. Holy Macro! Books.
6. Hart-Davis, G. (2019). Excel for beginners. Independently published.
7. Alexander, M., & Jelen, B. (2018). Microsoft Excel 2019 formulas and functions. Pearson Education

Web Resource:

1. www.google.com
2. <https://youtube.com/c/edurekaIN>
3. <https://openoregon.pressbooks.pub/beginningexcel19/>
4. <https://corporatefinanceinstitute.com/resources/ebooks/excel-book-pdf/>
<https://doc.lagout.org/operating%20system%20/Windows/Excel/Microsoft%20Excel%202010%20Step%20by%20Step.pdf>
5. <https://www.linkedin.com/learning/excel>
6. <https://www.youtube.com/channel/UCVLbzhxVTiTLiVKeGV7WEBg>

C21OE 1.1 FINANCIAL LITERACY

THEORY

Total Teaching Hours: 42

No. of Hours per Week: 3

(3 credits)

CObj	Course Objectives
CObj_1	To provide an understanding of the knowledge of financial literacy and to create awareness of the same.
CObj_2	To familiarize with the basic concepts of banking, accounting and insurance sectors.
CObj_3	To provide an awareness on managing personal finance in day-to- day life.

CO	Course Outcomes
	After completion of this course, students should be able to:
CO1	Understand the importance of financial literacy and its implementation of day-to day life.
CO2	Learn the basic accounting, banking and insurance concepts and their usage in daily life transactions.
CO3	Demonstrate an understanding of the different types of banking operations available for customers.
CO4	Recognize and understand the procedure involved in managing personal finance.
CO5	Explain the role of insurance and its importance including benefits.

CO-PO Mapping

	PO_1	PO_2	PO_3	PO_4	PO_5
CO_1			*		*
CO_2				*	*
CO_3					*
CO_4		*		*	*
CO_5		*	*		

Course Content

Sl. No.	Unit/chapter title	Content	Number of hours	Skills developed
1	Unit- I Introduction to financial literacy	Meaning, objectives, importance and scope of financial literacy; Prerequisites of Financial Literacy – level of education, numerical and communication ability, financial knowledge, financial attitude, financial culture, financial behavior, financial inclusion, financial planning, financial wellbeing.	06 Hrs	Cognitive Skills
2	Unit- II Basics of accounting	Introduction – Meaning and Definition – Objectives of Accounting – Functions of Accounting –Accounting basic terminologies, Users of Accounting Information – Limitations of accounting. Accounting Principles –financial statement importance-users-Social accounting & green accounting concepts	06 Hrs	Analytical Skills
3	Unit- III Banking operations	Types of banks; Banking Products and Services–Various services offered by banks; Types of bank deposit accounts – Savings Bank Account, Term Deposit, Current Account, Recurring Deposit, PPF, NSC etc. Formalities to open various types of bank accounts, PAN Card, Address proof, KYC norm. Various types of loans – short term, medium term, long term, micro finance, agricultural etc. Related interest rates offered by Various nationalized banks and post office; Cashless banking, e-banking, Check Counterfeit Currency; CIBIL, ATM, Debit and Credit Card, RTGS, NEFT and APP based Payment system, Banking complaints and Ombudsman. Institutions dealings in gold loans.	12 Hrs	Employable Skills
4	Unit- IV Managing personal finance	Meaning of personal finance, objectives, need, importance, Dos and don'ts in managing income, expenditure and savings, Mutual funds meaning, objectives, scope, process – types of mutual funds.	06 Hrs	Analytical Skills
5	Unit- V Insurance business in India	Meaning, definition, objectives, types of insurance –Life insurance meaning, objectives, progress of life insurance types of life insurance, policy, claims, endowment, life insurance contract, parties in the life insurance. General insurance meaning,	12 Hrs	Cognitive Skills

		objectives. Health insurance –meaning, objectives, need, types of health insurance catastrophe insurance growth of health insurance –future of health insurance. Liability and vehicle insurance concepts.		

Books for Reference:

1. Garman, E. T., & Forgue, R. (2020). Personal finance (13th ed.). Cengage Learning.
2. Dave, R. (2013). Smart money smart kids: Raising the next generation to win with money. Ramsey Press.
3. Collins, C. J. (2016). The millionaire next door: The surprising secrets of America's wealthy. Longstreet Press.
4. Kiyosaki, R. T. (2017). Rich dad poor dad: What the rich teach their kids about money that the poor and middle class do not! Plata Publishing.
5. Siegel, J. J. (2020). Stocks for the long run: The definitive guide to financial market returns & long-term investment strategies (6th ed.). McGraw-Hill Education.
6. Malkiel, B. G. (2019). A random walk down Wall Street: The time-tested strategy for successful investing (12th ed.). W. W. Norton & Company.
7. Robbins, T. (2014). Money: Master the game—7 simple steps to financial freedom. Simon & Schuster.
8. Bach, D. (2016). The automatic millionaire: A powerful one-step plan to live and finish rich. Crown Business

Web Resource:

1. <https://www.accountingcoach.com/links>
2. <https://libguides.utt Tyler.edu/c.php?g=948323&p=6838173>
3. <https://corporatefinanceinstitute.com/resources/knowledge/accounting/>
4. <https://online.hbs.edu/courses/financial-accounting/>

Journals:

1. Journal of Financial Counseling and Planning
2. Financial Services Review
3. Journal of Personal Finance
4. Financial Literacy and Education Journal
5. Journal of Financial Education
6. International Review of Economics Education

C21DC2.1: ADVANCED FINANCIAL ACCOUNTING**THEORY****Total Teaching Hours: 60****No. of Hours per Week: 4****(4 credits)**

CObj	Course Objectives
CObj_1	To provide students conceptual knowledge of accounting.
CObj_2	To review and understand the accounting tools and techniques influencing business organizations.
CObj_3	To effectively analyze, interpret and use financial statements.

CO	Course Outcomes
	After completion of this course, students should be able to:
CO1	Acquire conceptual knowledge of basics of fire insurance claims.
CO2	Develop the skill of recording the Consignment transactions in the books of Consignor and Consignee and ascertain Profit.
CO3	Identify and analyze the concepts of Joint Venture and prepare different sets of accounts on Joint Venture.
CO4	Familiarize the concept of Branch account and its system.
CO5	Equip with the knowledge of the accounting process and preparation of final accounts.

CO-PO Mapping

	PO_1	PO_2	PO_3	PO_4	PO_5
CO_1	*				
CO_2				*	
CO_3		*			
CO_4			*		
CO_5					

Course Content

Sl. No.	Unit/chapter title	Content	Number of hours	Skills developed
1	Unit- I Insurance Claims	Introduction-Need- Loss of Stock Policy-Fire insurance premium calculation-steps for ascertaining Fire insurance claim-Treatment of Salvage-Average Clause-Treatment of Abnormal Items-Computation of Fire insurance claims. Insurance of loss of profit.	14 Hrs	Analytical Skills
2	Unit- II Consignment Accounts	Introduction- Meaning- Consignor-Consignee-Goods invoiced at Cost Price-Goods invoiced at Selling Price-Normal Loss-Abnormal Loss- Valuation of Stock-Stock Reserve-Journal Entries- Ledger Accounts in the books of Consignor and Consignee	14 Hrs	Cognitive Skills
3	Unit- III Accounting for Joint Ventures	Introduction- Meaning- Objectives-Distinction between Joint Venture and Consignment-Distinction between Joint Venture and Partnership-maintenance of accounts in the books of coventurers-maintaining separate books for Joint Venture-preparation of Memorandum Joint Venture-problems.	12 Hrs	Employable Skills
4	Unit- IV Branch Accounts	Introduction- Meaning- Objectives-Types of Branches-Dependent Branches-Features-Supply of Goods at Cost Price-Invoice Price-Branch Account in the books of Head Office (Debtors System only)	10 Hrs	Transferrable/ Skill development Skills

5	Unit- V Final Accounts of a Proprietary Concern	Introduction- Objectives and importance of Final Accounts. Preparation of Trading Account, Preparation of Profit and Loss Account, Preparation of Balance sheet -Problems.	10 Hrs	Employable Skills

Books for Reference

1. Maheshwari, S. N., & Maheshwari, S. K. (2017). Advanced accounting (13th ed.). Vikas Publishing House.
2. Shukla, M. C., & Grewal, T. S. (2019). Advanced financial accounting (13th ed.). S. Chand & Company Ltd.
3. Rao, P. S. (2016). Advanced accounting (3rd ed.). Himalaya Publishing House.
4. Goyal, M. (2020). Financial accounting: A comprehensive approach (2nd ed.). PHI Learning.
5. Singh, S., & Kaur, P. (2019). Advanced financial accounting (2nd ed.). Kalyani Publishers.
6. Jain, S. P., & Narang, K. L. (2021). Advanced accounting (13th ed.). Kalyani Publishers.
7. Rama, G. S. V., & Reddy, A. S. (2018). Advanced financial accounting (8th ed.). Tata McGraw-Hill Education.
8. Grewal, T. S., & Gupta, R. (2020). Advanced financial accounting (14th ed.). S. Chand & Company Ltd.
9. Mohan, K. P. (2020). Advanced accounting principles (4th ed.). New Age International Publishers.
10. Khan, M. Y., & Jain, P. K. (2020). Advanced financial management (8th ed.). Tata McGraw-Hill Education

Web Resource:

1. <https://www.studocu.com/in/document/annauniversity/accounting/bcom second- semester- advanced-financial-accounting-notes/7546747>
2. <https://www.tppl.org.in/2020/second-sem/1872-advanced-financial-accounting-9789351633709.html>
3. <https://www.studynama.com/community/threads/advanced-financial-accounting-ebook- handout-pdf-download-bcom-second-sem-students.1307/>

Journals:

1. Journal of Accounting Research
2. Journal of Accounting Auditing and Finance
3. The Accounting Review
4. Contemporary Accounting Research

C21DC 2.2: QUANTITATIVE ANALYSIS FOR BUSINESS DECISIONS

THEORY

Total Teaching Hours: 60

No. of Hours per Week: 4

(4 credits)

CObj_ID	Course Objectives
CObj_1	To understand the basic concepts of Mathematics.
CObj_2	To have a proper understanding of mathematical applications in commerce.
CObj_3	To Develop abstract, logical and critical thinking and the ability to reflect critically upon their work and the work of others.

CO	Course Outcomes After completion of this course, students should be able to:
CO1	Describe, classify and summarize in commerce and business.
CO2	Apply appropriate descriptive and inferential statistical tools to analyze data and interpret the results.
CO3	Comprehend their understanding and apply sampling techniques to solve business problems in appropriate contexts.
CO4	Apprehend the basics of data analysis and forecasting techniques used in economics and business decisions.
CO5	Draw statistical inferences and communicate the same in quantitative and qualitative terms that aid in decision-making.

CO-PO Mapping

	PO_1	PO_2	PO_3	PO_4	PO_5
CO_1		*			
CO_2		*			
CO_3			*		
CO_4			*		
CO_5			*		

Course Content

S. No	Unit/Chapter	Module Content	Number of Hours	Skills Developed
1	Unit- I Number System	Introduction - Natural numbers - Even numbers – Odd numbers – Integers – Prime numbers – Rational & Irrational numbers, Real numbers, HCF & LCM (Simple problems).	04 Hrs	Cognitive Skills
2	Unit- II Theory of Equations	Introduction – Meaning – BODMAS - Types of Equations – Simple/ Linear Equations and Simultaneous Equations (only two variables), Elimination and Substitution Methods only. Quadratic Equation - Factorization and Formula Method ($ax^2 + bx + c = 0$ form only). Simple problems	14 Hrs	Cognitive Skills
3	Unit- III Matrices, Determinant and Indices	Meaning – types – operation on matrices – additions – subtractions and multiplication of two matrices – transpose – determinants – minor of an element – co-factor of an element – inverse – crammers' rule in two variables – problems. Indices: Meaning- Basic Laws of Indices and their application for simplification.	16 Hrs	Transferable Skills
4	Unit- IV Commercial Arithmetic	Simple Interest, Compound Interest including yearly and half-yearly calculations, Annuities, Percentages, Bills Discounting, Ratios and proportions, duplicate-triplicate and sub-duplicate of a ratio. Rule of 72 and 69. Proportions: third, fourth, and inverse proportion - problems	10 Hrs	Analytical Skills
5	Unit- V Progressions	Arithmetic Progression – Finding the 'nth' term of AP and Sum to the 'nth' term of AP. Insertion of Arithmetic Mean, Geometric Progression – Finding the 'nth' term of GP and sum to 'nth' term of GP and insertion of Geometric Mean.	10 Hrs	Analytical Skills

Books for Reference:

1. Khan, S.M. (2012). A textbook of Business Mathematics. Viva Books Private Limited.
2. Sancheti, D.C. and Kapoor, V.K. (2014). Business Mathematics. S. Chand & Sons.
3. Soper, J. (2004) Mathematics for Economics and Business: An Interactive Introduction. Wiley-Blackwell.
4. Schultheis, R.A. and Kaczmariski, R. M. (2005) Business Math. Cengage South Western.

Web Resource:

1. <https://www.educationworld.com/>
2. <https://mathworld.wolfram.com/>

Journals:

1. Journal of Mathematics
2. International Journal of Mathematics
3. Journal of the London Mathematics Society
4. Khayyam Journal of Mathematics

C21 DC 2.3: COST ACCOUNTING

THEORY

Total Teaching Hours: 60

No. of Hours per Week: 4

(4 credits)

CObj	Course Objectives
CObj_1	To Provide an understanding of basic techniques of cost accounting and to develop the skills necessary to apply those techniques
CObj_2	To provide an understanding of the use of cost accounting techniques in planning, control & decision making.
CObj_3	To provide an understanding of proper recording, presentation of cost data to management for measuring efficiency in cost control & cost reduction.

CO	Course Outcomes
	After completion of this course, students should be able to:
CO1	To explain relevant cost concepts & classification of costs used in the manufacturing / service sector.
CO2	To explain the purposes of cost accounting
CO3	To apply costing principles in the decision-making process.
CO4	To prepare the production cost statement & cost of goods sold statement.
CO5	To explain the relationship between cost & financial accounting.

CO-PO Mapping

	PO_1	PO_2	PO_3	PO_4	PO_5
CO_1	*		*		
CO_2		*	*		
CO_3	*	*			
CO_4				*	
CO_5					*

Course Content

Sl. No	Unit/chapter title	Content	Number of Hours	Skills Developed
1.	Unit-I Introduction to cost Accounting	Introduction – Meaning & Definition of Cost, Costing and Cost Accounting – Objectives of Costing - Comparison between Financial Accounting and Cost Accounting –Cost Concepts - Classification of Costs – Cost Unit – Cost Center – Elements of Cost – Preparation of Cost Sheet	10 Hrs	Cognitive Skills
2.	Unit-II Material management & cost control	Meaning–Types: Direct Material, Indirect Material. Material Control – Purchasing Procedure – Store Keeping– Techniques of Inventory Control –Levels settings– EOQ– Numerical examples - ABC Analysis – VED Analysis – Just In-Time – Perpetual Inventory System – Theoretical concepts-Methods of Pricing Material Issues: FIFO, LIFO, Weighted Average Price Method and Simple Average Price Method – valuation of Closing stock.	14 Hrs	Employable Skills
3.	Unit-III Labour cost control	Meaning –Types: Direct Labour, Indirect Labour- timekeeping – Time booking –Idle Time – Overtime – Labour Turnover. Methods of Labour Remuneration: Time Rate System, Piece Rate System, Incentive Systems (Halsey plan, Rowan Plan & Taylor's differential Piece Rate System)– Numerical examples	10 Hrs	Employable Skills
4.	Unit-IV Overhead cost control	Meaning and Definition – Classification of Overheads – Procedure for Accounting and Control of Overheads – Allocation of Overheads – Apportionment of Overheads –Primary Overhead Distribution Summary –Secondary Overhead Distribution Summary – Repeated Distribution Method and Simultaneous Equations Method – Absorption of Factory Overheads – Machine Hour Rate –Numerical examples on Machine Hour Rate.	16 Hrs	Evaluation/ Synthesis Skills

5	Unit-V Reconciliation of cost and financial account	Need for Reconciliation – Reasons for differences in Profit or Loss shown by Cost Accounts and Profit or Loss shown by Financial Accounts – Preparation of Reconciliation Statement and Memorandum Reconciliation Account. Numerical examples	10 Hrs	Cognitive Skills

Books for Reference:

1. J Made Gowda - 2018-Cost & Management Accounting, HPH
2. M V Shukla - 2017- Cost & Management Accounting HPH
3. N K Prasad - 2018- Cost Accounting, Books Syndicate Pvt. Ltd.
4. Nigam & Sharma - 2016- Cost Accounting, HPH
5. Khanna Pandey Ahuja - 2013 - S. Chand and Company Private Limited, New Delhi Company Practical Costing,
6. P.K. Sinha- 2015- Accounting & Cost for Managers- Skyward publishing
7. S. Anil kumar, V. Rajesh kumar, B. Mariyappa - 2019- Himalaya publishing house.

Web Resource:

1. <https://www.hbsp.harvard.edu/product/105039-PDF-ENG>
2. <https://www.accountingaccidentally.com/cost-accounting-you-tube-links/>
3. <https://www.udemy.com/course/cost-accounting-a-comprehensive-study/>

Journals:

1. Journal of Commerce and Accounting Research
2. MUDRA: Journal of Finance and Accounting
3. International Journal of Accounting & Finance Review

C21OE2.1 INVESTING IN STOCK MARKET

THEORY

Total Teaching Hours: 42

No. of Hours per Week: 03

(3 credits)

CObj	Course Objectives
CObj_1	Introduce students to monetary and financial markets in India and examine their structure, operations and products.
CObj_2	Enable the students with a conceptual framework of stock markets and commodity markets.
CObj_3	Develop an understanding of the principles of Investments in securities markets and provide the knowledge and skills required to undertake investments in stock market

CO	Course Outcomes After completion of this course, students should be able to:
CO1	To identify and compare different investment options available for individual investors and to effectively manage their personal finances/investments.
CO2	Understand & interpret the mechanism of investing, investment process and market indices.
CO3	Explain role and nature of stock market and range of services provided by these for individual investors.
CO4	Demonstrate an understanding of mutual fund investments, advantages and disadvantages.
CO5	Understand & interpret the mechanism of investing, investment process and market indices.

	PO_1	PO_2	PO_3	PO_4	PO_5
CO_1	*			*	
CO_2		*			
CO_3			*		*
CO_4			*		*
CO_5		*		*	

Course Content

Sl.	Unit/chapter title	Content	Number of	Skills

No.			hours	developed
1	Unit- I An Overview of Capital Market	Introduction, meaning of capital Market, Primary market, Secondary market, Stock Market: Meaning, objectives, Functions, issue mechanism, Types of companies issuing shares, Depositories, Player in new issues market.	08 Hrs	Cognitive Skills
2	Unit- II Indian Stock Market	Market Participants: Players of Indian stock market, Investor, Clearinghouse, Stock Exchanges. Role of stock exchange, Governing body, Stock exchanges in India- BSE, NSE. Market Indices: Nifty50, Sensex, Trading in securities Demat trading, Dematerialization and Dematerialization process.	10 Hrs	Employable Skills
3	Unit- III Regulatory Institution	SEBI: Introduction, objectives, functions & powers, regulatory measures & Guideline: IPO, Debenture: Issues & redemption	08Hrs	Employable Skills
4	Unit- IV Basics of Investing	Basics of Investment. Investment Environment. Risk and Return, Avenues of Investment, Equity shares, IPO FPO, Preference shares, Bonds & Debentures, Insurance Schemes, Mutual Funds in details, and Index Funds, ETFs	10 Hrs	Evaluation and Synthesis
5	Unit- V Investment in Real Estate	Introduction to REI, Meaning, Role of REIT, Basics of REI Niches, Types of Private equity Real Estate strategies, Sources of Raising fund, Real estate private equity vs Real estate investment trust vs Real estate operating companies	06 Hrs	Analytical Skills

Books for Reference:

1. Parikh, P. (2009). Value investing and behavioral finance: Insights into Indian stock market realities. McGraw Hill Education.
2. Mehta, D. (2012). How to make money in intraday trading: A master class by one of India's most famous traders. Vision Books.
3. Gala, A., & Gala, J. (2020). Stock market: A beginner's guide for Dummies India. Buzzing stock Publishing House.

4. Prasad, M. (2021). The winning strategy: How to achieve financial freedom through the stock market. CNBC Books.
5. Damodaran, A. (2012). Investment philosophies: Successful strategies and the investors who made them work. Wiley.
6. Patel, R. (2020). The beginner's guide to stock market investment in India. Buzzingstock Publishing House.
7. Basu, R. (2010). Business and financial journalism: Reporting, writing, and analyzing. Oxford University Press.

Web Resource:

1. <https://www.nseindia.com>
2. <https://www.bseindia.com>
3. <https://zerodha.com/varsity/>
4. <https://www.moneycontrol.com>
5. <https://economictimes.indiatimes.com/markets>
6. <https://www.morningstar.in>

Journals:

1. Journal of Financial Economics
2. Financial Management
3. Indian Journal of Finance

C21DC3.1: CORPORATE ACCOUNTING

Total Teaching Hours: 60

No. of Hours per Week: 4

(4 credits)

CObj	Course Objectives
CObj_1	To develop analytical skills requires in preparation of consolidated financial statements of a Joint Stock Company and various methods of valuation of shares, liquidators' final statement.
CObj_2	To provide an understanding of the provisions of the Companies Act,2013 including the updated provisions with reference to corporate mergers, acquisitions and other Accounting Standards.
CObj_3	To provide conceptual understanding of corporate accounting and the framework within which the accounting standards underlying the accounting procedures are used to measure business performance.

CO	Course Outcomes
	After completion of this course, students should be able to:
CO1	Able to demonstrate knowledge and skills in preparation of Financial Statements of a company according to the latest provisions.
CO2	Be able to apply various methods for valuation of shares and identify factors affecting it and apply the relevant provisions followed during the liquidation of companies and prepare the liquidator's final statement.
CO3	Apply various standards and principles in a given scenario with the detailed concepts of internal reconstructions, Financial situation and results of operations in an organization.
CO4	Able to develop an ability to apply appropriate standards with reference to corporate mergers and acquisitions for any given situation.
CO5	Be able to apply various methods of purchase consideration for corporate mergers, acquisitions and incorporate in the books of new company.

CO-PO Mapping

	PO_1	PO_2	PO_3	PO_4	PO_5

CO_1	*		*		
CO_2	*		*		
CO_3		*	*		
CO_4	*	*		*	*
CO_5	*	*	*	*	

Course Content

Sl. No.	Unit/chapter title	Content	Number of hours	Skills developed

1	Unit- I Company Final Accounts	Statutory Provisions regarding preparation of Company Final Accounts –Treatment of Special Items –Tax deducted at source – Advance payment of Tax – Provision for Tax – Depreciation – Interest on debentures – Dividends– Rules regarding payment of dividends – Transfer to Reserves – Preparation of Income Statement and Balance Sheet in vertical form (As per 2013 revised format)	16 Hrs	Employable Skills
2	Unit- II Valuation of Shares	Meaning – Need for Valuation – Factors affecting Valuation– Methods of Valuation: Intrinsic Value Method, Yield Method, Earning Capacity Method and Fair Value of shares - Rights Issue and Valuation of Rights Issue - Problems.	10 Hrs	Analytical Skills
3	Unit- III Internal Reconstruction	Meaning – Objective – Procedure– Form of Reduction –Passing of Journal Entries – Preparation of Reconstruction accounts– Preparation of Balance Sheet after Reconstruction. (Vertical Format) Problems.	10 Hrs	Employable Skills
4	Unit- IV Mergers Acquisition's &	Meaning of Amalgamation and Acquisition – Types of Amalgamation – Amalgamation in the nature of Merger – Amalgamation in the nature of Purchase - Methods of Purchase Consideration – Calculation of Purchase Consideration (Ind AS103) (Old AS14), Net asset Method- Net Payment Method, Accounting for Amalgamation - Entries and Ledger Accounts in the Books of Transferor Company and Transferee Company – Preparation of new Balance sheet. (Vertical Format)	14 Hrs	Transferrable Skills

5	Unit- V Liquidation of Companies	Meaning–Types of Liquidation – Order of Payment - Calculation of Liquidator's Remuneration – Preparation of Liquidators Final Statement of Account.	10 Hrs	Analytical Skills

Books for Reference:

1. Arora, M. N. (2012). Corporate accounting (6th ed.). Himalaya Publishing House.
2. Bhattacharyya, A. K. (2016). Corporate accounting (2nd ed.). Pearson Education India.
3. Gupta, R. L., & Gupta, V. K. (2015). Advanced accounting (19th ed.). Sultan Chand & Sons.
4. Jain, S. P., & Narang, K. L. (2016). Corporate accounting (7th ed.). Kalyani Publishers.
5. Ghosh, A. (2014). Financial accounting for management (3rd ed.). Pearson Education India.
6. Narayanaswamy, R. (2017). Financial accounting: A managerial perspective (6th ed.). Prentice Hall India.
7. Agarwal, P. (2018). Corporate accounting in practice (1st ed.). Academic Foundation.
8. Sharma, R. K., & Gupta, S. K. (2017). Corporate accounting (5th ed.). Kalyani Publishers.

Web Resource:

1. The Economist9economist.com/topics/corporate-accounting)
2. Accounting Coach(accountingcoach.com)
3. <https://testbook.com/learn/corporate-accounting/>
4. <http://onlinemasters.ohio.edu/blog/corporate-accounting/>

Journals:

1. The Accounting Review
2. Journal of Accounting and Economics
3. Journal of Accounting Research
4. Accounting, Organizations and Society

THEORY

Total Teaching Hours: 60

No. of Hours per Week: 4

(4 credits)

CObj	Course Objectives
CObj_1	To provide an understanding of statistics to describe, classify and summarize the data in commerce and business.
CObj_2	To provide the knowledge and skills that are required in the application and analysis of descriptive and inferential statistics and interpret the results in the context of business decisions.
CObj_3	To introduce the basic concepts of probability and sampling techniques and its importance in business decisions.

CO	Course Outcomes
	After completion of this course, students should be able to:
CO1	Describe, classify, and summarize the data for commerce and business purposes.
CO2	Apply appropriate descriptive and inferential statistical tools to analyze data and interpret the results.
CO3	Comprehend their understanding and apply probability laws and sampling techniques to solve business problems in appropriate contexts.
CO4	Apprehend the basics of data analysis and forecasting techniques in economics and business decisions.
CO5	Draw statistical inferences and communicate them in quantitative and qualitative terms that aid in decision-making.

	PO_1	PO_2	PO_3	PO_4	PO_5
CO_1	*				
CO_2			*		
CO_3				*	
CO_4					*
CO_5		*			

Course Content

Sl. No.	Unit/chapter title	Content	Number of hours	Skills developed
1	Unit- I Introduction to Statistics	Meaning and Definition – Functions – Scope – Limitations. Collection of data – census, sample and sampling techniques- Probability and Non-Probability sampling - Classification of data, preparation of frequency distribution and tabulation of data (Only Complex table)	05 Hrs	Cognitive Skills
2	Unit- II Descriptive Statistics	Meaning and Definition-Types of averages – Calculation of Arithmetic Mean, Median, Mode (excluding missing frequency and grouping method problems) - Meaning & Definition -Range, Quartile Deviation, Standard Deviation and Coefficient of Variation. Skewness- Meaning, uses, and problems on Karl Pearson's Co-efficient of skewness. (Direct Method only)	20 Hrs	Analytical Skills
3	Unit- III Inferential Statistics	Correlation- Meaning and Definition - Uses – Types – Karl Pearson's coefficient of correlation – probable error, Spearman's Rank Correlation Coefficient. Regression- Meaning- Uses - Regression lines- Regression Equations, Correlation Coefficient through Regression Coefficient.	20 Hrs	Research & Analytical Skills
4	Unit- IV Index Number and Time Series	Index Number: Meaning, simple problems on Laspeyres, Paschel, and Fishers's index number. Time Series: Meaning – Uses – Components of Time Series – Fitting a straight-line trend by the method of least squares and Computation of Trend Values (when $\Sigma X = 0$) including Graphical presentation of trend values – Problems.	10 Hrs	Analytical Skills

5	Unit- V Theory of Probability	Meaning and Importance of Probability- Experiment, Event and types of events, Addition Theory of probability (Simple Problems on addition theorem only)	05 Hrs	Research & Analytical Skills

Books for Reference:

1. Akhilesh K. B. and Balasubrahmanyam S (2008), Mathematics and Statistics for Management, Delhi, Vikas Publishing
2. Gupta S.P. (2014), Statistical Methods, (43rd Ed), New Delhi, Sultan Chand & Sons
3. J K Sharma (2014), Business Statistics, Vikas Publication House.
4. Dorai Raj (2002), Business Mathematics and Statistics, United Publishers.

Web Resource:

1. <https://www.statistics.com/>
2. <https://www.statslab.cam.ac.uk/clinic/resources.html>

Journals:

1. Journal of the American Statistical Association.
2. International Journal of Applied Mathematics and Statistics.
3. Journal of the Royal Statistical Society. (Series C: Applied Statistics).
4. Journal of Advances and Applications in Statistics.

C21DC3.3 E-COMMERCE AND DIGITAL MARKETING

Total Teaching Hours: 60

No. of Hours per Week: 04

(4 credits)

CObj	Course Objectives
CObj_1	To provide an understanding of E-commerce framework including emerging technologies used in various Business Models
CObj_2	To familiarize students` with the knowledge of common ethical and legal issues involved in E-commerce
CObj_3	To provide an exposure to various Digital Marketing tools, theories and frameworks

CO	Course Outcomes
	After completion of this course, students should be able to:
CO1	Be able to understand the basic concepts and technologies used in E-commerce and Business Models.
CO2	Be able to develop and awareness of Ethical, legal and other issues in Ecommerce and their implications on Business
CO3	Demonstrate an understanding of various Digital Marketing tools used in E commerce.
CO4	Demonstrate an understanding of designing various revenue models for efficient E-Business operations.
CO5	Be able to apply various tools and techniques of digital marketing, e payment and other delivery mechanisms necessary to integrate IT Based solutions into the user environment.

CO-PO Mapping

	PO_1	PO_2	PO_3	PO_4	PO_5
CO_1	*				
CO_2	*	*			
CO_3		*			
CO_4	*				
CO_5		*			*

Course Content

Sl. No.	Unit/chapter title	Content	Number of hours	Skills developed
1	Unit- I E-commerce business models and concepts	Introduction to E commerce, difference between traditional and Ecom business models, Architectural framework of Electronic Commerce types - B2C, B2B, C2B C2C, online market place, major players in India in E commerce business.	10 Hrs	Analytical Skills
2	Unit- II Electronic Data Interchange	Meaning and Benefits of EDI, EDI technology, EDI standards, EDI communications, EDI Implementation, EDI Agreements, EDI Security. Electronic Payment Systems, Need of Electronic Payment System: Study and examine the use of Electronic Payment system and the protocols used, Study of Electronic Fund Transfer and secure electronic transaction protocol for credit card payment.	12 Hrs	Cognitive Skills
3	Unit- III Digital marketing	Meaning, and characteristics of digital marketing. Types of digital marketing, SEO, SEM Pay-per-click (PPC), Google ads, you tube marketing, advertising, Content marketing, social media marketing, influencer marketing, organic and inorganic search.	12 Hrs	Employability Skills
4	Unit- IV Ecosystem required for Ecommerce business	Web technologies – global publishing concept, hypertext, URLs, HTTPD, Servers, HTML, HTML Forms & CGI gateway services, Web system architecture, http, sttp, ftp, tele net, internet, hardware's & software's, cloud systems and services , e-payment types, logistics, Types of e-payment System; E-cash & currency servers, e-cheques, credit cards, smart cards, electronic purses & debit cards	15 Hrs	Evaluation Skills

5	Unit- V Cyber laws	Security risks of e-commerce, type of threats, sources of threats, security tools & risk Importance of cyber laws, types of Cyber Crimes, Information Technology Act, 2000, Important features of IT Act Understanding Ethical, Social and Political issues in E-Commerce	11 Hrs	Evaluation/ Synthesis Skills

Books for Reference:

1. Shivasharana, & Reddy, D. N. (2013). Ecommerce. Himalaya Publishing House.
2. Kingsnorth, S. (2016). Digital marketing strategy: An integrated approach to online marketing. Kogan Page Publishers.
3. Myneni, S. R. (2016). Information technology law (cyber laws). Asia Law House.
4. Oturkar, S. (2015). Ebusiness. Everest Publishing House.
5. Awad, E. M. (n.d.). Electronic commerce. Prentice-Hall of India Pvt. Ltd.
6. Kalakota, R., & Whinston, A. B. (n.d.). Electronic commerce: A manager's guide. Addison-Wesley.
7. Turban, E., Lee, J., King, D., & Chung, H. M. (n.d.). Electronic commerce: A managerial perspective. Addison-Wesley.
8. Awad, E. M. (n.d.). Electronic commerce from vision to fulfillment (3rd ed.). PHI.

Web Resource:

1. <https://www.investopedia.com/terms/b/business-ecosystem.asp>
2. www.marketo.com
3. www.vikaspedia.in

Journals:

1. Journal of Electronic Commerce Research
2. Journal of Business Research International
3. Journal of Electronic Commerce
4. Journal of Internet Commerce
5. Journal of Digital & Social Media Marketing
6. Journal of Advertising

21SBC 3 .1: DIGITAL FLUENCY II

(ARTIFICIAL INTELLIGENCE-IOT-CLOUD COMPUTING-CYBER SECURITY)

Theory

Total Teaching Hours: 30

No. Of Hours Per Week: 2

(2 Credits)

CObj	Course Objectives
CObj_1	To provide a basic understanding of Artificial Intelligence and its importance in today's world.
CObj_2	To provide an understanding of cyber security and its importance in protecting internet-connected systems against malicious cyber-attacks.
CObj_3	To provide a basic understanding of cloud computing and other related services over networks.

CO	Course Outcomes After completion of this course, students should be able to:
CO1	Demonstrate an understanding of machine languages and learning such as visual perception in decision making.
CO2	To develop a thorough knowledge of cyber security and apply appropriate tools and techniques to protect systems, networks, programs, worms and malicious cyber-attacks.
CO3	Apply and familiarize with services such as Dropbox, resource pooling, using the storage facilities, etc.
CO4	Demonstrate an understanding of IoT, create information about the connected objects, analyse it and make decisions.
CO5	Interpret and apply strong data storage and privacy of data in storage and transit.

CO-PO Mapping:

	PO_1	PO_2	PO_3	PO_4	PO_5
CO_1	*				
CO_2					
CO_3		*	*		*
CO_4			*		
CO_5				*	

Course Content

Sl. No.	Unit/chapter title	Content	Number of hours	Skills developed
1	Unit- I Artificial Intelligence	Overview of Artificial Intelligence-meaning-definition-concept of AI-scope of AI. Application of Artificial Intelligence- How AI and machine learning are used in Business – Examples of AI in Business. AI in E-Commerce. Advantages and limitations of using AI in business. Meaning of machine learning-deep learning.	10 Hrs	Transferable/ Application/ Logical Skills
2	Unit- II Internet of Things (IoT)	Introduction-meaning and definition of IoT, IoT devices and examples. Features of IoT, Technologies of IoT, Advantages and disadvantages of using IoT. Major components of IoT, Trusted IoT development companies in India. Applications of IoT.	8 Hrs	Technological/ Analytical Skills
3	Unit- III Cloud Computing	Introduction, Meaning & definition of cloud computing. Characteristics of Cloud computing. Models of cloud computing. Cloud computing applications. Advantages & disadvantages of cloud computing.	7 Hrs	Application/ Technological/ Analytical Skills
4	Unit- IV Cyber Security	Introduction- Meaning & importance of cyber security. key concepts of cyber security. Types of cyber security.	5 Hrs	Cognitive/ logical/ Analytical Skills

Books for Reference:

1. Saha, K., Kantesha, A., & Asif. (2021). Digital fluency (1st ed.). Himalaya Publishing House.
2. Russell, S., & Norvig, P. (2010). Artificial intelligence: A modern approach (3rd ed.). Prentice Hall.
3. Erickson, J. (2008). Hacking: The art of exploitation (2nd ed.). Pearson Education.
4. Wang, R., Ranjan, R., & Chen, D. (2017). Cloud computing (1st ed.). CRC Press.

Web Resource:

1. Coursera - AI for Everyone by Andrew Ng
2. IBM AI Solutions
3. IoT For All
4. Internet of Things Consortium
5. AWS Cloud Computing

C21OE 3.1: MANAGING PERSONAL FINANCE

Total Teaching Hours: 45

No. of Hours per Week: 3

3 credits

CObj	Course Objectives
CObj_1	To Provide an understanding of basic principles of investments, its importance in managing personal finance.
CObj_2	To Provide the knowledge and skills that are required in financial planning and decision making.
CObj_3	To Provide an understanding on various options available for Investing, Creating and Managing personal portfolios.

CO	Course Outcomes
	After completing the course students must be able to:
CO1	Compare and evaluate various options available for investments in terms of their risk and returns.
CO2	Develop appropriate financial decisions in terms of planning personnel budgets, retirement, real estate and insurance plans.
CO3	Apply financial principles to demonstrate practical decision making and understand, manage and plan for personnel saving, expenditure and tax planning.
CO4	Analyze basic economic information in terms of various types of borrowings and examine the risk associated with them
CO5	Plan for the retirement and creating provisions to meet personal contingencies, such as health and other risks.

CO-PO Mapping

	PO1	PO2	PO3	PO4	PO5
CO1					
CO2	*		*		
CO3				*	
CO4		*			
CO5					*

Sl. No.	Unit/chapter title	Content	Number of hours	Skills developed
1	Unit I Introduction to Personal Finance	Aspects of personal finance, importance of managing personal finance, principles of managing personal finance, objectives, Planning and Budgeting, do's and don'ts of personal finance	8 Hrs	Cognitive Skills
2	Unit II Earnings– Sources of income, core income, creating additional income	Money earned from employment or Business, Dividends, Capital Gains, Rental Income derived from property ownership and profit sharing from businesses.	8 Hrs	Analytical Skills
3	Unit III Spending, Saving & tax planning	Understanding essential and non-essential Expenditure Elizabeth Warren Rule, Savings, Investments. Real estate, Bullion, FDs, Recurring deposits, Mutual Funds types, stocks etc. Tax Deductible Investment Schemes, create an Emergency Fund Procedures to invest in shares, KYC, Mutual Funds and other Avenues.	12 Hrs	Employability Skills
4	Unit IV Investments, Borrowings & Insurance planning	Effect of Inflation and interest rates on personal finance, EMI planning, vehicle loans, Student loans, Importance of diversification, Limit borrowings, home loans. Evaluating various insurance schemes Life, General & Health to hedge risks and create funds, improving credit worthiness, understanding CIBIL scores.	12 Hrs	Research Skills
5	Unit V Retirement Planning	Planning for retirement, Pension plans available in India, Analysis of important pension schemes in India.	5 Hrs	Evaluation/ Analytical Skills

Books Reference:

1. Subramanyam, P. V. (2019). Retire rich (350 pages). TV18 Broadcast Ltd.
2. Halanis, M. (2018). Let's talk money (204 pages). Harper Business.
3. Chauhan, M. (2014). How to be your own financial planner in 10 steps (236 pages). Network 18 Publications.
4. Suneja, A. (2021). Casual finance – A millennial's guide to personal finance (108 pages). Evince Publisher.

Web Resources:

1. www.learnvest.com
2. www.thebirdy.com
3. www.dailyworth.com

Journals:

1. Journal of Financial Planning
2. Journal of Personal Finance
3. Financial Planning Review
4. Personal Finance & Investor Education
5. Journal of Consumer Affairs

Total Teaching Hours:
60 No. of Hours per
Week:04 [4 Credits]

CObj	Course Objectives
CObj_1	To provide an understanding of the key elements of financial statements, importance, and types of analysis of financial statements.
CObj_2	To provide different Tools and Techniques used for analysis and evaluation of financial statements of listed Companies, predict corporate bankruptcy and prepare reports for decision making.
CObj_3	To familiarize students with various models for assessing credit risk, cash flow statements, off-balance sheet analysis and reporting for business decisions.

CO_ID	Course Outcomes
	After completion of the course students should be able to
CO1	Demonstrate their understanding on various items of financial statements, their importance and types of analysis used in evaluating financial performance of a company.
CO2	Apply, interpret, and analyze the published financial statements, in various decision- making contexts using common size statement analysis, trend analysis, ratio analysis, Du-pont analysis and be able to communicate the results to appropriate authorities.
CO3	Prepare and interpret segmental analysis and inter-firm comparisons through application of appropriate ratios and clearly interpret the result.
CO4	Apply various models such as Altman Z score, credit risk assessment models and predict probable corporate bankruptcy and report the same for further decision making.
CO5	Interpret annual reports and accompany notes in addition to management discussion and analysis to assess the financial performance and efficiency of operations of a company.

	PO_1	PO_2	PO_3	PO_4	PO_5
CO_1	*				
CO_2	*	*			
CO_3		*			
CO_4	*				
CO_5		*			*

Course Content

Sl. No	Unit/chapter title	Content	Number of Hours	Skills Developed
1	Unit- I Introduction to Financial Statement & Analysis	Introduction, Meaning, Definition, Objectives, Types of Financial, Statements and Users of Financial Statements: Internal & External, Limitations of Financial Statements, Basics of Income Statement & Statement of Financial Position, Methods in financial Analysis, Comparative Statement, Common size Statement and Trend Analysis.	14 Hrs	Transferrable Skills
2	Unit- II Ratio Analysis	Ratio Analysis: Introduction, Meaning, Objectives – Types, Problems on calculating Ratios - Preparation of financial statements with the help of Accounting Ratios- DuPont and Altman Z Score Analysis.	14 Hrs	Cognitive Skills
3	Unit- III Cash Flow Statement Analysis	Cash Flow Statement: Meaning-Definition, Concept of Cash Cash Equivalents-Uses-Limitations–Provisions of AS-3 – Procedure of Cash Flow Statement Cash Flow from Operating Activities – Cash Flow from Investing Activities and Cash Flow from Financing Activities (Only Analysis)	12 Hrs	Employability Skills
4	Unit- IV Credit Risk Analysis And Off Balance Sheet	Credit risk analysis- meaning- Types of credit risk: concentration risk- Institutional risk, commercial credit analysis- Assessing Credit risk- purpose of credit analysis, Probability of Default- Credit Analysis process- Credit Analyst role-credit rating analysis. Off Balance Sheet- Meaning- Benefits- Balance Sheet items- Lease and Buy back agreement.	12 Hrs	Analytical Skills
5	Unit- V Management Reporting	Meaning of Management Reporting – Requisites of a Good Reporting System – Principles of Good Reporting System – Kinds of Reports – Drafting of Reports under different Situations.	8 Hrs	Evaluation/ Analytical Skills

Books for Reference:

1. Helfert, E. A. (1992). *Techniques of financial analysis*. Tata McGraw Hill.
2. Chandra, P. (2017). *Financial management*. McGraw-Hill.
3. Pandey, I. M. (2016). *Financial management*. Vikas Publications.
4. Maheshwari, S. N. (2016). *Management accounting*. Vikas Publishing.
5. Bhat, S. (2016). *Management accounting*. Excel Books.

Web Resources:

1. Icai.bos
2. Google.com

Journals:

1. Journal of Financial Statement Analysis
2. Financial Analysts Journal
3. International Journal of Accounting and Finance
4. The Journal of Accounting, Auditing, and Finance (JAAF)
5. Journal of Business Finance and Accounting.

No. of Hours per Week:04

[4 Credits]

CObj	Course Objectives
CObj_1	To develop conceptual understanding of financial management, objective, functions, goals and structure of organization
CObj_2	To provide in depth knowledge of capital structure, investment and dividend decision and familiarize with the required tools to evaluate the same.
CObj_3	To provide an understanding of working capital management, analytical skills to compute the working capital requirements of an organization.
CObj_1	To develop conceptual understanding of financial management, objective, functions, goals and structure of organization

CO	Course Outcomes
	After completion of the course students should be able to
CO 1	To be able to demonstrate the conceptual understanding of capital structure and analyze its impact on earnings of the company
CO 2	Be able to identify various source of short-term finance and apply different techniques in managing working capital requirements.
CO 3	Be able to demonstrate their understanding on dividends decisions and its impact on earning of their company
CO 4	Be able to evaluate the different methods of working capital management
CO 5	Be able to compare and contrast different valuation methods and strategies for corporate restructuring of the organization

CO-PO Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5
CO 1	*				*
CO 2		*	*		
CO 3		*		*	*
CO 4	*		*		
CO 5				*	*

Course Content

Sl. No.	Unit/chapter title	Content	Number of hours	Skills developed
1	Unit I Introduction	Financial Management - Meaning, Objectives, Functions and Goals of Financial Management Capital Structure – Factors influencing Capital Structure – Optimum Capital Structure – Theories of Capital Structure -Net Income, Net Operating Income, Computation and Analysis of EBIT, EBT, and EPS. Operating and Financial Leverage. Simple Problems.	14 Hrs	Analytical Skills
2	Unit II Financing Decision	Cost of Capital and Financing Decision, Sources of long-term financing, components of cost of capital. Methods for Calculating cost of equity capital, Cost of Retained Earnings, Cost of Debt and Cost of Preference Capital, Weighted Average cost of capital WACC and Marginal cost of capital.	10 Hrs	Cognitive Skills
3	Unit III Investment Decision	Time value of money - Meaning& Definition Need – Future Value-Single Flow – Uneven Flow & Annuity. Present Value -Single Flow Uneven Flow & Annuity. Doubling Period–Rule of 69, Concept of Valuation: Valuation of Bonds, Debentures and shares - Simple Problems. The Capital Budgeting Process - Payback Period Method, Accounting Rate of Return, Net Present Value NPV, Internal Rate of Return IRR Profitability Index-Simple Problems.	16 Hrs	Evaluation Skills
4	Unit IV Working Capital Decisions	Concepts of working capital, the risk-return trade off, Sources of short-term finance, Computation of working capital- simple problems, policies of working capital, cash management-theory, inventory management, EOQ – Problems.	8 Hrs	Analytical Skills
5	Unit V Dividend Decisions	Dividend Decisions Meaning and Definition of Dividend- Factors determining dividend policy- Types of Dividends-Dividend policies in practice, Dividend theories – Relevance and Irrelevance theory, Modigliani and	8 Hrs	Analytical Skills

		Miller theory.		

Books for Reference:

1. Van Horne, J. C., & Dhamija, S. 2011. Financial management and policy. Pearson Education.
2. Levy, H., & Sarnat, M. 1988. Principles of financial management. Pearson Education.
3. Joy, O. M. 1980. Introduction to financial management. McGraw Hill Education.
4. Brigham, E. F., & Houston, J. F. 2005. Fundamentals of financial management. Cengage Learning.
5. Khan, M. Y., & Jain, P. K. 2017. Basic financial management. McGraw Hill Education.
6. Chandra, P. 2017. Fundamentals of financial management. McGraw Hill Education.
7. Rustagi, R. P. 2021. Fundamentals of financial management 16th ed.. Taxmann Publication Pvt. Ltd.
8. Pandey, I. M. 2016. Financial management. Vikas Publications.

Web Resources:

1. www.investopedia.com
2. www.khanacademy.org
3. www.corporatefinanceinstitute.com

Journals:

1. Journal of Financial Management
2. Financial Management FM
3. The Journal of Finance
4. Journal of Corporate Finance
5. Review of Financial Studies

C21DC 4.3 – FINANCIAL SYSTEMS AND SERVICES**Total Teaching Hours: 60****No. of Hours per Week: - 04****(4 credits)**

CObj	Course Objectives
CObj_1	To provide an understanding of various products & services offered by banks and financial institutions
CObj_2	To create an awareness of regulatory frameworks with reference to financial sector in India
CObj_3	To provide an understanding of capital market operations in India

CO	Course Outcomes
	After completion of this course, students should be able to:
CO1	Demonstrate an understanding of the dynamics and framework within which the financial institutions operate in India.
CO2	Recognize the importance and functions of regulatory framework with reference to financial institutions in India.
CO3	Demonstrate an understanding of capital markets and their operations in the Indian context.
CO4	Compare and contrast various financial services available in Indian Financial System.
CO5	Appreciate the role played by technology in financial systems and services in India.

CO-PO Mapping

	PO_1	PO_2	PO_3	PO_4	PO_5
CO_1	*		*		
CO_2		*			
CO_3					
CO_4			*		
CO_5			*		*

Course Content

Sl. No.	Unit/Chapter Title	Content	Number of Hours	Skills developed
1	Unit-I Introduction	Nature and Functions of Financial Systems, Role played by Financial Systems and Services in economic development, Financial Inclusion and Economic Growth.	08 Hrs	Cognitive Skills
2	Unit-II Participants in FS&S	Financial Institutions, Intermediaries, Stock, Commodity and Currency Exchanges, Primary and Secondary markets for equity and debt, Capital Market, Money Market, Rating Agencies, Leasing Companies - Housing Finance Institutions - Asset Reconstruction Companies.	12 Hrs	Research Skills
3	Unit-III Financial Products and Services	Financial Instruments, Venture capital funds, types of loans, Fintech companies, Microfinance companies, Fund based and non-fund based activities, Concept of Cashless Economy, Tele-banking, Mutual funds, E-banking, Rupay, Paytm, BHIM app.	14 Hrs	Employability Skills
4	Unit-IV Regulatory Bodies for FSS	RBI, SEBI, IRDA, PFRDA, AMFI, MCA - important functions and structure of these organizations.	12 Hrs	Evaluation/ Synthesis Skills
5	Unit-V Analysis of Financial Institutions in India	Analysis of Top companies in various financial sectors based on Revenue, market capitalization, profits and number of employees. Five financial sectors for analysis - Banking, Insurance, Mutual Funds, NBFC, gold loan companies.	14 Hrs	Analytical Skills

Books for Reference:

1. M Y Khan, “Financial Services”, TMH, 7th edition
2. Ravi M. Kishore, “Financial Management”, Taxmann S, 6th edition
3. Bhole. L.M. and Jitendra Mahakud “Financial Institutions & Markets - Structure, Growth & Innovations”, TMH 5th edition
4. Anthony Saunders & Marcia Millon Cornett, “Financial Markets & Institutions”, TMH
5. E Gardon & K Natarajan: Financial Markets & Services, HPH, 7th Edition, Mumbai
6. Vasant Desai: Financial Markets & Financial Services, Himalaya Publishing House, 1st Edition, Mumbai
7. V. A. Avashani: Financial Services in India, 2009, HPH, 1st Edition

Web Resources:

1. www.intechnic.com
2. www.corporatefinanceinstitute.com
3. www.financialservices.gov.in

Journals:

1. International Journal of Financial Services Management
2. The International Journal of Financial Systems

C21OE4.1: BUSINESS ENTREPRENEURSHIP (OPEN ELECTIVE)**Total Teaching Hours: 45****No. of Hours per Week: 3****(3 credits)**

CObj	Course Objectives
CObj_1	To provide basic knowledge & skills required to encourage entrepreneurial success in a variety of settings and explain concepts of entrepreneurship in situations in which entrepreneurs act.
CObj_2	To familiarize students with various concepts used in understanding processes involved in entrepreneurship and business formation and to develop a positive attitude towards starting up new business ventures.
CObj_3	To provide an understanding of startups and the stage of the entrepreneurial process, opportunities and the resources needed for the successful development of entrepreneurial ventures and Government initiatives in India.

CO	Course Outcomes
	After completion of this course, students should be able to:
CO1	Identify risks & rewards associated with entrepreneurship and the types of entrepreneurs and the steps involved in an entrepreneurial venture.
CO2	Apply basic knowledge & skills required in starting a venture, running startups, planning & executing new and creative startups including the marketing strategies.
CO3	Identify key factors and apply the entrepreneurial process, command and control, calculated risk-taking and opportunity recognition for business development and tackle the Financial Issues of Startups.
CO4	Demonstrate their understanding of the legal and financial conditions for starting a business venture, and Government Initiatives for Startups in India.
CO5	Develop their personal creativity and entrepreneurial initiative and take up Entrepreneurship as a Profession.

CO-PO Mapping

	PO_1	PO_2	PO_3	PO_4	PO_5
CO_1		*			*
CO_2		*	*		*
CO_3		*			*
CO_4			*		*
CO_5				*	*

Course Content

Sl. No.	Unit/Chapter Title	Content	Number of Hours	Skills developed
1	Unit- I Fundamentals of Entrepreneurship	Introduction – Conceptual understanding of Entrepreneurship, – Functions of Entrepreneur - Pros and Cons of being an entrepreneur – Qualities of an Entrepreneur – Types of Entrepreneurs-Women Entrepreneurs, Agro- Entrepreneurs, Business Entrepreneurs, Social Entrepreneurs, Technopreneurship	10 Hrs	Employability Skills
2	Unit- II Preparing the Business Plan	Meaning – importance – basics of preparing Business Plan (BP) –BP format: Various dimensions of a Business Plan, Financial aspects of BP, Marketing aspects of BP, Human Resource aspects of BP, Technical aspects of BP, Social aspects of BP. Common pitfalls to be avoided in preparation of a BP.	12 Hrs	Entrepreneurship Skills
3	Unit- III Startups and its Financial Issues	Introduction- Meaning – Features – Ideation – Design Thinking, 3 Pillars to Initiate startup-Handholding, Funding & Incubation. Startup Financial issues: Feasibility Analysis - The cost & Process of Raising capital – Unique Funding issues of a High tech Ventures –Funding with equity – Financing with debt – Funding strategies with bootstrapping – Crowd funding – Venture Capital- Creativity & innovation in India.	12 Hrs	Managerial Skills
4	Unit- IV Government initiatives for startups in India	Government Initiatives – Startup India Initiative, Seed Fund – ASPIRE – SAMRIDDHI Scheme –Mudra Scheme -Sishu, Kishore & Tarun – ATAL Innovation Mission. MSME Multiplier Grants Scheme-Credit Guarantee Fund Trust for micro & small business – Software Technology Park – Venture	11 Hrs	Transferrable Skills

		Capital Assistance Scheme. Single Point Registration scheme – M-SIPS – Self Employment & Talent Utilization (SETU)		

Books for Reference:

1. Agarwal, P. (2015). Entrepreneurship development and small business enterprises. Tata McGraw-Hill.
2. Bansal, S., & Gupta, R. (2018). Entrepreneurship: A global perspective. Pearson Education India.
3. Bhattacharyya, S. K. (2013). Entrepreneurship development and management. Excel Books.
4. Chandra, P. (2014). Entrepreneurship development: A strategic approach. Tata McGraw-Hill.
5. Desai, V. (2013). Entrepreneurship and small business management in India. Himalaya Publishing House.
6. Dewan, P. (2012). Entrepreneurship and innovation: A managerial approach. Global India Publications.
7. Dixit, R. (2016). Entrepreneurship and business development. S. Chand Publishing.
8. Gupta, C. B., & Srinivasan, R. (2014). Entrepreneurship development. Sultan Chand & Sons.

Web Resource:

1. <https://www.econlib.org/library/Enc/Entrepreneurship.html>
2. <https://corporatefinanceinstitute.com/resources/knowledge/strategy>
3. [make-or-buy-decision/>https://www.wallstreetmojo.com/cash-budget/>](https://www.wallstreetmojo.com/cash-budget/)

Journals:

1. Journal of Management Development
2. AMC Indian Journal of Entrepreneurship
3. Journal of World Business
4. Journal of International Business Studies
5. Journal of International Management

C21 DC 5.1 – ENTREPRENEURSHIP DEVELOPMENT AND SMALL BUSINESS MANAGEMENT**Total Teaching Hours: 60****No. of Hours per Week: - 04****(4 credits)**

CObj	Course Objectives
CObj_1	To provide understanding of the basic concepts of entrepreneurship and small business enterprise.
CObj_2	Knowledge about the functions on entrepreneurial activities and their prerequisites under practical conditions.
CObj_3	An understanding of the value of mentorship and the success of an entrepreneur and their ventures.

CO	Course Outcomes
	After completion of this course, students should be able to:
CO1	Develop awareness about entrepreneurship and successful entrepreneurs.
CO2	Summarize the creative problem-solving technique and types of innovation.
CO3	Build their competence to identify the different sources of finance available for start-ups and relate their role in different stages of business.
CO4	Explore the entrepreneurial skills and management function of a company with special reference to SME sector.
CO5	Develop and entrepreneurial mindset by learning key skills and to explore marketing methods and new trends in entrepreneurship.

CO-PO Mapping

	PO_1	PO_2	PO_3	PO_4	PO_5
CO_1			*		*
CO_2				*	*
CO_3					*
CO_4		*		*	*
CO_5		*	*		

Sl. No.	Unit/chapter title	Content	Number of hours	Skills developed
1	Unit-I Introduction	Introduction to entrepreneur, concept of entrepreneur, entrepreneurial, characteristics, types of entrepreneurs. New venture creation - creativity and innovation, entrepreneurial orientation, challenges of small business growth, small business failures.	12 Hrs	Employable skills
2	Unit-II Entrepreneurship development skills	Meaning, types of entrepreneurship skills, importance of small and medium enterprises - small and large business, SME's and economic development, branding, marketing and networking skills, entrepreneurial imagination and creativity, steps in creating inventions and innovations, idea generation.	14 Hrs	Analytical/ Creative thinking/Entrepreneurship Skills
3	Unit-III Small and medium entrepreneurship (SME)	Concepts and definitions, role of SME's in Indian economy, rural entrepreneurship, women entrepreneurship, employment and export opportunities in MSME's. Issues and challenges of MSME's, and its policy in India.	12 Hrs	Logical/Entrepreneurship Analytical Skills
4	Unit-IV Small business finance	Concept of small business finance forms of SME's, venture capital, crowd financing, financial bootstrapping, business angel funding for startups. Financial support, long term and short term, role of financial institutions - SIDBI, DST, SIDCO	12 Hrs	Analytical Skills
5	Unit-V Business plan	Meaning, importance, preparation of business plan - creating a good business plan / how to create a business plan, business models-business model canvas, forecasting and proforma of financial statements and marketing aspects, HR aspects, technical and social aspects of business plan, common pitfalls to be avoided for the	10 Hrs	Cognitive / Communication/ Presentation Skills

**Course
Content**

		preparation of business plan.		

Books References:

1. Poornima, M. (2016). Entrepreneurship development and small business enterprise. Pearson Education.
2. Desai, V. (2017). Dynamics of entrepreneurial development & management. Himalaya Publishing House.
3. Dollinger, M. J. (2016). Entrepreneurship: Strategies and resources. Pearson Education.
4. Kumar, S. (2015). Small business and entrepreneurship. I. K. International Pvt Ltd.
5. Rekha, & Vibha. (2014). Entrepreneurship development. Vision Book House.
6. Sharma, S. (2016). Developing entrepreneurship. PHI Learning Private Limited.

Web Resources:

1. <https://www.pasc.edu.in/wp-content/uploads/2021/04/ENTREPRENEURSHIP-DEVELOPMENT-III-BBA.pdf>
2. [https://www.iare.ac.in/sites/default/files/lecture_notes/IARE Entrepreneurial Development NOTES.pdf](https://www.iare.ac.in/sites/default/files/lecture_notes/IARE_Entrepreneurial_Development_NOTES.pdf)
3. <http://www.startupindia.gov.in/>
4. [http://startup.karnataka.gov.in/docs/Startup Policy Karnataka.pdf](http://startup.karnataka.gov.in/docs/Startup_Policy_Karnataka.pdf)

Journals:

1. Entrepreneurship Development
2. Journal of Developmental Entrepreneurship
3. Journal of Entrepreneurship Development
4. Journal of Entrepreneurship

C21DC5.2 MANAGEMENT ACCOUNTING

Total Teaching Hours: 60

No. of Hours per Week: - 04

(04 credits)

Cobj	Course Objectives
CObj_1	A rational and critical approach to current Management Accounting practices.
CObj_2	Management Accounting techniques in the areas of planning, control, and decision-making.
CObj_3	An understanding of the use, interpretation, and analyze Management Accounting information, while critically appraising the use of such information.

CO	Course Outcomes
	After completion of this course, students should be able to:
CO1	Assess the impact of an accounting control system within organizations.
CO2	Demonstrate an understanding of the role of management accounting in planning and decision making.
CO3	Apply relevant quantitative and qualitative information requirements and appropriate techniques for decision-making in various scenarios.
CO4	Examine, analyze and interpret the data for planning and cost control using Budgeting, CVP, and other techniques.
CO5	Understand the various recent trends, emerging areas, and contemporary issues in Management Accounting.

CO-PO Mapping

	PO_1	PO_2	PO_3	PO_4	PO_5
CO_1		*			
CO_2			*		
CO_3		*		*	*
CO_4		*	*		
CO_5	*	*			

Course Content

Sl. No.	Unit/Chapter title	Content	Number of Hours	Skills Developed
1	Unit-I Management Accounting in Global Business Environment	Introduction to Management Accounting: Definition – Objectives – Nature and Scope– Role of Management Accountant – Relationship between Financial Accounting, Cost Accounting and Management Accounting, the role of management: Planning, Implementing & Control.	08 Hrs	Cognitive Skills
2	Unit-II Decision-Making Techniques	CVP Analysis: Meaning, Procedure, practical application, limitation of CVP, CVP analysis with change in selling price, numerical problems Marginal Costing: Meaning, Definition, Features, Argument in favor of marginal costing, Criticism against marginal costing, numerical problems Differential Cost Analysis: Meaning, Characteristics, Differential cost analysis, Marginal costing vs Differential Costing, numerical problems	12 Hrs	Analytical/Logical Skills
3	Unit-III Decisions involving Alternative Choices	Relevant Costs for Decision Making: Meaning, features, Analysis of relevant cost, numerical problems, Pricing Decisions, Make or Buy decisions, consideration in make or buy decisions, Accept or Reject new orders, Shutdown or continue, numerical problems, Qualitative factors to be considered.	16 Hrs	Analytical/Decision-Making Skills

4	Unit IV Forecasting, Budgeting & Budgetary Control	Introduction: Meaning & Definition of Budget and Budgetary Control – Objectives of Budgetary Control – essential requirements of budgetary control – advantages and disadvantages of budgetary control, General principles in the Budgetary process, Types of Budgets -. Numerical problems on Flexible budgets and cash budgets.	14 Hrs	Cognitive/ Analytical Skills
5	Unit-V Emerging Trends in Management Accounting	Theory of Constraints, Balanced Scorecard, Drawbacks of traditional financial measures, Attributes of the good performance measurement system, concepts of BSC, Four Perspectives of BSC, and how to implement BSC. Business Process Reengineering: Meaning Definition, BPR Methodology. Total Quality Management: Meaning, Core concepts of TQM, Benefits. The Value Chain Management: Meaning VCM architecture, Methodology, Advantages.	10 Hrs	Transferable/ Research Skills

Books for Reference:

1. Drury, Colin, (2015) Management & Cost Accounting, 9th Edition, Thompson Books
2. Horngren, C.T, Sundem G.L., Stratton W.O, (2013) Introduction to Management Accounting, 16th Edition, Pearson Education
3. Kishore, R. M, (2021) Management Accounting & Financial Analysis 6th edition, Taxman Allied Services.
4. Khan, M. Y & Jain, P.K (2017) Management Accounting Text, Problems & Cases 7th edition, Tata McGraw Hill.
5. Kulkarni M.A, (2014) Management Accounting, 2nd edition, career

Web Resources:

1. <https://khatabook.com/blog/management-accounting/>
2. <https://www.iedunote.com/management-accounting>
3. <https://corporatefinanceinstitute.com/resources/accounting/managerial-accounting/>

Journals:

1. The Management Accountant journal January 1966
2. The Management Accountants 2024

C21 DC 5.3: Income Tax Law & Practice - I

THEORY

Total Teaching Hours: 60

No. of Hours per Week: - 4

(4 credits)

CObj	Course Objectives
CObj_1	Provide students to gain knowledge about the provisions of Indian Income Tax Act, 1961.
CObj_2	Familiarize students about Powers and Functions of Central Board of Direct taxes.
CObj_3	Provide an understanding of deductions under the Head Salary U/S 16 and House Property U/S 24.

CO	Course Outcomes
	After completion of this course, students should be able to:
CO1	After completion of the course, the students will have a complete understanding of rules to gross up the securities.
CO2	Understand the provisions relating to the heads Income of salary, house property and other sources incomes.

CO3	Demonstrate their understanding in terms for computing Residential Status of an Individual.
CO4	Enable them to understand various exemptions U/S 10 of Income Tax Act, 1961.
CO5	Develop the understanding of TDS rate for calculating casual incomes and Interest on securities.

CO-PO Mapping

	PO_1	PO_2	PO_3	PO_4	PO_5
CO_1	*				
CO_2		*		*	*
CO_3			*		*
CO_4		*			*
CO_5			*		

Course Content

Sl. No.	Unit/chapter title	Content	Number of hours	Skills developed
1	Unit-I Introduction to income tax	Introduction to the income tax act, 1961. Definitions: Person, assessee, assessment year, previous year, exceptions to previous year, rates of tax, exempted incomes u/s 10 income tax act, 1961.	08 Hrs	Logical/ Analytical Skills
2	Unit-II Residential status	Residential status of an individual assessee – determination of residential status – incidence of tax (numerical problems).	12 Hrs	Analytical Skills
3	Unit-III Income from salary	Scope of changeability, allowances, perquisites, provident fund, gratuity, commuted pension, leaves salary, deductions from salary u/s 16 (numerical problem).	18 Hrs	Analytical Skills
4	Unit-IV Income from house property	Basis of charge – deemed owners – exempted incomes from house property – composite rent - annual value – determination of annual value – treatment of unrealized rent – loss due to vacancy – deductions from annual value – problems on income from house property. (numerical problems)	12 Hrs	Cognitive Skills

5	Unit-V Income from other sources	Incomes – taxable under the head other sources – securities – kinds of securities – rules for Grossing up – ex-interest securities – cum-interest securities – bond washing transactions (numerical problems)	10 Hrs	Analytical Skills

Books for Reference:

1. Dr. Vinod K.Singhania, 2022-23, Direct Taxes – Law and Practice, Taxmann publication.
- 2.B.B. Lal: Direct Taxes,2023-24 Konark Publisher (P) ltd.
3. Dr.Mehrotra and Dr. Goyal 2023-24Direct Taxes – Law and Practice,SahityaBhavan Publication.-
4. Dinakar Pagare 2022-23 Law and Practice of Income Tax, Sultan Chand and sons.
- 5.Gaur & Narang: Income Tax.
- 6.7 Lectures 2022-23 Income Tax – I, VBH
7. Dr.V.Rajesh Kumar and Dr.R.K.Sreekantha 2022-23 Income Tax – I, Vittam Publications.

Web Resource:

1. <https://www.incometax.gov.in>
2. <https://incometaxindiaefiling.gov.in>
3. <https://icmai.in>
4. <https://www.taxnotes.com>

Journals:

1. <https://www.forbes.com>
2. <https://www.taxmann.com/bookstore/product/2967-journal-taxman-the-tax-law-weekly>

C21DCA5.4 (ACCOUNTS ELECTIVE) - COST MANAGEMENT

Total Teaching Hours:

No. of Hours per Week: - 04

[04 credits)

CObj	Course Objectives
CObj_1	Skills relevant to cost management techniques in the areas of planning, controlling, and decision-making.
CObj_2	Information to use, interpret and analyze the cost reduction techniques, while critically appraising the use of such information.
CObj_3	Awareness of the recent trends in the field of cost.

CO	Course Outcomes
	After completion of this module, students should be able to
CO1	Understand some of the important techniques of costing methods applicable to services and the construction industry
CO2	Assess the impact of cost management/ cost reduction techniques in profit maximization within the organizations.

CO3	Demonstrate and apply relevant quantitative information requirements and appropriate cost reduction techniques to decision-making scenarios using ABC, Standard Costing, and JIT.
CO4	Analyze and interpret the equilibrium cost of the product using cost-reduction techniques.
CO5	Understand the various recent trends, emerging areas, and contemporary issues in cost management.

CO-PO Mapping

	PO_1	PO_2	PO_3	PO_4	PO_5
CO_1		*			
CO_2			*		
CO_3		*		*	
CO_4		*	*		
CO_5	*	*			

Course Content

Sl. No.	Unit/Chapter title	Content	Number of Hours	Skills Developed
1	Unit-I Contract costing	Meaning, features of contract costing, Applications of contract costing, similarities and dissimilarities between job and contract costing, the procedure of contract costing, profit on incomplete contracts, and Numerical Problems.	08 Hrs	Cognitive Skills
2	Unit-II Operating costing	Introduction, Meaning and application of Operating Costing, - Powerhouse, costing or boiler house costing, canteen or hotel costing, hospital costing (Theory only), and Transport Costing – numerical Problems on Transport costing.	12 Hrs	Analytical/ Logical Skills
3	Unit-III Standard costing	Introduction – Meaning & Definition of Standard Cost and Standard Costing - Advantages & Disadvantages of Standard Costing –preliminaries in establishing a system of standard costing – Variance Analysis – Material Variance, Labor	16 Hrs	Analytical/ Decision-Making Skills

		Variance and Overheads Variance – Numerical Problems on Material Variances and Labor Variances.		
4	Unit-IV Activity-based costing	Introduction - Weakness of conventional system – the concept of ABC – Kaplan and Cooper’s Approach – cost drivers and cost pools – allocation of overheads under ABC – Characteristics of ABC – Steps in the implementation of ABC – Benefits from an adaptation of ABC system – difficulties faced by the industries in the successful implementation of ABC – Numerical Problems on ABC.	14 Hrs	Cognitive/Analytical Skills
5	Unit-V Emerging trends in cost management	Strategic Cost Management JIT, Benchmarking, Target Costing, Kaizen Costing, Product life cycle costing	10 Hrs	Cognitive Skills

Books for Reference:

1. Srikanth M Datar and Madhav V (2017) Horngren’s Cost Accounting, 16th edition, Pearson publisher
2. Ravi Chawacharia, Yash doctor (2022), Cost & Management Accounting, 3rd Edition, taxman publisher.
3. Kalpesh Ashar (2019) Cost Accounting and Management Essentials. 4th Edition, Vibrant Publisher.
4. M.N Arora, Priyanka Katyal, (2021) Cost Accounting 12th Edition, Vikas Publishing House Private Limited
5. M.C Shukla, T.S Grewal & Dr. M.P Gupta (2007) Cost Accounting, S Chand & Company Pvt. Ltd. ISO 9001 2008

Web Resources:

1. <https://store.tax.thomsonreuters.com/accounting/Finance/Cost-Management/p/100238087>
2. <https://www.iedunote.com/cost-accounting>
3. <https://www.wallstreetmojo.com/cost-management/>

Journals:

1. Journal of Cost Management 1987-2023.

2. Journal of Cost Management, Volume 17, Warren, Gorham & Lamont, 2003

C21DCF 5.4(FINANCE ELECTIVE): SECURITY ANALYSIS AND PORTFOLIO MANAGEMENT

Total Teaching Hours: 45

No. of Hours per week: 3

(3 credits)

CObj	Course Objectives
CObj_1	Develop an understanding of the nature and significance of security analysis and portfolio management.
CObj_2	Expose students to contemporary approaches to security analysis and portfolio management.
CObj_3	Enable students to evaluate the risk and return associated with investments and select the right mix to construct optimal portfolios.

CO	Course Outcomes After completion of this course, students should be able to:
CO1	Demonstrate an understanding of relevant theories, concepts and frameworks of investment management, stock trading mechanics and asset allocation that will equip students with skills of analysis, evaluation and synthesis to develop various investment decisions.
CO2	Apply and analyze bond valuation models and predict the present value of various types of bonds.
CO3	Apply and examine the relevant concepts and models to analyze the historical behavior of various stocks in the market and investigate the risk-return profile of individual securities.
CO4	Compare the intrinsic value of securities with that of the market value for taking investment decisions.
CO5	Evaluate the risk and return associated with investments, use relevant theories, and select the right mix to construct an optimal portfolio.

CO-PO Mapping

	PO_ 1	PO_ 2	PO_ 3	PO_ 4	PO_ 5
CO_ 1	*	*			
CO_ 2	*				
CO_ 3					

CO_ 4			*		*
CO_ 5			*		*

Course Content

Sl. No.	Unit/chapter title	Content	Number of hours	Skills developed
1	Unit- I Introduction to Security Analysis & Portfolio Management	Introduction- meaning and importance of security analysis and portfolio management. Risk-Return profile, components of investments.	09 Hrs	Conceptual Skills

2	Unit- II Bond Valuation	Meaning of Bonds- types of bonds- bond valuation theorem- calculation of present value of bonds- redeemable, irredeemable bonds- YTM- Holding Period Returns- Macaulay's Duration (Excel exercises)	09 Hrs	Analytical/ Logical Skills
3	Unit- III Equity Valuation	Dividend Capitalization- Calculation of intrinsic value- single period valuation model- multi-period valuation model- two stage growth model- numerical examples.	09 Hrs	Logical/ Cognitive Skills
4	Unit- IV Asset Pricing Models	Meaning of asset pricing- systematic and unsystematic risk- Markdown optimum portfolio construction- Sharpe's Measure- Jensen's Alpha and Treynor's Measure	09 Hrs	Analytical/Logical/ Research Skills
5	Unit- V Approaches to Security Analysis	Fundamental analysis- country analysis- industry analysis- company analysis. Technical analysis- types of charts- tools- RSI-macs- support and resistance.	09 Hrs	Analytical/Logical/ Cognitive/Research Skills

Books for Reference:

1. Ravindran, R. (2019). Fundamentals of Security Analysis and Portfolio Management. Chennai: McGraw-Hill India.
2. Fisher, M., & Jordan, R. J. (2019). Security Analysis and Portfolio Management. New Delhi: Pearson Education India.
3. Raghu, P. (2019). Equity Research and Valuation. Mumbai: Jaico Publishing House.
4. Mandal, N. K., & Roy, M. (2018). Investment Management. New Delhi: Prentice Hall of India Pvt Ltd.
5. Parameswaran, S. (2018). Fundamentals of Financial Instruments: An Introduction to Stocks, Bonds, Foreign Exchange, and Derivatives. New Delhi: Wiley India.

6. Pathak, B. (2018). Indian Financial System: Markets, Institutions and Services. New Delhi: Pearson Education India.
7. Bodla, B. S., & Bishnoi, S. (2017). Security Analysis and Portfolio Management. New Delhi: Deep & Deep Publications.
8. Chandra, P. (2017). Investment Analysis and Portfolio Management. New Delhi: McGraw-Hill Education.
9. Prasanna, C. (2017). Financial Management: Theory and Practice. New Delhi: McGraw-Hill Education.
10. Prasanna, C. (2017). Financial Management: Theory and Practice. New Delhi: McGraw-Hill Education.

Web Resource:

1. www.ft.com
2. www.economist.com
3. www.nyse.com
4. www.nasdaq.com
5. www.businessweek.com
6. www.nseindia.com
7. www.bse.com

Journals:

1. International Journal of Trend in Scientific Research and Development (IJTSRD)
2. Journal of Emerging Technologies and Innovative Research (JETIR)
3. DSIMS Research Journal
4. Research Gate
5. Journals of Finance

**21VOC5.1 GOODS AND SERVICES TAX
THEORY
Total Teaching Hours: 45
No. of Hours per Week: - 3
(3 credits)**

CObj	Course Objectives
CObj_1	Analyze and evaluate the effect of indirect taxes on consumers, producers, and government.

CObj_2	Acquaint students with principles underlying the provisions of indirect tax laws
CObj_3	Enhance capability to apply theoretical knowledge in practical situation.

CO	Course Outcomes After completion of this course, students should be able to:
CO1	Acquire conceptual knowledge of indirect tax
CO2	Enable students to compute transaction value and tax liability
CO3	Enable students to understand the procedure to compute the tax liability of assesses
CO4	Apportion input tax with CGST, SGST, UTGST & IGST.
CO5	Enable students to assess GST Returns

CO-PO Mapping

	PO_1	PO_2	PO_3	PO_4	PO_5
CO_1		*			
CO_2		*	*		
CO_3				*	

CO_4		*			*
CO_5					

Course Content

Sl. No.	Unit/chapter title	Content	Number of hours	Skills developed

1	Unit-I Introduction	Introduction of GST in India; definition - supply, aggregate turnover, person, business, mixed supply, composite supply, GSTN, GSTIN, e-commerce input tax credit etc. GST models: Single & dual GST; types of GST (in brief): - CGST, SGST/UTGST, IGST; levy and collection of GST.	12 Hrs	Employable skills
2	Unit- II Registration procedures and conditions	Registration under GST: Persons liable to get registered, turnover limits, compulsory registration, registration procedure, reverse charge mechanism, composition scheme and assessment under composition scheme; exempted supply, zero rated supply; exemption from GST, GST tax rate.	12 Hrs	Analytical skills
3	Unit- III Computation of transaction value and apportionment of credit	Input tax credit (ITC), eligibility and conditions for taking input tax credit, apportionment of ITC; transaction value-problems under forward charge problems under composite and mixed supply. Apportionment of CGST, SGST, IGST.	13 Hrs	Analytical Skills
4	Unit- IV Assessment and returns	Assessment and administration of GST - types of GST returns, types of assessment & assessment procedures, role and functions of GST council, tax authorities and their powers	08 Hrs	Employable and Analytical Skills

Books for Reference:

1. Garg, G. (2019). GST made simple: A guide for students. Taxmann Publications.

2. Koolwal, A. (2017). Commercial's Goods and Services Tax Law, Practice & Procedure (GST) (2nd HB ed.). Anon Container.
3. Vashisht, N. (2018). Goods and Services Tax: A comprehensive guide. New Era Law Publications.
4. Bansal, P., & Aggarwal, M. (2017). GST law and practice: A step-by-step approach (1st ed.). Bharat Law House.
5. Sood, K. (2020). Goods and Services Tax (GST) in India: A study of implications and applications. Universal Law Publishing.

Web Resource:

1. <https://idtc.icaai.org/gst-topic-wise-study-material-list.html>
2. <https://cbic-gst.gov.in/sectoral-faq.html>
3. <https://www.gstcouncil.gov.in/>

Journals:

1. Journals of Indian Taxation
2. Indian journal of Finance
3. Journals of Accounting and Taxation
4. Economics and political weekly

No. of Hours per week:03

(3 credits)

CObj	Course Objectives
CObj_1	Expose students to digitally apply the accounting techniques and prepare financial statements using tally prime.
CObj_2	The knowledge regarding concepts of financial accounting and their preparations in terms of creating vouchers, payments in the tally prime.
CObj_3	The student's ability to use tally in order to equip them with required employable and transferable skills.

CO	Course Outcomes
	After completion of this course, students should be able to:
CO1	Master tally prime in terms of creating, recording classifying all the accounting transactions of business concerns.
CO2	Develop competency in terms of handling all the accounting work including finalization of company accounts.
CO3	Demonstrate their understanding in terms of generating and filing GST returns for various business organizations.
CO4	Develop students' ability to operate to accounting package in the entire accounting process
CO5	Master tally prime for making E- payments and generating reports.

CO-PO Mapping

	PO_1	PO_2	PO_3	PO_4	PO_5
CO_1		*			
CO_2	*				*
CO_3			*		
CO_4				*	*
CO_5		*			

Course Content

Sl. No .	Unit/chapter title	Content	Number of hours	Skills developed
1	Unit-I Introduction to tally	Introduction: getting started with ERP- company creation-shut a company-select a company-alter company details company features and configurations- f11: Company features- f12: Configuration Chart of accounts-ledger-group- ledger creation- single ledger creation-multi ledger creation-altering and displaying ledgers-group creation-single group creation-multiple group creation-displaying groups and ledgers-displaying groups display of ledgers-deletion of groups and ledger.	4 Hrs	Communication/ Analytical/ Logical/ Research/ Employable Skills
2	Unit-II Stock keeping units in ERP	Stock keeping units in ERP: inventory masters in ERP - creating inventory masters-creation of stock group- creation of units of measure creation of stock item-creation of godown-defining of stock opening balance in ERP stock category-reports.	6 Hrs	Communication/ Analytical/Logical/ Research/Employable Skills
3	Unit-III Recording day-to-day transactions in ERP	Recording day-to-day transactions in ERP: business transactions source document for voucher-recording transactions in ERP - accounting vouchers-receipt voucher (f6)-contra voucher (f4)-payment voucher (f5) purchase voucher (f9)-sales voucher (f8)-debit note voucher-credit n (CTRL+f8)- journal voucher (f7). Introduction-accounts payable and receivables-maintaining bill-wise details activation of maintain bill-wise details feature-new reference-against reference advance-on account- stock category report changing the financial year in ERP.	10 Hrs	Communication/ Analytical/Logical/ Research/Employable Skills

4	Unit-IV Getting started with GST	Getting started with GST: enabling GST and defining then tax details-transferring the input tax credit to GST -interstate supply of goods – inter-state inward supply – inter-state outward supply -Intra state supply -intra state inward supply-intrastate outward supply-return of goods -purchase returns sales returns-supplies inclusive of tax	5 Hrs	Communication/ Analytical/Logical/ Research/Employable Skills
5	Unit-V Application of GST rates	Defining tax rates in master and at transaction level: defining GST rates at stock group level -defining GST rates at stock item level -defining GST rates at transactions level-hierarchy of applying tax rate details	5 Hrs	Skills Developed Communication/ Analytical/Logical/ Research/Employable Skills

Book References:

1. Khalekuzzaman, A. T. M. (2019). *Accounting and inventory application in Tally*. dspace.uiu.ac.bd.
2. Singh, S. (2015). *Tally ERP 9: Power of simplicity*. V&S Publishers.
3. Mooney, U. (2014). *Accounting manual and computerized*. M.H. Gill & Company U. C.
4. Ng, P. A. (2014). *21st century computer solutions: A manual accounting simulation*. AuthorHouse.
5. Romney, M. B., & Steinbart, P. J. (2003). *Accounting information systems*. Prentice Hall.

Web resources:

1. <http://dspace.uiu.ac.bd/handle/52243/1244> <https://www.viirj.org/vol13issue1/110.pdf>
2. https://link.springer.com/chapter/10.1007/978-981-16-2838-2_16
3. <https://dl.acm.org/doi/abs/10.5555/3235174>

Journals:

1. The journal entry Tally Prime 14 September 2022
2. The journal entry Tally Prime 03 October 2024

C21 DC 6.1 ADVANCED MANAGEMENT ACCOUNTING

THEORY

Total Teaching Hours: 60

No. of Hours per Week: 4

(4 credits)

CObj	Course Objectives
CObj_1	To provide a rational and critical approach to current management accounting practices.
CObj_2	To impart management accounting techniques in the areas of planning, control, and decision-making.
CObj_3	To create an understanding of the management accounting information and thus to interpret and analyze the information and while critically appraising the benefits of such information.

CO	Course Outcomes After completion of this course, students should be able to:
CO1	Demonstrate an understanding of the strategic role of the Management Accountant in the control system of organizations.
CO2	Examine, analyze, and interpret the data for planning and evaluating risk and uncertainty using sensitivity analysis, decision tree analysis and other techniques.
CO3	Apply relevant quantitative and qualitative information requirements and appropriate techniques for pricing strategies in various scenarios of an organization
CO4	Evaluate and forecast the cost of the product/order and able to take decision for cost reduction & profit maximization.
CO5	Analyze the various recent trends, emerging areas, and contemporary issues in performance measurement.

CO-PO Mapping

	PO_1	PO_2	PO_3	PO_4	PO_5
CO_1		*			
CO_2			*		
CO_3		*		*	*
CO_4		*	*		
CO_5	*	*			

Course Content

Sl. No.	Unit/chapter title	Content	Number of hours	Skills developed
1	Unit-I Management Accounting Overview	Meaning and importance of Management Accounting- Tools of Management Accounting (Descriptive, Analytical, Diagnostic, and Predictive) – Skills required for Management Accountants- Strategic Role of Management Accountants- Functions of Management Accountants	12 Hrs	Logical Skills
2	Unit-II Decision making under Risk and Uncertainty	Nature and types of risk- Techniques for decision making under risk and uncertainty- Optimistic and Pessimistic estimates- Risk Adjusted Discount Rate- Certainty Equivalent Sensitivity Technique- Probability Technique- Decision Tree Analysis.	12 Hrs	Decision-Making Skills
3	Unit-III Pricing Strategies	Introduction- Meaning- Objectives- Pricing Strategies- Pricing Methods- Cost-Plus Pricing- Standard Cost Pricing- Differential Pricing- ROCE Pricing- Incremental Pricing (Advantages and Disadvantage)- Numerical Problems on Cost-Plus Pricing.	12 Hrs	Analytical Skills
4	Unit-IV Target Costing	Introduction- Meaning- Objectives, Feature, Pros & Cons. Cost Accountant role in Target Costing, Target costing Environment, Sources of data for Target Costing, Steps in target costing, Numerical examples.	12 Hrs	Logical Skills
5	Unit-V Performance Measurement & Trends	Financial and non-financial measurement of performance ROI – Residual Income: Concept and measurement -Benchmarking: Objectives- Benefits- New horizons in Management Control- Responsibility Accounting– Social Cost-benefit Analysis. Recent trends: Kaizen Costing, ERP, MRP.	12 Hrs	Measuring Skills

Books for Reference:

1. B. Saravana Prasath (2022), Cost & Management Accounting, 7th Edition, Commercial Law Publishers.
2. Kishore, R. M, (2021), Management Accounting & Financial Analysis 6th edition, Taxman Allied Services.
3. Khan, M. Y & Jain,P.K (2017)Management Accounting Text, Problems & Cases 7th edition, Tata McGraw Hill.
4. Drury,Colin (2015), Management & Cost Accounting, 9th Edition, Thompson Books.
5. Horngren,C.T, SundemG.L., Stratton W.O, (2013), Introduction to Management Accounting, 16th Edition, Pearson Education.
6. Kulkarni M.A, (2014) Management Accounting, 2ndedition, career

Web Resource:

1. <https://khatabook.com/blog/management-accounting>
2. <https://www.iedunote.com/management-accounting>
3. <https://corporatefinanceinstitute.com/resources/accounting/managerial-accounting>

Journals:

1. Journal of Management Accounting Research (JMAR)
2. Journal of Management Accounting Research (JMAR)
3. Management Accounting Research

C21 DC 6.2 – PRINCIPLES AND PRACTICE OF AUDITING**Total Teaching Hours: 60****No. of Hours per Week: - 04****(4 credits)**

CObj	Course Objectives
CObj_1	To develop an appreciation of the need for and requirement of auditing to categories of stakeholders in Indian context.
CObj_2	To impart knowledge of the various techniques of auditing and auditing standards used by professional auditors.
CObj_3	To provide an understanding of the entire process of external auditing and the duties, responsibilities, and liabilities of a company auditor.

CO	Course Outcomes
	After completion of this course, students should be able to:
CO1	Assess consistency and appropriateness of auditing concepts used in financial statements within the context of local and national regulatory environment.
CO2	Develop audit procedures for key items in financial statements based on underlying principles and practices.
CO3	Appraise the professional provisions (auditing standards and ethical guidelines) that constitute the regulatory framework for the conduct of external auditing.
CO4	Analyze the contents of audit report and relevance of their inclusion primarily to the shareholders.
CO5	Familiarize the students of the audit procedure of different types of undertakings.

CO-PO Mapping:

	PO_1	PO_2	PO_3	PO_4	PO_5
CO_1	*				*
CO_2	*		*		
CO_3		*		*	
CO_4	*	*			
CO_5		*	*		

Course Content

Sl. No.	Unit/chapter title	Content	Number of hours	Skills developed
1	Unit-I Introduction to Auditing	Introduction - Meaning - Definition - Nature - Purpose - Scope of an audit - Objectives - limitations - Differences between Accountancy and Auditing - Types of Audits - Advantages of Auditing - Preparation before commencement of new Audit - Recent Trends in Auditing: Cost Audit - Management Audit and Tax Audit - Nature and Significance.	12 Hrs	Transferable/ Knowledgeable Skills
2	Unit-II Internal Audit and review and corporate governance	Internal Control: Meaning and objectives. Internal Check: Meaning, objectives and fundamental principles. Internal Check as regards: Wage Payments, Cash Sales, Cash Purchases. Internal Audit: Meaning - Advantages and Disadvantages of Internal Audit- Differences between Internal Check and Internal Audit - Requirements of internal audit in India - Corporate Governance - Outsourcing of internal audit functions - Audit Committee.	12 Hrs	Logical Skills
3	Unit-III Audit Planning	Audit planning and knowledge of business - Audit Sampling - Overall audit plan - Audit Risk - Materiality - Audit Notebook, Audit working papers, Audit programme - Meaning, Advantages and disadvantages - Meaning - Definition - Importance - Routine Checking and Vouching - Voucher - Vouching of Receipts: Cash Sales, Receipts from debtors, Proceeds of the sale of Investments. Vouching of Payments: Cash Purchases, Payment to Creditors, Deferred Revenue Expenditure.	12 Hrs	Analytical Skills
4	Unit-IV Verification and Valuation of	Meaning and Objectives of verification and valuation - Position of an Auditor as regards the Valuation of Assets -	12 Hrs	Logical Skills

	Assets and Liabilities	Verification and Valuation of different Items: Assets: Land & Building, Plant & Machinery, Goodwill - Investment - Stock in Trade. Liabilities: Bills Payable - Sundry Creditors - Contingent Liabilities.		
5	Unit-V Audit of Financial Statements and Preparing Audit Reports	Audit Control objectives, procedures and tests of control: Audit of non-current assets - Audit of current assets - Audit of liabilities and capital. Audit Reports - preparations, qualified and unqualified. Investigation - Objectives of Investigation - Audit of Computerized Accounts - Electronic Auditing - Investigation under the provisions of Companies Act.	12 Hrs	Evaluation Skills

Books for Reference:

1. Michael Knapp, CONTEMPORARY AUDITING, Cengage Publishing, 12th Edition, 2021
2. Kumar, R., & Sharma, V. (2015). AUDITING: PRINCIPLES AND PRACTICE.
3. Basu, S. K. (2016). Auditing & Assurance.
4. GOMEZ, C. (2012). AUDITING AND ASSURANCE: THEORY AND PRACTICE.
5. Fernando, A. C. (2011). Corporate Governance: Principles, Policies and Practices, 2/e
6. Ravinder Kumar, Virender Sharma, Auditing - Principles and Practice, 3rd Edition, PHI Learning.

Web Resource:

1. www.investopedia.com
2. www.wallstreetmojo.com
3. <https://www.theforage.com>
4. <https://corporatefinanceinstitute.com/resources/accounting/audit/>

Journals:

3. Journal of Accounting Research
4. Accounting Research Journal
5. The International Journal of Auditing

C21 DC 6.3 INCOME TAX LAW & PRACTICE - II

Total Teaching Hours: 60 No. of

Hours per Week: - 04

(04 credits)

CObj	Course Objectives
CObj_1	To provide an understanding of the various provisions related to income from Business and Profession and Capital Gains as per Indian Income Tax Act, 1961.
CObj_2	To create an understanding about Powers and Functions of the Central Board of Direct Taxes.
CObj_3	To provide an understanding of various deductions that are available u/s 80 C to 80 U including setting off and carrying forward of losses as per the new regime.

CO	Course outcomes After completion of this module, students should be able to:
CO1	Apply appropriate provisions related to computation of tax liability under the heads of Income from Business and Profession and Income from Capital Gains.
CO2	Develop an understanding of the functions and powers of CBDT, Appellate Tribunal and understand the duties and responsibilities of various Authorities under CBDT.
CO3	Develop an understanding of various provisions, exemptions u/s 54 to 54F of the Assessment procedure.
CO4	Apply appropriate procedures in computation of various deductions u/s 80C to 80U of Income Tax Act 1961.
CO5	Develop an understanding to apply provisions of set off and carry forward of the losses with respect to individual Assessee.

CO-PO Mapping

	PO1	PO2	PO3	PO 4	PO5
CO1	*				
CO2		*		*	*
CO3			*		*
CO4		*			*
CO5			*		

Course Content

Sl. No.	Unit/chapter title	Content	Number of hours	Skills Developed
1	Unit I Introduction to Income Tax Authorities and Assessment Procedures	Income Tax Authorities: Powers & functions of CBDT, CIT, Appellate Tribunal & AO Assessment-Meaning- Types of Assessment - Meaning and classification of Capital & Revenue receipts and expenditure. Differences between Capital & Revenue receipts and expenditure.	12 Hrs	Conceptual Skills
2	Unit II Profits and Gains from Business and Profession	Meaning and Definition of Business, Profession – Vocation - Expenses Expressly Allowed and Disallowed – Allowable losses – Numerical examples on Business relating to Sole Trader and numerical examples on Profession relating to Chartered Accountant, Advocate and Medical Practitioner.	12 Hrs	Logical Skills
3	Unit III Capital Gains	Meaning-types-Basis of Charge – Capital Assets – Transfer of Capital Assets – Computation of Capital Gains – Exemptions U/S 54, 54B, 54D, 54EC, 54F– Numerical examples on short term and long-term Capital Gain.	12 Hrs	Technical skills
4	Unit IV Deductions from Gross Total Income	Deductions available u/s: 80 C, 80 CCC, 80 CCD, 80 D, 80 G, 80 GG, 80 GGA, and 80 U –Numerical examples.	12 Hrs	Analytical Skills
5	Unit V Assessment of Individuals. Set-off & Carry Forward of Losses.	Assessment of Individuals-Computation of Total Income and Tax Liability of an Individual Assessee - numerical examples of Salary and House Property to be included. Meaning –Provision for Set-off & carry forward of losses.	12 Hrs	Assessing Skills

Books for Reference:

1. Singhanian, V. K. (2022). Direct taxes: Law and practice (56th ed.). Taxmann Publication.
2. Taxmann. (2023). Finance Act 2023: Income tax (68th ed.). Taxmann Publication.
3. Mehrotra, H. C., & Goyal, S. (2022). Corporate tax planning & management (43rd ed.). Sahityabhavan Publications.
4. Gaur, V., & Narang, D. (2022). Direct taxes (5th ed.). Kalyani Publishers.
5. Gaur, V., Puri, R., Gaur, P., & Narang, D. (2022). Income tax law and practice (49th ed.). Kalyani Publishers.
6. Mittal, N. (2022). Principles of income tax law and practice (1st ed.). Cengage India Publisher.
7. Saha, U. D. N., & Bhaskara, B. G. (2022). Income tax: 7 lectures (15th revised ed.). Vision Book House Publisher.

Web Resources:

1. <https://www.incometax.gov.in>
2. <https://incometaxindiaefiling.gov.in>
3. <https://icmai.in>
4. <https://www.taxnotes.com>

Journals:

1. Taxman Journals
2. ICMA Journals
3. ICAI Journals
4. National Tax Journals
5. Scholarly Tax Journals

C21 DCA 6.4 – Indian Accounting Standards-1

Total Teaching Hours: 45

No. of Hours per Week: - 03

(3 credits)

CObj	Course Objectives
CObj_1	To develop an understanding of the nature and significance of Indian Accounting Standards
CObj_2	To expose students to contemporary approaches to the various standards being adopted in accounting
CObj_3	To enable students to evaluate the various provisions available in the Indian Accounting Standards.

CO	Course Outcomes
	After completion of this course, students should be able to:
CO1	Demonstrate the need and benefits of accounting standards.
CO2	Prepare the financial statements as per Indian Accounting standards
CO3	Comprehend the requirements of Indian Accounting Standards for recognition, measurement and disclosures of certain items appear in financial statement
CO4	Analyze the Accounting Standards for Items that do not Appear in Financial Statements
CO5	Interpret the provisions of various liabilities according to the accounting standards

CO-PO Mapping

	PO_1	PO_2	PO_3	PO_4	PO_5
CO_1	*	*			
CO_2	*				
CO_3			*		*
CO_4			*		*
CO_5				*	*

Course Content

Sl. No.	Unit/chapter title	Content	Number of hours	Skills developed
1	Unit-I Introduction to Indian Accounting Standards	Introduction- Meaning and Definition of Accounting Standards – Objectives of Accounting Standards – Benefits and Limitations of Accounting Standards – Process of Formulation of Accounting Standards in India – List of Indian Accounting Standards (Ind-AS) – Need for Convergence Towards Global Standards– International Financial Reporting Standards - Features and Merits and Demerits of IFRS – Benefits of Convergence with IFRS – Applicability of Ind- AS in India	09 Hrs	Logical Skills
2	Unit-II Preparation of Financial Statements (Ind AS 1)	Frame work for preparation of Financial Statements, presentation of Financial Statement as per Ind AS 1. Statement of Profit and Loss, Balance Sheet, Statement of changes in Equity, statement of Cash flow and Notes to accounts. Problems on preparation of Statement of Profit and Loss and Balance Sheet as per Schedule III of Companies Act, 2013	09 Hrs	Analytical Skills
3	Unit-III Provision under Accounting Standard for items appear in Financial Statements	Property, Plant and Equipment (Ind AS-16) - Intangible assets (Ind AS-38) - Impairment of assets (Ind AS-36) – Inventories (Ind AS 2) - Borrowing costs (Ind AS- 23) – Investment Property (Ind AS-40) –objectives, Scope, definitions, Recognition Measurement and disclosures of the above-mentioned Standards. Simple problems on the above standards	09 Hrs	Logical Skills
4	Unit-IV Provisions under Accounting Standards for items that do not	Segment Reporting (Ind AS 108), Related Party Discloser (Ind AS 24), Events Occurring after Balance Sheet Date (Ind AS 10), Interim Financial Reporting (Ind AS 34).	09 Hrs	Analytical Skills

Books for Reference:

	appear in Financial Statements			
1. 5 C h a k r a b o r t y	Unit-V Liability Based Indian Accounting Standards.	Provisions, Contingent liabilities and contingent assets (Ind AS 37) – Scope, provision, liability, obligating event, legal obligation, constructive obligation, contingent liability, contingent asset, relationship between provisions and contingent liability, recognition of provisions, Contingent asset and contingent liability, Measurement and Disclosure of Information in the Financial Statements.	09 Hrs	Know How Skills

- S. (2017). Indian Accounting Standards (Ind AS) Made Simple. Taxmann Publications.
2. Kumar, A., Kumar, R., & Mariyappa, T. (n.d.). Indian Accounting Standards. Himalaya Publishing House.
 3. Rao, M. R. (2018). Accounting Standards and IFRS in India: A Practical Approach. McGraw Hill Education.
 4. Sundar, S. (2019). Indian Accounting Standards (Ind AS): A Comprehensive Guide. CCH India.
 5. Bansal, P., & Aggarwal, M. (2019). Indian Accounting Standards (Ind AS): A Practical Approach for Students and Professionals. Bharat Law House.
 6. Khurana, A. (2016). Indian Accounting Standards (Ind AS) – A Student's Guide. Taxmann Publications.
 7. Ghosh, T. P. (2017). Indian Accounting Standards (Ind AS) and IFRS: A Concise Guide. Taxman Allied Services Private Limited.
 8. Ministry of Corporate Affairs. (2015). Indian Accounting Standards (Ind AS) – A Comprehensive Overview. Government of India.

Web Resource:

1. www.ifrs.org
2. www.journalofaccountancy.com

Journals:

1. Journal of Accountancy
2. International Accounting Standards
3. Asia Journal of Accounting
4. Indian Journal of Finance
5. Journal of Corporate Finance

C21 DCF 6.4 INVESTMENT MANAGEMENT

Total Teaching Hours: 45

No of Hours per Week: - 03

(3 credits)

CObj	Course Objectives
CObj_1	To develop an understanding of the nature and significance of investments
CObj_2	To expose students to contemporary approaches to risk and returns
CObj_3	To enable students to evaluate the valuation of various securities and interpret the various techniques adopted

CO	Course Outcomes After completion of this course, students should be able to:
CO1	Demonstrate the concept of investments, its features and various instruments.
CO2	Comprehend the functioning of secondary market in India
CO3	Analyze the concept of risk and return and their relevance in purchasing and selling of securities.
CO4	Interpret the valuation of securities and finding out the values for purchase and sale of securities.
CO5	Demonstrate the fundamental analysis to analyze the company for purchase and sale of securities and technical analysis for trading in the share market.

CO-PO Mapping

	PO_1	PO_2	PO_3	PO_4	PO_5
CO_ 1	*	*			
CO_ 2	*				
CO_ 3			*		*
CO_ 4			*		*
CO_ 5				*	*

Course Content

Sl. No.	Unit/chapter title	Content	Number of hours	Skills developed
1	Unit-I Concept of Investment	Introduction - Investment: Attributes, Economic vs. Financial Investment, Investment and speculation, Features of a good investment, Investment Process. Financial Instruments: Money Market Instruments, Capital Market Instruments. Derivatives.	09 Hrs	Logical skills
2	Unit-II Portfolio Management	Portfolio Management: Meaning, Need, Objectives, process of Portfolio management, Selection of securities and Portfolio analysis. Construction of optimal portfolio using Sharpe's Single Index Model. Portfolio Performance evaluation (Theory only).	09 Hrs	Analytical Skills
3	Unit-III Valuation of Securities	Valuation of securities—meaning, need, objectives, and intrinsic value. Preference shares, equity shares- no growth rate, normal growth rate and super normal growth rate.	09 Hrs	Technical Skills
4	Unit-IV Mathematical Indicators	Dow Theory, Eliot wave theory. Charts-Types, Trend and Trend Reversal Patterns. Mathematical Indicators – Moving averages, ROC, RSI, and Market Indicators. Investment in Gold- Real Estate	09 Hrs	Logical Skills
5	Unit-V Emerging Trends in Indian Capital Market	Depositories and scripless trading-constituents of depository system, benefits to investors and issuing companies. Book building –meaning and types. Green Shoe Option (GSO), Grading of IPOs, Merchant Banker, portfolio manager, demutualization of stock exchanges, reverse mortgage-meaning only	09 Hrs	Analytical Skills

Books for Reference:

1. I M Pandey, (2018), Financial Management, Vikas publications, New Delhi.
2. Abrish Guptha, (2016), Financial Management, Pearson.
3. Khan & Jain, (2018), Basic Financial Management, TMH, New Delhi.
4. S N Maheshwari, (2021), Principles of Financial Management, Sultan Chand & Sons, New Delhi.
5. Chandra & Chandra D Bose, (2017), Fundamentals of Financial Management, PHI, New Delhi.
6. B.Mariyappa, (2019), Financial Management, Himalaya Publishing House, New Delhi.
7. Ravi M Kishore, (2020), Financial Management, Taxman Publications
8. Prasanna Chandra, (2019), Financial Management, Theory and Practice, Tata McGraw Hill.

Web Resource:

1. <https://www.icaai.org/>
2. <https://www.icsi.edu/>
3. <https://cag.gov.in>
4. <https://www.aicpa-cima.com/>

Journals:

1. Institute of Chartered Accountants of India
2. Journal of Investment Management
3. Journal of Portfolio Management.

C21 SBC 6.1 – CYBER SECURITY

Total Teaching Hours: 45

No. of Hours per Week: - 03

(3 credits)

CObj	Course Objectives
CObj_1	To equip students with the technical knowledge and skills needed to protect and defend against cyber threats.
CObj_2	To systematically educate the necessity to understand the impact of cyber-crimes and threats with solutions in a global and societal context.
CObj_3	To expose students to governance, regulatory, legal, economic, environmental, social and ethical contexts of cyber security.

CO	Course Outcomes
	After completion of this course, students should be able to:
CO1	Develop a deeper understanding and familiarity with various types of cyber-attacks, cyber-crimes, vulnerabilities and remedies thereto.
CO2	Evaluate and communicate the human role in security systems with an emphasis on ethics, social engineering vulnerabilities and training.
CO3	Analyse and evaluate existing legal framework and laws on cyber security.
CO4	Analyse and evaluate the security aspects of social media platforms and ethical aspects associated with use of social media.
CO5	Increase awareness about cyber-attack vectors and safety against cyber-frauds.

CO-PO Mapping

	PO_1	PO_2	PO_3	PO_4	PO_5
CO_1	*			*	*
CO_2	*	*	*		*
CO_3	*			*	
CO_4		*		*	
CO_5		*			*

Course Content

Sl. No.	Unit/chapter title	Content	Number of hours	Skills developed
1	Unit-I Introduction to Cyber Security	Defining Cyberspace and Overview of Computer and Web-technology, Architecture of cyberspace, Communication and web technology, Internet, World Wide Web, Advent of internet, Internet infrastructure for data transfer and governance, Internet society, Regulation of Cyberspace, Concept of cyber security, Issues and challenges of cyber security.	09 Hrs	Basic Conceptual Skills
2	Unit-II Cyber Crime	Classification of cyber-crimes, Common cyber-crimes - cyber-crime targeting computers and mobiles, cyber-crime against women and children, financial frauds, social engineering attacks, malware and ransomware attacks, zero day and zero click attacks, Cyber criminal's modus-operandi, Reporting of cyber-crimes, Remedial and mitigation measures, Legal perspective of cyber-crime.	09 Hrs	Analytical Skills
3	Unit-III Cyber Law	IT Act 2000 and its amendments, Cyber-crime and offences, Organizations dealing with Cyber-crime and Cyber security in India, Case studies.	09 Hrs	Exploratory Skills
4	Unit-IV Social Media Overview and Security	Introduction to Social networks, Types of social media, social media platforms, social media monitoring, Hashtag, Viral content, social media marketing, social media privacy, Challenges, opportunities and pitfalls in online social network, Security issues related to social media, Flagging and reporting of inappropriate content, Laws regarding posting of inappropriate content, best practices for the use of social media,	09 Hrs	Analytical Skills

		Case studies.		
5	Unit-V Digital Devices Security Tools and Technologies for Cyber Security	End Point device and Mobile phone security, Password policy, Security patch management, Data backup, Downloading and management of third-party software, Device security policy, Cyber Security best practices, Significance of host firewall and Anti-virus, Management of host firewall and Anti-virus, Wi-Fi security, Configuration of basic security policy and permissions.	09 Hrs	Evaluation Skills

Books for Reference:

1. Mishra, R. C. (2010). Cyber Crime Impact in the New Millennium.
2. Sumit Belapure and Nina Godbole, (2011). Cyber Security Understanding Cyber Crimes. Computer Forensics and Legal Perspectives Wiley India Pvt. Ltd.
3. Henry A. Oliver. (2001). Security in the Digital Age: Social Media Security Threats and Create Space Independent Publishing Platform. Pearson Publications.
4. Kumar K. Cyber Laws : Intellectual Property & E-Commerce Security Dominant Publishers.
5. Maiwald E. Fundamentals of Network Security. McGraw Hill.
6. Eric Cole, Ronald Krutz, James W. Conley. 2nd Edition Network Security Bible 2nd Edition. Wiley India Pvt. Ltd.

Web Resource:

1. www.kaspersky.com
2. www.techtarget.com
3. www.imperva.com
4. www.javatpoint.com

Journals:

1. Journal of Cybersecurity
2. Journal of Cybersecurity and Privacy
3. Journal of International Cybersecurity

21VOC6.1 INTERNSHIP

BACHELOR OF COMMERCE (B.Com.)

1. Objectives:

- a) The internship aims at enabling the students to get a practical exposure to the working functioning of the industry.
- b) The internship provides an opportunity to students to substantiate their classroom learning with practical experience.

2. Guidelines for Internship:

- 1) Students of the V Semester, after completion of the End Semester Examination have to undergo the internship for a minimum of 4-6 weeks (min 90 hours). The area of Internship can be only in the fields of Commerce or Management. The choice of internship is no way associated with choice of electives
- 2) The choice of organization for Internship is restricted to business enterprises and corporate establishments only like Micro, Small, Medium, and Large-Scale organizations, Sole Proprietary and Partnership firm, Government Organizations, Government departments and local bodies, Public and private sector banks like SBI, Canara Bank, Bank of Baroda, HDFC Bank, ICICI Banks, Axis bank and Non-Govt. Organizations (NGOs), Development agencies, Any other organizations with minimum of four functional departments and internships can be pursued in any location (anywhere in India or abroad).
- 3) On completion of the internship, a certificate from the company is to be obtained stating the period of the internship and a brief description of the nature of the internship i.e. responsibilities handled. Also, the confidential rating on various parameters (1-6) (Like Regularity to work, Attitude towards work, Professional Competence, Ability to interact with other staff/colleagues, Willingness to learn etc,) has to be obtained from the Company.
- 4) A report of internship undertaken along with certificate and confidential rating will have to be submit to the Department of the concerned College.

3. The Internship Report

It should include Four (4) chapters

1. Chapter-1 Introduction: - Introduction of the organization includes - Inception, SWOC analysis, nature of business, profile, Organizational Structure, Functional Areas.
2. Chapter-2 Design of the study: - Objective of study, methodology adopted-source of data - technique, limitation of the study etc.
3. Chapter -3 Discussion: - Discussion/Analysis and Interpretation/Findings of the study, conclusions, and suggestions.
4. Chapter-4 Learning Outcomes: - Learning Experience like Work profile and job responsibilities handled by the students during internship, their contribution and learning experience. Weekly report of work done etc.

4. Evaluation of the Report:

1. After the successful submission of the report by students, concerned Colleges shall evaluate the report for 60 marks as per the Evaluation Format. The following is the break up used for evaluation of Internship. Internship Report - 60 Marks Presentation - 30 Marks Confidential Rating by the company/business establishment -10 Marks Total= 100 Marks. The HOD, Department of commerce, Concerned College shall conduct Presentation for 30 marks as per format and calendar of events notified by the University.

5. Presentation of the Report:

1. Typing should be done on one side of the A-4 size paper.
2. The margin left side 1.75 inches, the right, top and bottom margin should be 1 inch each.
3. Font size: Chapter heading: 14; Sub-heading: 12 (Bold) and text of the running matter: 12.
4. Font to be used are Times New Roman.
5. The text of the report should have 1.5 line spacing; quotations and foot notes should be in single-line space
6. The total of the report to be in the range of 70 to 80 pages
7. The report should be presented in hardbound/ Spiral (Normal binding) for report evaluation
8. The students shall also submit the hard & PDF Soft copy of the report to the HOD, Department of Commerce, Concerned College should keep the record in library
9. In case of any doubt or ambiguity in the interpretation of the guidelines mentioned in the guidelines, the decision of the Dean, Faculty of Commerce, shall be final



Affiliated to Bangalore North University

SCHEME AND SYLLABUS

For the Programme

Bachelor of Computer Applications (BCA)

w.e.f 2021-22 till 2023-24

(Choice Based Credit System – 2021 scheme)

**DEPARTMENT OF COMPUTER SCIENCE
Indian Academy Degree College – Autonomous
Hennur Cross, Hennur Main Road, Bangalore**

PEO_ID	BCA-Programme Educational Objectives
PEO1	Provide a strong foundation in both software and hardware aspects of computing and develop core competencies in developing computing-based solutions to real world problems
PEO2	Provide opportunities to learn and apply modern techniques of data storage and analytics as well as apply problem solving techniques to create cutting-edge technology in various domains
PEO3	Equip students with excellent technical and communication skills to work independently on software projects or collaborate as an effective team member
PEO4	Provide training in project development and research methods which includes analysis, designing algorithms as solutions to solve real world problems and inculcate ethical and moral values
PEO5	Encourage students to become entrepreneurs and also practice continuous learning in order to achieve professional and personal excellence

PO_ID	BCA-Programme Outcomes
On completion of the BCA Honors programme, the student will be able to:	
PO1	Acquire core competencies to design, implement and evaluate a computational system to meet desired needs within realistic constraints
PO2	Apply the mathematical and programming knowledge as well as standard software engineering practices and strategies to develop applications in various domains
PO3	Possess strong communication and leadership skills, acquaint with the contemporary trends in industry, collaborate with a team and create innovative solutions to existing problems based on legal and ethical principles
PO4	Apply research methods including design of experiments, analysis, interpretation of data, synthesis of information, developing online/offline applications to provide authentic and environment friendly solutions contributing to the well-being of the society
PO5	Adapt to technological advances through active participation in life-long learning to acquire professional excellence and become successful entrepreneurs or professionals contributing to the society

NEP- Curriculum Framework

Bachelor of Computer Applications (B.C.A) - Matrix for I Semester (batch 2021 to 2023)

I SEMESTER							
Code	Course Code	Course	Teaching Hours/ week	Course Components			Credits
				L	T	P	
AECC	B21KN 1.1/ B21HN 1.1/ B21AE 1.1	Language-I (Kannada/Hindi/Additional English)	45	3	1	-	3
AECC	B21GE1.1	Language-II (Generic English)	60	3	1	-	3
DSC1	B21DC 1.1	Discrete Structures	45	2	1	-	3
DSC1	B21DC 1.2	Problem Solving Techniques using C	45	2	1	-	3
DSC1	B21DC 1.3	Data Structures	45	2	1	-	3
DSC1	B21DC 1.4	C-Programming Lab	60	-	-	4	2
DSC1	B21DC 1.5	Data Structures Lab	60	-	-	4	2
OE-1	B21OE 1.1	Office Automation and Designing*	45	2	1	-	3
SEC-SB	21SBC 1.2	Office Management Tools	30	-	-	2	2
SEC-VB	21VBC 1.1	Health and Well-being	30	-	-	2	1
SEC-VB	21VBC 1.2	Physical Education-Yoga	30	-	-	2	1
Total							26

Note:

DSC - Discipline-Specific Course

DSE – Discipline-Specific Elective

SEC - VB Skill Enhancement Course -Value Based

SEC - SB Skill Enhancement Course -Skill Based

OE- Open Elective for non-Computer Science programmes*

BCA students will select open elective offered by other departments

NEP- Curriculum Framework

Bachelor of Computer Applications (B.C.A) - Matrix for II Semester (Batch 2021 to 2023)

II SEMESTER							
Code	Course Code	Course	Teaching Hours	Course Components			Credits
				L	T	P	
AECC	B21KN2.1/ B21HN2.1/ B21AE2.1	Language-I (Kannada/Hindi/Additional English)	45	3	1	-	3
AECC	B21GE2.1	Language-II (Generic English)	60	3	1	-	3
AECC	21SBC 2.1	Environmental Studies	45	2	1	-	3
DSC2	B21DC 2.1	Computer Architecture	45	2	1	-	3
DSC2	B21DC 2.2	Object Oriented Programming Using Java	45	2	1	-	3
DSC2	B21DC 2.3	Database Management Systems	45	2	1	-	3
DSC2	B21DC 2.4	Java Lab	60	-	-	4	2
DSC2	B21DC 2.5	DBMS lab	60	-	-	4	2
OE-2	B21OE 2.1	Cyber Space*	45	2	1	-	3
SEC-VB	21VBC 2.1	NCC/NSS/Cultural	30	-	-	2	1
SEC-VB	21VBC 2.2	Sports	30	-	-	2	1
Total							27

Note:

DSC - Discipline-Specific Course

DSE – Discipline-Specific Elective

SEC - VB Skill Enhancement Course -Value Based

SEC - SB Skill Enhancement Course -Skill Based

OE- Open Elective for non-Computer Science programmes*

BCA students will select open elective offered by other departments

NEP- Curriculum Framework

Bachelor of Computer Applications (B.C.A) - Matrix for III Semester (w.e.f. 2021 onwards)

III SEMESTER							
Code	Course Code	Course	Teaching Hours	Course Components			Credits
				L	T	P	
AECC	B21KN 3.1/ B21HN 3.1/ B21AE 3.1	Language-I (Kannada/Hindi/Additional English)	45	3	1	-	3
AECC	B21GE3.1	Language-II (Generic English)	60	3	1	-	3
DSC3	B21DC3.1	Operating System	45	2	1	-	3
DSC3	B21DC3.2	Computer Networks	45	2	1	-	3
DSC3	B21DC3.3	Python Programming	45	2	1	-	3
DSC3	B21DC3.4	Computer Networks Lab	60	-	-	4	2
DSC3	B21DC3.5	Python Programming Lab	60	-	-	4	2
OE-3	B21OE 3.1	Computer Fundamentals and Program Concepts in C	45	2	1	-	3
SEC-SB	21SBC 3.1	PC Assembling and Troubleshooting	30	1	-	2	2
SEC-VB	21VBC 3.1	NCC/NSS/R&R/Cultural	30	-	-	2	1
SEC-VB	21VBC 3.2	Sports	30	-	-	2	1
Total							26

Note:

DSC - Discipline-Specific Course

DSE – Discipline-Specific Elective

SEC - VB Skill Enhancement Course -Value Based

SEC - SB Skill Enhancement Course -Skill Based

OE- Open Elective for non-Computer Science programmes*

BCA students will select open elective offered by other departments

NEP- Curriculum Framework

Bachelor of Computer Applications (B.C.A) - Matrix for IV Semester (w.e.f. 2021 onwards)

IV SEMESTER							
Code	Course Code	Course	Teaching Hours	Course Components			Credits
				L	T	P	
AECC	B21KN 4.1/ B21HN 4.1/ B21AE 4.1	Language-I (Kannada/Hindi/Additional English)	45	3	1	-	3
AECC	B21GE4.1	Language-II (Generic English)	60	3	1	-	3
AECC	21SBC 4.1	Constitution of India	45	2	1	-	3
DSC4	B21DC4.1	Software Engineering	45	2	1	-	3
DSC4	B21DC4.2	Artificial Intelligence	45	2	1	-	3
DSC4	B21DC4.3	Internet Technologies and Web Designing	45	1	2	-	3
DSC4	B21DC4.4	Artificial Intelligence Lab	60	-	-	4	2
DSC4	B21DC4.5	Internet Technologies and Web Designing Lab	60	-	-	4	2
OE-4	B21OE 4.1	Web Designing*	45	2	1	-	3
SEC-VB	21VBC 4.1	NCC/NSS/R&R/Cultural	30	-	-	2	1
SEC-VB	21VBC 4.2	Sports	30	-	-	2	1
Total							26

Note:

DSC - Discipline-Specific Course

DSE – Discipline-Specific Elective

SEC - VB Skill Enhancement Course -Value Based

SEC - SB Skill Enhancement Course -Skill Based

OE- Open Elective for non-Computer Science programmes*

BCA students will select open elective offered by other departments

NEP- Curriculum Framework

Bachelor of Computer Applications (B.C.A) - Matrix for V Semester (w.e.f. 2021 onwards)

V SEMESTER							
Code	Course Code	Course	Teaching Hours	Course Components			Credits
				L	T	P	
DSC5	B21DC5.1	Design and Analysis of Algorithms	60	2	2	-	4
DSC5	B21DC5.2	Data Analytics	60	2	2	-	4
DSC5	B21DC5.3	Web Programming	60	2	2	-	4
DSC5	B21DC5.4	Data Analytics Lab	60	-	-	4	2
DSC5	B21DC5.5	Web Programming Lab	60	-	-	4	2
ELEC-1	B21DCE5.6	Data Mining	45	2	1	-	3
	B21DCE5.7	Or Computer Graphics					
VOC-1	21VOC5.1	Accounting and Financial Management	45	2	1	-	3
SEC-SB	21SBC5.1	Cyber Crime, and Cyber Law	30	1	1	-	2
Total							24

Note:

DSC - Discipline-Specific Course

DSE – Discipline-Specific Elective

SEC - VB Skill Enhancement Course -Value Based

SEC - SB Skill Enhancement Course -Skill Based

NEP- Curriculum Framework

Bachelor of Computer Applications (BCA) - Matrix for VI Semester (w.e.f. 2023-24 onwards)

VI SEMESTER							
Code	Course Code	Course	Teaching Hours	Course Components			Credits
				L	T	P	
DSC6	B21DC6.1	Theory of Computation	60	2	2	-	4
DSC6	B21DC6.2	Machine Learning	60	2	2	-	4
DSC6	B21DC6.3	Mobile Application Development	60	2	2	-	4
DSC6	B21DC6.4	Machine Learning Lab	60	-	-	4	2
DSC6	B21DC6.5	Project Lab	60	-	-	4	2
ELEC-2	B21DCE6.6	Operations Research	45	2	1	-	3
	B21DCE6.7	Image Processing					
VOC-2	21VOC6.1	Vocation Course II: Computer Animation	45	2	-	2	3
SEC-SB	21SBC6.1	Professional and Business Communication	45	1	-	2	2
Total							24

Note:

DSC - Discipline-Specific Course

DSE – Discipline-Specific Elective

OE- Open Elective

SEC - VB Skill Enhancement Course -Value Based

SEC - SB Skill Enhancement Course -Skill Based



MATRIX AND SYLLABUS

For the Programme Bachelor of Computer Applications (B.C.A)

NEP Based Curriculum (2021 onwards)

I Semester

NEP- Curriculum Framework

Bachelor of Computer Applications (B.C.A) - Course Matrix (w.e.f. 2024-25 onwards)

I SEMESTER							
Code	Course Code	Course	Teaching Hours	Course Components			Credits
				L	T	P	
AECC	B21KN1.1/ B21HN1.1/ B21AE1.1	Language-1 (Kannada/Hindi/Additional English)	45	3	1	-	3
AECC	B21GE1.1	Language-2 (Generic English)	60	3	1	-	3
DSC1	B21DC 1.1	Discrete Structures	45	2	1	-	3
DSC1	B21DC 1.2	Problem Solving Techniques using C	45	2	1	-	3
DSC1	B21DC 1.3	Data Structures	45	2	1	-	3
DSC1	B21DC 1.4	C-Programming Lab	60	-	-	4	2
DSC1	B21DC 1.5	Data Structures Lab	60	-	-	4	2
OE-1	B21OE 1.1	Office Automation and Designing	45	2	1	-	3
SEC-SB	21SBC 1.2	Office Management Tools	30	-	-	2	2
SEC-VB	21VBC 1.1	Health and Well-being	30	-	-	2	1
SEC-VB	21VBC 1.2	Physical Education-Yoga	30	-	-	2	1
Total							26

Note:

AECC- Ability Enhancement Compulsory Course

DSC - Discipline-Specific Course

OE- Open elective (course offered by the department to students of other stream)

DSE – Discipline-Specific Elective

SEC - VB Skill Enhancement Course -Value Based

SEC - SB Skill Enhancement Course -Skill Based

Continuous Internal Assessment – Scheme of Evaluation

For Theory Courses

End Semester Examination: 60%

Continuous Internal Assessment: 40%

Activities (CIA: 40 Marks)	Proposed and Approved Scheme		Total Marks
	IA-1	IA-2	
Session Test Maximum Marks	30	30	
1. Weightage (Marks)	10	10	20
2. Assignment (Marks)	20		20
i. Writing	10		
ii.Quiz / Presentation	05		
iii. Classroom participation	05		
Total			40

For Practical Courses

End Semester Examination: 50%

Continuous Internal Assessment: 50%

CIA (25 marks) + End Semester Exam (25 marks)

Activities	Total Marks
1. Lab Performance	10
2. Observation record	05
3. Internal exam	10
Total	25

B21DC 1.1: DISCRETE STRUCTURES
THEORY
Total Teaching Hours: 45
No. of Hours per Week: 3
(3 credits)

CObj	Course Objectives
CObj_1	To provide a strong understanding of the concepts of sets, relations and functions.
CObj_2	To provide good foundation of probabilities and statistical analysis
CObj_3	To distinguish between discrete and continuous random variables and to compute probabilities using discrete and continuous distribution.

CO	Course Outcomes
	After completion of this module, students should be able to:
CO1	Demonstrate the basic principles of sets and operations, relations and functions, mathematical induction.
CO2	Implement propositional and counting principles.
CO3	Apply the recurrence relations in computer science specific problem domains.
CO4	Compute probabilities using discrete and continuous distribution and apply in real world problems.
CO5	Implement practical solutions using graph theory.

CO-PO Mapping

	PO_1	PO_2	PO_3	PO_4	PO_5
CO_1	*	*		*	
CO_2	*	*		*	
CO_3	*	*		*	
CO_4	*	*	*	*	*
CO_5	*	*	*	*	*

Course Content

Sl. No.	Unit/chapter title	Content	Number of hours	Skills developed
1	Unit- I	Set Theory and Logic: Fundamentals of Set theory, Set Operations and the Laws of Set Theory, Counting and Venn Diagrams, Cartesian Products and Relations-Definition and types of relations, Representing relations using matrices and digraphs, Functions–One-to-One, Onto Functions, Function Composition and Inverse Functions. Fundamentals of Logic, Propositional Logic, Logical Connectives and Truth Tables, Logic Equivalence.	12 Hrs	Cognitive Skills
2	Unit- II	Mathematical Induction and Counting: Mathematical Induction, Basics of counting, Pigeonhole Principle, Permutation and Combinations, Binomial coefficients. Recurrence relations, Modeling with recurrence relations with examples of Fibonacci numbers and the tower of Hanoi problem. Divide and Conquer relations with examples.	12 Hrs	Analytical / Cognitive Skills
3	Unit- III	Probability: The Concept of Probability-Sample Spaces, Probability as Relative Frequency, Axiomatic Definition of Probability, Properties of Probability, Additive Property, Conditional Probability, Multiplicative Law of Probability, Law of Total Probability, Bayes' Formula, Independent Events. Random Variables, Distribution Functions, Discrete Random Variables, Continuous Random Variables, Probability Mass Function and Probability Density Function, Expectation and Variance.	10 Hrs	Cognitive / Synthesis Skills
4	Unit- IV	Graph Theory: Graphs: Introduction, Representing Graphs in memory, Graph Isomorphism, Operations on graphs. Trees: Introduction, Applications of Trees, Tree Traversal, Spanning Trees, Minimum cost Spanning Trees, Prim's and Kruskal's Algorithms. Euler and Hamiltonian Paths, Planar Graphs. Directed graphs: Fundamentals of Digraphs, Directed Graphs, Out-degree, in-degree, orientation, Eulerian and Hamilton directed graphs, tournaments.	11 Hrs	Cognitive / Analytical / Synthesis Skills

Books for Reference:

1. Kenneth H Rosen, Kamala Krithivasan (2022). Discrete Mathematics and its Applications (8th Edition). Mc Gram Hill.
2. S C Gupta and V K Kapoor (2020). Fundamentals of Mathematical Statistics (12th Edition). Sultan Chand & Sons.
3. S C Gupta(2018). Fundamentals of Statistics (7th Edition). Himalaya Publishing House.
4. Balakrishnan (2019).A text book of Graph Theory (2nd Edition).Springer.
5. Sheldon M Ross. (2020). Introduction to Probability and Statistics for Engineers and Scientists. (6th edition). Academic Press.
6. J. P. Tremblay and R.P. Manohar. (2017). Discrete Mathematical Structures with applications to Computer Science. Mc Graw Hill Ed. Inc.
7. Michael Baron. (2019). Probability and Statistics for Computer Scientists. (3rd Edition). CRC.

Web Resources:

1. <https://www.my-mooc.com/en/categorie/mathematics>
2. <http://www.nptelvideos.in/2012/11/discrete-mathematical-structures.html>
3. <https://ocw.mit.edu/courses/mathematics/>

**B21DC 1.2: PROBLEM SOLVING TECHNIQUES USING C
THEORY**
Total Teaching Hours: 45
No. of Hours per Week: 3
(3 credits)

CObj	Course Objectives
CObj_1	To inculcate necessary skills, design algorithms and flowcharts for developing applications to solve real world problems.
CObj_2	To provide appropriate knowledge of structured programming concepts using C.
CObj_3	To inculcate the ability to develop modular programs and small projects in C.

CO	Course Outcomes
	After completion of this module, students should be able to:
CO1	Devise algorithms and draw flow charts to provide solutions to problems.
CO2	Develop C programs by using the program constructs efficiently.
CO3	Apply proper data structure to efficiently store and retrieve data in memory.
CO4	Design modular programs to solve real world problems.
CO5	Create mini projects in C

CO-PO Mapping

	PO_1	PO_2	PO_3	PO_4	PO_5
CO_1	*	*	*	*	
CO_2	*	*	*	*	
CO_3	*	*	*	*	
CO_4	*	*	*	*	*
CO_5	*	*	*	*	*

Course Content

Sl. No.	Unit/chapter title	Content	Number of hours	Skills Developed
1	Unit- I	Introduction: The Role of Algorithms in Computing, Algorithms as a technique, Designing algorithms, Fundamental Algorithms: Finding the largest of three numbers, Exchanging the values of two variables, Counting, Summation of a set of numbers, Factorial Computation, Generating of the Fibonacci sequence, Reversing the digits of an integer, Checking if a given number is prime or not, Summation of two matrices.	10 Hrs	Cognitive Skills
2	Unit- II	C Programming: Getting Started, Variables and Arithmetic expressions. Input and Output: Standard input and output, formatted output-printf, variable length argument list, formatted input-scanf. Control Flow: Statements and Blocks, If-else, else-if, switch, loops: while loop, for loop, do while, break and continue, goto and labels. Factoring Methods: Finding the square root of a number, the smallest Divisor of an integer, the greatest common divisor of two integers, computing the prime factors of an integer, generation of pseudo random numbers, raising a number to a large power.	12 Hrs	Analytical / Cognitive / Employable Skills
3	Unit- III	Arrays: Definition, Linear arrays, Traversing Linear arrays, Inserting and deleting, Multi-dimensional arrays, Matrices and Sparse matrices. Array Techniques: Array order Reversal, Finding the maximum number in a set, removal of duplicates from an ordered array, partitioning an array, Finding the kth smallest element, multiplication of two matrices. Command line arguments. Storage classes. Structures and Unions in C. Preprocessor directives, Macros in C.	12 Hrs	Cognitive / Employable Skills Synthesis Skills
4	Unit- IV	Functions in C: Types of Functions, Passing arguments to functions, Nested and recursive functions in C. Pointers in C: pointers and address. Pointers as function arguments. Text processing and Pattern searching: User-defined functions to perform various string related operations, Naïve string pattern matching algorithm. User-defined header files.	11 Hrs	Analytical / Cognitive / Employable Skills Synthesis Skills

Books for Reference:

1. R.G.Dromey. (2008). How to Solve it by Computer. Pearson Education India.
2. Thomas H. Cormen, Charles E. Leiserson. (2009). Ronald L. Rivest, Clifford Stein, Introduction to Algorithms. 3rd Edition, The MIT Press Cambridge, Massachusetts London, England.
3. Brian M. Kernighan, and Dennis M. Ritchie. (2012). The C Programming Language. (2nd edition). Princeton Hall Software Series.
4. E. Balagurusamy. (2019). Programming in ANSI C. 8th Edition, McGrawHill
5. Steven S. Skiena. (2008). The Algorithm Design Module. 2nd Edition, Springer-Verlag London Limited.
6. Donald E. Knuth. (1997). The Art of Computer Programming. Volume 1: Fundamental Algorithms, 3rd Edition, Addison Wesley Longman.
7. Donald E. Knuth. (1998). The Art of Computer Programming. Volume 2: Seminumerical Algorithms, 3rd Edition, Addison Wesley Longman.
8. Greg Perry and Dean Miller. (2014). C programming Absolute Beginner's Guide. (3rd edition). Pearson Education, Inc.
9. Ashok N. Kamthane. (2006). Programming with ANSI and Turbo C. Pearson Education.

Web Resource:

1. <http://algorithmsforinterviews.com> Algorithms for Interviews
2. https://onlinecourses.nptel.ac.in/noc20_cs06/preview

B21DC 1.3: DATA STRUCTURES**THEORY****Total Teaching Hours: 45****No. of Hours per Week: 3****(3 credits)**

CObj	Course Objectives
CObj_1	To impart knowledge on storing and managing data in various structures
CObj_2	To emphasize the importance of data structures in developing and implementing efficient algorithms
CObj_3	To provide an understanding of the operations on different data structures and their applications

CO	Course Outcomes
	After completion of this module, students should be able to:
CO1	Demonstrate an understanding of the concepts, types and operations of data structures
CO2	Sort, search and implement higher order data structure using arrays.
CO3	Apply concepts of dynamic memory allocation, linked list in developing solutions to real world problems
CO4	Apply the concept of Stacks and Queues in real world applications
CO5	Identify and apply appropriate graph and tree data structure to solve a given problem.

CO-PO Mapping

	PO_1	PO_2	PO_3	PO_4	PO_5
CO_1	*	*		*	
CO_2	*	*		*	
CO_3	*	*	*	*	*
CO_4	*	*	*	*	*
CO_5	*	*	*	*	*

Course Content

Sl. No.	Unit/chapter title	Content	Number of hours	Skills Developed
1	Unit- I	Introduction and Overview: Definition, Elementary data organization, Data Structures, data Structures operations, Abstract data types. control structures, Complexity of algorithms, asymptotic notations for complexity of algorithms, time-space trade off. Arrays as data structure, arrays as ADT, Representation of Linear Arrays in Memory. Searching:, Sequential Search, Binary Search, Comparison of search Methods.	10 Hrs	Cognitive Skills
2	Unit- II	Linked list: Definition, Representation of Singly Linked List in memory, Traversing a Singly linked list, Searching in a Singly linked list, Memory allocation, Garbage collection, Insertion into a singly linked list, Deletion from a singly linked list; Doubly linked list, Header linked list, Circular linked list. Stacks: Definition, Array representation of stacks, Linked representation of stacks, Stack as ADT, Arithmetic Expressions: Polish Notation, Conversion of infix expression to postfix expression, Evaluation of Postfix expression, Application of Stacks, Recursion, Towers of Hanoi, Implementation of recursive procedures by stack.	12 Hrs	Analytical / Cognitive Skills
3	Unit- III	Queues: Definition, Array representation of queue, Linked list representation of queues. Types of queue: Simple queue, Circular queue, Double-ended queue, Priority queue, Operations on Queues, Applications of queues. Binary Trees: Definitions, Tree Search, Traversal of Binary Tree, Building a Binary Search Tree, Tree Sort, Height Balance: AVL Trees, Contiguous Representation of Binary Trees: Heaps, Applications of Trees. Graphs: Mathematical Background, Computer Representation, Graph Traversal	12 Hrs	Cognitive / Synthesis Skills
4	Unit- IV	Sorting: Introduction and Notation, Bubble sort, Insertion Sort, Selection Sort, Divide And Conquer: Merge sort, Quick sort. Hashing: Sparse Tables, Choosing a Hash function, Collision Resolution with Open Addressing, Collision Resolution by Chaining.	11 Hrs	Cognitive / Analytical / Synthesis skills

Books for Reference:

1. Seymour Lipschutz. (2011). Data Structures with C. Schaum's outLines, Tata Mc Graw Hill,.
2. Robert Kruse. (2009). C.L.Tondo, Bruce Leung, Shashi Mogalla, Data Structures and Program Design using C. Pearson Education.
3. Mark Allen Weiss. (2013). Data Structures and Algorithm Analysis in C. Second Edition, Pearson Education.
4. Forouzan. (2008). A Structured Programming Approach using C. 2nd Edition, Cengage Learning India.
5. Ellis Horowitz. (2008). Fundamentals of Data Structures in C". Second Edition, Universities Press.

Web Resources:

1. <https://www.geeksforgeeks.org/data-structures/>
2. <https://www.javatpoint.com/data-structure-tutorial>

B21DC 1.4 : C PROGRAMMING LAB
PRACTICAL
Total Teaching Hours: 60
No. of Hours per Week: 4
(2 credits)

Programs	Skills Developed
1. Write a C program to read radius of a circle and to find area and circumference 2. Write a C program to read three numbers and find the biggest of three 3. Write a C program to check whether the number is prime or not 4. Write a C program to read a number, find the sum of the digits, reverse the number and check it for palindrome 5. Write a C program to read numbers from keyboard continuously till the user presses 999 and to find the sum of only positive numbers 6. Write a C program to read percentage of marks and to display appropriate message (Demonstration of else-if ladder) 7. Write a C program to find the roots of quadratic equation 8. Write a C program to read marks scored by n students and find the average of marks (Demonstration of single dimensional array) 9. Write a C program to remove Duplicate Element in a single dimensional Array 10. Write a C program to perform addition and subtraction of Matrices 11. Write a C program to find factorial of a number 12. Write a C program to generate fibonacci series 13. Write a C program to remove Duplicate Element in a single dimensional Array 14. Write a C program to find the length of a string without using built in function 15. Write a C program to demonstrate string functions 16. Write a C program to read, display and add two m x n matrices using functions 17. Write a C program to read a string and to find the number of alphabets, digits, vowels, consonants, spaces and special characters. 18. Write a C program to Swap Two Numbers using Pointers	Employable / Analytical Skills

19. Write a C program to demonstrate student structure to read & display records of n students

20. Write a C program to demonstrate the difference between structure & union.

B21DC 1.5 : DATA STRUCTURES LAB**PRACTICAL****Total Teaching Hours: 60****No. of Hours per Week: 4****(2 credits)**

List of Programs	Skills Developed
1. Write a program to implement Linear search 2. Write a program to implement Binary search 3. Write a program to implement Bubble Sort Algorithm 4. Write a program to implement Selection Sort Algorithm 5. Write a program to implement Stack data structure 6. Write a program to convert an infix expression to its postfix expression 7. Write a program to evaluate a postfix expression 8. Write a recursive program to find GCD of three numbers. 9. Write a program to insert the elements into a linear queue and delete elements from the list. Display your list after each insertion and deletion. 10. Write a program to insert the elements into a circular queue and delete elements from the queue. Display your queue after each insertion and deletion. 11. Write a program to insert the elements into a singly linked list and delete elements from the list. Display your list after each insertion and deletion. 12. Write a program to create a binary tree and find the height of the tree 13. Write a program to create a binary search tree with the elements and perform inorder, preorder and post order traversal. 14. Write a program to Sort the following elements using heap sort 15. Given two strings perform the following: I. Find the length of the string II. Concatenate the strings III. Extract the substring IV. Replace a string with another string	Employable / Analytical / Cognitive Skills

21SBC 1.1: OFFICE MANAGEMENT TOOLS
PRACTICALS
Total Teaching Hours: 30
No. of Hours per Week: 2
(2 credits)

CObj	Course Objectives
CObj_1	To provide hands-on experience on word processing
CObj_2	To impart the skills to work on data using spreadsheets
CObj_3	To equip the skills to design presentations

CO	Course Outcomes
	After completion of this module, students should be able to:
CO1	Demonstrate an understanding of creating formatted documents
CO2	Acquire skills to analyze data using spreadsheets
CO3	Design attractive presentations
CO4	Create charts in spreadsheets and visualize the data
CO5	Demonstrate an understanding of the usage of common shortcut keys in the office management tools

CO-PO Mapping

	PO_1	PO_2	PO_3	PO_4	PO_5
CO_1	*	*		*	
CO_2	*	*		*	
CO_3	*	*	*	*	*
CO_4	*	*	*	*	*
CO_5	*	*	*	*	*

Course Content

Sl. No.	Unit/chapter title	Content	Number of hours	Skills developed
1	Unit- I Word Processing	Working with Documents - Formatting page & setting Margins, Converting files to different formats, Importing & Exporting documents, Sending files to others, Using Toolbars, Ruler, Using Icons, using help, Formatting Documents - Setting Font styles, Font selection, Setting Paragraph style, Alignments, Indents, Line Space, Margins, Bullets & Numbering. Setting Page style - Formatting Page, Page tab, Margins, Layout settings, Paper tray, Border & Shading, Columns, Header & footer, Setting Footnotes & endnotes – Shortcut Keys; Inserting manual page break, Creating sections & frames, Anchoring & Wrapping, Table of Contents, Index, Creating Master Documents, Web page. Creating Tables- Table settings, Borders, Alignments, Insertion, deletion, Merging, Splitting, Sorting, and Formula, Drawing - Inserting ClipArts, Tools – Word Completion, Spell Checks, Mail merge, Templates, Creating contents for books, Creating Letter/Faxes, Creating Web pages, Using Wizards, Tracking Changes, Security, Digital Signature. Printing Documents Skill based exercises to be done: 1. Creating the documents with Special effects like underline, bold, different size, different font and different color. 2. Creating Paragraphs Inserting Date & Time, Pictures, Bullets & Numbering, indentation etc. in MS-Word, librewriter 3. Formatting features of MS-Word: it includes paper-size, margins, header and footer, page no. and creation of table options. 4. Creation of mail merge for sending the new year wish to your class group.	10 Hrs	Transferable / Employable / Cognitive Skills
2	Unit- II Spreadsheet	Spread Sheet & its Applications, Opening Spreadsheet, Menus - main menu, Formula Editing, Formatting, Toolbars, Using Icons, Using help, Shortcuts, Spreadsheet types. Working with Spreadsheets- opening, Saving files, setting Margins, Converting files to different formats (importing, exporting, sending files to others), Spread sheet addressing - Rows, Columns & Cells, Referring Cells & Selecting Cells – Shortcut Keys. Entering & Deleting Data- Entering data, Cut, Copy, Paste, Undo, Redo, Filling Continuous rows, columns,	15 Hrs	Transferable / Employable / Cognitive / Analytical Skills

		Highlighting values, Find, Search & replace, Inserting Data, Insert Cells, Column, rows & sheets, Symbols, Data from external files, Frames, Clipart, Pictures, Files etc, Inserting Functions, Manual breaks, Setting Formula - finding total in a column or row, Mathematical operations (Addition, Subtraction, Multiplication, Division, Exponentiation), Using other Formulae. Formatting Spreadsheets- Labelling columns & rows, Formatting- Cell, row, column & Sheet, Category - Alignment, Font, Border & Shading, Hiding/ Locking Cells, Anchoring objects, Formatting layout for Graphics, Clipart etc., Worksheet Row & Column Headers, Sheet Name, Row height & Column width, Visibility - Row, Column, Sheet, Security, Sheet Formatting & style, Sheet background, Colour etc, Borders & Shading – Shortcut keys. Working with sheets – Sorting, Filtering, Validation, Consolidation, and Subtotal. Creating Charts - Drawing. Printing. Using Tools – Error checking, Spell Checks, Formula Auditing, Creating & Using Templates, Pivot Tables, Tracking Changes, Security, Customization. Skill based exercises to be done: 1. Creating Worksheets in Excel-, Inserting, Deleting, Copying, Moving worksheets in Excel Usage of formulas, Built-in functions in Excel 2. Graph-Plotting facilities in MS Excel 3. Writing conditional expressions (using IF) and Using logical functions (AND, OR, NOT) Using lookup and reference functions (VLOOKUP, HLOOKUP, MATCH, INDEX) 4. Data Validations :Specifying a valid range of values for a cell, Specifying a list of valid values for a cell, Specifying custom validations based on formula for a cell, Sorting and Filtering Data ,Macro facility in MS Excel		
3	Unit- III Presentation	Introduction to presentation – Opening new presentation, Different presentation templates, Setting backgrounds, Selecting presentation layouts. Creating a presentation - Setting Presentation style, Adding text to the Presentation. Formatting a Presentation - Adding style, Colour, gradient fills, Arranging objects, Adding Header & Footer, Slide Background, Slide layout. Adding Graphics to the Presentation- Inserting pictures, movies, tables etc into presentation, Drawing Pictures using Draw. Adding Effects to the Presentation- Setting Animation & transition effect. Printing Handouts, Generating Standalone	5 Hrs	Transferable / Employable / Cognitive Skills

		Presentation viewer. Skill based exercises to be done: 1. Creating a presentation in PowerPoint-- Inserting/Deleting slides in PowerPoint. 2. Creation of Slide transition and Editing special effects in PowerPoint. 3. Creation of Inserting sound and picture in PowerPoint. 4. Creation of Inserting chart and organization chart in PowerPoint.		

Books for Reference:

1. Wallace Wang. (2018). Microsoft Office 2019 for Dummies. Wiley.
2. Ken Bluttman. (2020). Microsoft Excel Formulas & Functions for Dummies. Wiley
3. CA Manmeet Singh Mehta. (2022). Microsoft Excel Professional 2021 Guide. BPB Publications.
4. [Beth Brown](#). (2019). Microsoft PowerPoint 2019 In 90 Pages. Belleyre Books.
5. John Walkenbach, Herb Tyson, Faithe Wempen, Cary N. Prague, Michael R. groh, Peter G. Aitken, and Lisa a. Bucki. (2007). Office 2007 bible. Wiley.

COMPUTER SCIENCE OPEN ELECTIVE FOR FIRST SEMESTER
B21OE1.1: OFFICE AUTOMATION AND DESIGNING
THEORY

Total Teaching Hours: 45

No. of Hours per Week: 3

(3 credits)

CObj	Course Objectives
CObj_1	To provide hands-on experience on word processing
CObj_2	To impart skills to work on data using spreadsheets
CObj_3	To instill skills to design presentations

CO	Course Outcomes
	After completion of this module, students should be able to:
CO1	Create formatted documents.
CO2	Analyze and interpret data using spreadsheets.
CO3	Design attractive presentations.
CO4	Create charts in spreadsheets and visualize the data.
CO5	Demonstrate the usage of common shortcut keys in the office management tools.

Course Content

Sl. No.	Unit/chapter title	Content	Number of hours	Skills Developed
1	Unit- I	Working with Documents -Opening & Saving files, Editing text documents, Inserting, Deleting, Cut, Copy, Paste, Undo, Redo, Find, Search, Replace, Formatting page & setting Margins, Converting files to different formats, Importing & Exporting documents, Sending files to others, Using Tool bars, Ruler, Using Icons, using help, Formatting Documents - Setting Font styles, Font selection- style, size, colour etc, Type face - Bold, Italic, Underline, Case settings, Highlighting, Special symbols, Setting Paragraph style, Alignments, Indents, Line Space, Margins, Bullets & Numbering. Setting Page style - Formatting Page, Page tab, Margins, Layout settings, Paper tray, Border & Shading, Columns, Header & footer, Setting Footnotes & end notes – Shortcut Keys; Inserting manual page break, Column break and line break, Creating sections & frames, Anchoring & Wrapping, Setting Document styles, Table of Contents, Index, Page Numbering, date & Time, Author etc., Creating Master Documents, Web page. Creating Tables- Table settings, Borders, Alignments, Insertion, deletion, Merging, Splitting, Sorting, and Formula, Drawing - Inserting ClipArts, Pictures/Files etc., Tools – Word Completion, Spell Checks, Mail merge, Templates, Creating contents for books, Creating Letter/Faxes, Creating Web pages, Using Wizards, Tracking Changes, Security, Digital Signature. Printing Documents – Shortcut keys.	10 Hrs	Transferable / Employable / Cognitive / Analytical Skills
2	Unit- II	Spread Sheet & its Applications, Opening Spreadsheet, Menus - main menu, Formula Editing, Formatting, Toolbars, Using Icons, Using help, Shortcuts, Spreadsheet types. Working with Spreadsheets- opening, Saving files, setting Margins, Converting files to different formats (importing, exporting, sending files to others), Spread sheet addressing - Rows, Columns & Cells, Referring Cells & Selecting Cells – Shortcut Keys. Entering & Deleting Data- Entering data, Cut, Copy, Paste, Undo, Redo, Filling Continuous rows, columns, Highlighting values, Find, Search & replace, Inserting Data, Insert Cells, Column, rows & sheets, Symbols, Data from external files, Frames, Clipart, Pictures, Files etc, Inserting Functions, Manual breaks, Setting Formula - finding total in a column or row, Mathematical operations (Addition, Subtraction, Multiplication, Division, Exponentiation), Using other Formulae. Formatting Spreadsheets- Labelling columns & rows, Formatting-Cell, row, column & Sheet, Category - Alignment, Font, Border & Shading, Hiding/ Locking Cells, Anchoring objects, Formatting layout for Graphics, Clipart etc.,	15 Hrs	Transferable / Employable / Cognitive / Analytical Skills

		Worksheet Row & Column Headers, Sheet Name, Row height & Column width, Visibility - Row, Column, Sheet, Security, Sheet Formatting & style, Sheet background, Colour etc, Borders & Shading – Shortcut keys. Working with sheets – Sorting, Filtering, Validation, Consolidation, and Subtotal. Creating Charts - Drawing. Printing. Using Tools – Error checking, Spell Checks, Formula Auditing, Creating & Using Templates, Pivot Tables, Tracking Changes, Security, Customization.		
3	Unit- III	Introduction to presentation – Opening new presentation, Different presentation templates, Setting backgrounds, Selecting presentation layouts. Creating a presentation - Setting Presentation style, Adding text to the Presentation. Formatting a Presentation - Adding style, Colour, gradient fills, Arranging objects, Adding Header & Footer, Slide Background, Slide layout. Adding Graphics to the Presentation- Inserting pictures, movies, tables etc into presentation, Drawing Pictures using Draw. Adding Effects to the Presentation- Setting Animation & transition effect. Printing Handouts, Generating Standalone Presentation viewer	10 Hrs	Transferable / Employable / Cognitive / Analytical Skills
4	Unit- IV	Introduction to Designing , Open source design tools, card designing, Poster making	10 Hrs	Employable / Cognitive / Analytical Skills

Books for Reference:

1. Wallace Wang. (2018). Microsoft Office 2019 for Dummies. Wiley.
2. Ken Bluttman. (2020). Microsoft Excel Formulas & Functions for Dummies. Wiley
3. CA Manmeet Singh Mehta. (2022). Microsoft Excel Professional 2021 Guide. BPB Publications.
4. Beth Brown. (2019). Microsoft PowerPoint 2019 In 90 Pages. Belleyre Books.
5. John Walkenbach, Herb Tyson, Faithe Wempen, Cary N. Prague, Michael R. Groh, Peter G. Aitken, and Lisa A. Bucki. (2007). Office 2007 bible. Wiley.

Web Resources:

1. <https://spreadsheeto.com/excel-crash-course/>
2. <https://24slides.com/presentbetter/powerpoint-101-the-ultimate-tutorial-for-beginners>
3. <https://opentextbc.ca/computerstudies/part/basic-word-processing-skills/>



MATRIX AND SYLLABUS

For the Programme Bachelor of Computer Applications (B.C.A)

NEP Based Curriculum (2021 onwards)

II Semester

NEP- Curriculum Framework

Bachelor of Computer Applications (B.C.A) - Course Matrix (w.e.f. 2021-22 onwards)

II SEMESTER							
Code	Course Code	Course	Teaching Hours	Course Components			Credits
				L	T	P	
AECC	B21KN2.1/ B21HN2.1/ B21AE2.1	Language-1 (Kannada/Hindi/Additional English)	45	3	1		3
AECC	B21GE2.1	Language-2 (Generic English)	60	3	1		3
AECC	21SBC 2.1	Environmental Studies	45	2	1	-	3
DSC2	B21DC 2.1	Computer Architecture	45	2	1	-	3
DSC2	B21DC 2.2	Object Oriented Programming Using Java	45	2	1	-	3
DSC2	B21DC 2.3	DataBase Management Systems	45	2	1	-	3
DSC2	B21DC 2.4	Java Lab	60	-	-	4	2
DSC2	B21DC 2.5	DBMS Lab	60	-	-	4	2
OE-2	B21OE 2.1	Cyber Space	45	2	1	-	3
SEC-VB	21VBC 2.1	NCC/NSS/Cultural	30	-	-	2	1
SEC-VB	21VBC 2.2	Sports	30	-	-	2	1
Total							27

Note:

AECC- Ability Enhancement Compulsory Course

DSC - Discipline-Specific Course

OE- Open elective (course offered by the department to students of other stream)

DSE – Discipline-Specific Elective

SEC - VB Skill Enhancement Course -Value Based

SEC - SB Skill Enhancement Course -Skill Based

Continuous Internal Assessment – Scheme of Evaluation

For Theory Courses

End Semester Examination: 60%

Continuous Internal Assessment: 40%

Activities (CIA: 40 Marks)	Proposed and Approved Scheme		Total Marks
	IA-1	IA-2	
Session Test Maximum Marks	30	30	
1. Weightage (Marks)	10	10	20
2. Assignment (Marks)	20		20
i. Writing	10		
ii.Quiz / Presentation	05		
iii. Classroom participation	05		
Total			40

For Practical Courses

End Semester Examination: 50%

Continuous Internal Assessment: 50%

CIA (25 marks) + End Semester Exam (25 marks)

Activities	Total Marks
1. Lab Performance	10
2. Observation record	05
3. Internal exam	10
Total	25

B21DC 2.1: COMPUTER ARCHITECTURE
THEORY
Total Teaching Hours: 45
No. of Hours per Week: 3
(3 credits)

CObj	Course Objectives
CObj_1	To provide an understanding of the basic concepts and structure of computers and concepts of Instruction code and computer register.
CObj_2	To instill knowledge of different types of addressing modes and data transfer techniques.
CObj_3	To provide knowledge of the memory hierarchy and types in computer architecture and concepts of parallel computing.

CO	Course Outcomes
	After completion of this module, students should be able to:
CO1	Comprehend the fundamental concepts of electronics.
CO2	Demonstrate an understanding of the functional units of a processor.
CO3	Develop an understanding on the addressing modes, instruction formats and program control statements.
CO4	Demonstrate a good understanding of system memory hierarchy.
CO5	Apply the basic concept of parallel computing.

CO-PO Mapping

	PO_1	PO_2	PO_3	PO_4	PO_5
CO_1	*	*			
CO_2	*	*	*		
CO_3	*	*			
CO_4	*	*	*	*	*
CO_5	*		*	*	*

Course Content

Sl. No.	Unit/chapter title	Content	Number of hours	Skills developed
1	Unit- I	Number Systems: Binary, Octal, Hexadecimal numbers, base conversion, addition, subtraction of binary numbers, one's and two's complements, positive and negative numbers, character codes ASCII, EBCDIC. Computer Arithmetic: Addition and Subtraction, Multiplication and Division algorithms, Floating-point Arithmetic Operations, Decimal arithmetic operations. Structure of Computers: Computer types, Functional units, Basic operational concepts, Von-Neumann Architecture, Bus Structures, Software, Performance, Multiprocessors and Multicomputer, Digital Logic Circuits: Logic gates, Boolean algebra, Map Simplification. Combinational Circuits: Half Adder , Full Adder, flip flops. Sequential circuits: Shift registers, Counters, IntegratedCircuits, Mux, Demux, Encoder, Decoder. Data representation: Fixed and Floating point.	11 Hrs	Cognitive Skills
2	Unit- II	Basic Computer Organization and Design: Instruction codes, Computer Registers, Computer Instructions and Instruction cycle. Timing and Control, Memory-Reference Instructions, Input-Output and interrupt. Central processing unit: Stack organization, Instruction Formats, Addressing Modes, Data Transfer and Manipulation, Complex Instruction Set Computer (CISC) Reduced Instruction Set Computer (RISC), CISC vs RISC.	11 Hrs	Analytical / Cognitive Skills
3	Unit- III	Register Transfer and Micro-operations: Register Transfer Language, Register Transfer, Bus and Memory Transfers, Arithmetic Micro-Operations, Logic Micro-Operations, Shift Micro-Operations, Arithmetic logic shift unit. Micro-programmed Control: Control Memory, Address Sequencing, Micro-Program example, Design of Control Unit. Input Output: I/O interface, Programmed IO, Memory Mapped IO, Interrupt Driven IO, DMA. Instruction level parallelism: Instruction level parallelism (ILP)-overcoming data hazards, limitations of ILP.	12 Hrs	Cognitive Skills

4	Unit- IV	Memory System: Memory Hierarchy, Semiconductor Memories, RAM(Random Access Memory), Read Only Memory (ROM), Types of ROM, Cache Memory, Performance considerations, Virtual memory, Paging, Secondary Storage, RAID. Multiprocessors And Thread level Parallelism: Characteristics of multiprocessors, Multi-Threaded Architecture, Distributed Memory MIMD Architectures, Interconnection structures.	11 Hrs	Cognitive / Analytical skills

Books for Reference:

1. Mano M Morris.(2019).Computer System Architecture. (3rd edition). Pearson India.
2. William Stallings.(2016). Computer Organization and Architecture designing for performance. (10th edition). Pearson
3. Subrata Ghoshal, Computer Architecture And Organization. Pearson India(2011).
4. Andrew S. Tanenbaum.(2006). Structured Computer Organization. (5th edition). Pearson Education Inc
5. Carl Hamacher, Zvonks Vranesic, SafeaZaky.(2002). Computer Architecture And Organization. (5th edition) McGraw Hill New Delhi, India.
6. Kai Hwang.(2008) , Advanced Computer Architecture - Parallelism, Scalability, Programmability. Tata Mcgraw-Hill.

Web Resources:

1. <https://www.javatpoint.com/computer-organization-and-architecture-tutorial>
2. <https://www.geeksforgeeks.org/computer-organization-and-architecture-tutorials/>

B21DC 2.2: OBJECT ORIENTED PROGRAMMING USING JAVA
THEORY
Total Teaching Hours: 45
No. of Hours per Week: 3
(3 credits)

CObj	Course Objectives
CObj_1	To impart knowledge of object-oriented programming concepts using Java
CObj_2	To instill the skills to create graphical user interface using graphical tools
CObj_3	To provide knowledge for designing and implementing console based and GUI based Java applications.

CO	Course Outcomes
	After completion of this module, students should be able to:
CO1	Demonstrate a good understanding of object oriented concepts using java.
CO2	Design, write, and test Java programs to provide solutions to a given problem.
CO3	Design and implement console based and GUI based Java applications
CO4	Create multithreaded applications and animations in Java
CO5	Apply the acquired skills to implement object-oriented projects using Java

CO-PO Mapping

	PO_1	PO_2	PO_3	PO_4	PO_5
CO_1	*	*			
CO_2	*	*		*	
CO_3	*	*	*	*	*
CO_4	*	*	*	*	*
CO_5	*	*	*	*	*

Course Content

Sl. No.	Unit/chapter title	Content	Number of hours	Skills developed
1	Unit- I	Introduction to Java: Basics of Java programming, Data types, Variables, Operators, Control structures including selection, Looping, Java methods, Overloading, Math class, Arrays in java. Objects and Classes: Basics of objects and classes in java, Constructors, Finalizer, Visibility modifiers, Methods and objects, Inbuilt classes like String, Character, String Buffer, File, this reference	11 Hrs	Cognitive Skills
2	Unit- II	Inheritance and Polymorphism: Inheritance in java, Super and subclass, Overriding, Object class, Polymorphism, Dynamic binding, Generic programming, Casting objects, Instance of operator, Abstract class, Interface in java, Package in java, UTIL package.	12 Hrs	Analytical / Cognitive / Employable Skills
3	Unit- III	Event and GUI programming: Event handling in java, Event types, Mouse and key events, Frames, Layout Managers: Flow Layout, Border Layout, Grid Layout, GUI components like Buttons, Check Boxes, Radio Buttons, Labels, TextFields, Text Areas, Choice, Lists, Applet and its life cycle. Exception handling with try-catch-finally, multi-catch, Arithmetic Exception, NumberFormatException, ArrayIndexOutOfBoundsException, Introduction to swing,	12 Hrs	Cognitive / Synthesis / Employable Skills
4	Unit- IV	Multithreading in java: Thread life cycle and methods, Runnable interface, Thread synchronization, Introduction to Collections in java, Introduction to JavaBeans and Network Programming. I/O programming: Text and Binary I/O, Binary I/O classes, Object I/O, Random Access Files. Reading and writing bytes from/to a file, Reading and writing characters from/to a file.	10 Hrs	Cognitive / Analytical / Synthesis / Employable Skills

Books for Reference:

1. E. Balagurusamy. (2007). Programming with JAVA, McGraw Hill, New Delhi
2. Raj Kumar Buyya,. (2014). Object Oriented Programming with JAVA, McGraw Hill, 2009
3. Herbert Schildt. (2014). Java A Beginner's Guide – Create, Compile, and Run Java Programs Today, Sixth Edition, Oracle Press
4. Ken Arnold, James Gosling. (2005). The Java Programming Language, Fourth Edition, Addison Wisely.
5. Herbert Schildt. (2007). The Complete Reference Java, 7th Edition, McGraw Hill

Web Resource:

1. <https://docs.oracle.com/javase/tutorial/>
2. <https://javabeginnerstutorial.com/core-java-tutorial/>

B21DC 2.3: DATABASE MANAGEMENT SYSTEMS**THEORY****Total Teaching Hours: 45****No. of Hours per Week: 3****(3 credits)**

CObj	Course Objectives
CObj_1	To provide knowledge on organizing and maintaining data in a database.
CObj_2	To provide an understanding of the mathematical principles and concepts implemented in DBMS.
CObj_3	To impart knowledge on storing, manipulating and retrieving data efficiently and effectively using DBMS.

CO	Course Outcomes
	After completion of this module, students should be able to:
CO1	Demonstrate an understanding of the fundamental elements of relational database management systems.
CO2	Apply the concepts of relational data model, entity-relationship model, relational database design, relational algebra and SQL.
CO3	Design ER-models to represent database applications effectively to solve societal problems.
CO4	Formulate SQL queries to handle data in relational databases and apply the acquired skills to solve research problems.
CO5	Create database designs, applying normalization and familiarize with transaction processing.

CO-PO Mapping

	PO_1	PO_2	PO_3	PO_4	PO_5
CO_1	*	*			
CO_2	*	*			
CO_3	*	*	*	*	*
CO_4	*	*	*	*	*
CO_5	*	*	*	*	*

Course Content

Sl. No.	Unit/chapter title	Content	Number of hours	Skills developed
1	Unit- I	Databases and Database Users: Introduction, an example, Characteristics of the Database Approach, Actors on the Scene, Workers behind the Scene, Advantages of Using DBMS Approach, A Brief History of Database Applications, When Not to Use a DBMS. Database System Concepts and Architecture: Data Models, Schemas, and Instances, Three-schema Architecture and Data Independence, Database Languages and Interfaces, The Database System Environment, Centralized and Client-Server Architectures, Classification of Database Management Systems.	10 Hrs	Cognitive Skills
2	Unit- II	Data Modeling Using Entity-Relationship Model: Using High-Level Conceptual Data Models for Database Design, An Example Database Application, Entity Types, Entity Sets, Attributes and Keys, Relationship Types, Relationship Sets, Roles and Structural Constraints, Weak Entity Types, Refining the ER Design Company Database Diagrams, Naming Conventions and Design. Issues, File organization and storage, secondary storage devices, type of single level ordered index, multi-level indexes, indexes on multiple keys, other types of indexes.	12 Hrs	Analytical / Cognitive / Employable Skills
3	Unit- III	Relational Model and Relational Algebra: Relational Model Concepts, Relational Model Constraints and Relational Database Schemas, Update Operations, Transactions and Dealing with Constraint Violations, Unary Relational Operations: SELECT and PROJECT, Relational Algebra Operations from SET Theory, Binary Relational Operations: JOIN and DIVISION, Additional Relational Operations, Examples of Queries in Relational Algebra. Relational Database Design: Anomalies in a database, functional dependency, normal forms, lossless join and dependency, BCNF, normalization through synthesis, higher order normal forms. SQL- SQL Data Definition and Data Types, Specifying Constraints in SQL, Schema Change Statements in SQL, Basic Queries in SQL, More Complex SQL Queries, Insert, Delete and Update Statements in SQL, Specifying Constraints as Assertion and Trigger, Views(Virtual Tables) in SQL, Embedded SQL, Dynamic SQL	12 Hrs	Cognitive / Employable Skills Synthesis Skills

4	Unit- IV	Introduction to transaction processing, transaction and system concepts, desirable properties of transactions, transaction support in SQL. Concurrency control techniques: two-phase locking techniques, concurrency control based on timestamp ordering. Recovery techniques: recovery concepts, recovery in multi-database systems, database backup and recovery from catastrophic failures.	11 Hrs	Analytical / Cognitive / Employable Skills Synthesis Skills

Books for Reference:

1. Elmasri and Navathe. (2016). Fundamentals of Database Systems, 7th Edition, Addison -Wesley.
2. Silberschatz, Korth and Sudharshan. (2019). Database System Concepts, 7th Edition, Tata McGraw Hill.
3. C.J. Date, A. Kannan, S. Swamynatham. (2009). An Introduction to Database Systems, 8th Edition, Pearson education
4. Raghu Ramakrishnan and Johannes. (2003).Gehrke Database Management Systems, 3rd Edition, McGraw- Hill.

Web Resources:

1. <https://www.javatpoint.com/dbms-tutorial>
2. <https://www.geeksforgeeks.org/dbms/>
3. <https://www.tutorialspoint.com/dbms/index.htm>

B21DC 2.4 : JAVA LAB
PRACTICAL
Total Teaching Hours: 60
No. of Hours per Week: 4
(2 credits)

List of Programs	Skills Developed
1. Write a simple java application, to print the message, Welcome to java” 2. Write a program to display the month of a year. Months of the year should be held in an array. 3. Write a program to demonstrate a division by zero exception 4. Write a program to create a user defined exception say Pay Out of Bounds.. 5. Write a java program to add two integers and two float numbers. When no arguments are supplied, give a default value to calculate the sum. Use function overloading. 6. Write a program to perform mathematical operations. Create a class called AddSub with methods to add and subtract. Create another class called MulDiv that extends from AddSub class to use the member data of the super class. MulDiv should have methods to multiply and divide A main function should access the methods and perform the mathematical operations. 7. Write a program with a class variable that is available for all instances of a class. Use static variable declaration. Observe the changes that occur in the object’s member variable values. 8. Write a java program to create a student class with following attributes: Enrollment_id: Name, Mark of sub1, Mark of sub2, mark of sub3, Total Marks. Total of the three marks must be calculated only when the student passes in all three subjects. The pass mark for each subject is 50. If a candidate fails in any one of the subjects his total mark must be declared as zero. Using this condition, write a constructor for this class. Write separate functions for accepting and displaying student details. In the main method create an array of three student objects and display the details. 9. In a college first year class are having the following attributesName of the class (BCA, BCom, BSc), Name of the staff No of the students in the class, Array of students in the class 10. Define a class called first year with above attributes and define a suitable	Employable / Analytical Skills

constructor. Also write a method called bestStudent() which processes a first-year object and returns the student with the highest total mark. In the main method define a first-year object and find the best student of this class

11. Write a Java program to define a class called employee with the name and date of appointment. Create ten employee objects as an array and sort them as per their date of appointment. ie, print them as per their seniority.
12. Create a package 'student.Fulltime.BCA' in your current working directory
 - a. Create a default class student in the above package with the following attributes: Name, age, sex.
 - b. Have methods for storing as well as displaying
13. Write a small program to catch Negative Array Size Exception. This exception is caused when the array is initialized to negative values.
14. Write a program to handle Null Pointer Exception and use the "finally" method to display a message to the user.
15. Write a program which create and displays a message on the window
16. Write a program to draw several shapes in the created window
17. Write a program to create an applet and draw grid lines
18. Write a program which creates a frame with two buttons: father and mother. When we click the father button the name of the father, his age and designation must appear. When we click mother, similar details of mother also appear.
19. Create a frame which displays your personal details with respect to a button click
20. Create a simple applet which reveals the personal information of yours.
21. Write a program to move different shapes according to the arrow key pressed.
22. Write a java Program to create a window when we press M or m the window displays Good Morning, A or a the window displays Good After Noon E or e the window displays Good Evening, N or n the window displays Good Night
23. Demonstrate the various mouse handling events using suitable examples.
24. Write a program to create menu bar and pull-down menus.

B21DC2.5: DBMS LAB
PRACTICAL
Total Teaching Hours: 60
No. of Hours per Week: 4
(2 credits)

Programs to be done using any DBMS software	Skills Developed
PART – A 1. Draw E-R diagram and convert entities and relationships to relation table for a given scenario. Two assignments shall be carried out i.e. consider two different scenarios (eg. bank, college) 2. Consider the Company database with following Schema EMPLOYEE (FNAME, MINIT, LNAME, SSN, BDATE, ADDRESS, SEX, SALARY, SUPERSSN, DNO) DEPARTMENT (DNAME, DNUMBER, MGRSSN, MSRSTARTDATE) DEPT_LOCATIONS (DNUMBER, DLOCATION) PROJECT (PNAME, PNUMBER, PLOCATION, DNUM) WORKS_ON (ESSN, PNO<HOURS) DEPENDENT (ESSN, DEPENDENT_NAME, SEX, BDATE, RELATIONSHIP) 3. Perform the following: Viewing all databases, Creating a Database, Viewing all Tables in a Database, Creating Tables (With and Without Constraints), Inserting/Updating/Deleting Records in a Table, Saving (Commit) and Undoing (rollback) 4. Perform the following: Altering a Table, Dropping/Truncating/Renaming Tables, Backing up / Restoring a Database. 5. For a given set of relation schemes, create tables and perform the following Simple Queries, Simple Queries with Aggregate functions, Queries with Aggregate functions (group by and having clause). 6. Execute the following queries How the resulting salaries if every employee working on the ‘Research’ Departments is given a 10% raise. Find the sum of the salaries of all employees of the ‘Accounts’ department, as well as the maximum salary, the minimum salary, and the average salary in this department 7. Execute the following queries Retrieve the name of each employee Controlled by Department number 5 (use EXISTS operator). Retrieve the name of each dept and number of employees working in each Department which has at least 2 employees 8. Execute the following queries For each project, retrieve the project number, the project name, and the number of employees who work on that project. (use GROUP BY) Retrieve the name of employees who born in the year 1990’s For each Department that has more than five employees, retrieve the department number and number of employees who are making a salary more than 40000.	Employable / Analytical Skills

For each project on which more than two employees work, retrieve the project number, project name and the number of employees who work on that project.
For a given set of relation tables perform the following: Creating Views (with and without check option), Dropping views, Selecting from a view

PART B

9. Create the following tables with properly specifying Primary keys, Foreign keys and solve the following queries.
BRANCH (Branchid, Branchname, HOD) STUDENT (USN, Name, Address, Branchid, sem)
BOOK (Bookid, Bookname, Authorid, Publisher, Branchid) AUTHOR (Authorid, Authormame, Country, age) BORROW (USN, Bookid, Borrowed_Date)
10. Perform the following:
Viewing all databases, Creating a Database, Viewing all Tables in a Database, Creating Tables (With and Without Constraints), Inserting/Updating/Deleting Records in a Table, Saving (Commit) and Undoing (rollback)
11. Execute the following Queries:
 - a. List the details of Students who are all studying in 2nd sem BCA.
 - b. List the students who have not borrowed any books.
12. a. Display the USN, Student name, Branch_name, Book_name, Author_name, Books_Borrowed_ Date of 2nd sem BCA Students who borrowed books.
b. Display the number of books written by each Author.
13. a. Display the student details who borrowed more than two books.
b. Display the student details who borrowed books of more than one Author.
14. a. Display the Book names in descending order of their names.
b. List the details of students who borrowed the books which are all published by the same publisher.
15. Consider the following schema:
STUDENT (USN, name, date_of_birth, branch, mark1, mark2, mark3, total, GPA)
16. Perform the following:
Creating Tables (With and Without Constraints), Inserting/Updating/Deleting Records in a Table, Saving (Commit) and Undoing (rollback)
17. Execute the following queries:
Find the GPA score of all the students.
Find the students who were born on a particular year of birth from the date_of_birth column.
 - a. List the students who are studying in a particular branch of study.
 - b. Find the maximum GPA score of the student branch-wise.

COMPUTER SCIENCE OPEN ELECTIVE FOR SECOND SEMESTER**B21OE2.1: CYBER SPACE****THEORY****Total Teaching Hours: 45****No. of Hours per Week: 3****(3 credits)**

CObj	Course Objectives
CObj_1	To provide an understanding of cyberspace and role of social media in cyberspace.
CObj_2	To create an awareness on IT Act 2000/2008 including their pros and cons.
CObj_3	To provide basic understanding of concepts such as Digital Signature, Electronic Signature, e-commerce, and e-governance.

CO	Course Outcomes
	After completion of this module, students should be able to:
CO1	Comprehend the various cyber laws and the importance of the current cyber law in force.
CO2	Develop an awareness on cyber rules and regulations and security issues
CO3	Develop an understanding of the concepts of Digital Signature, Electronic Signature, e-commerce, and e-governance and the associated benefits and drawbacks.
CO4	Develop an insight into accountability in the governance process.
CO5	Effectively apply the knowledge of search engines and social media platforms.

Course Content

Sl. No.	Unit/chapter title	Content	Number of hours	Skills Developed
1	Unit- I	Basics of internet, www, http, html, DNS, IP Address, electronic mail, web browsers, search engines, Social Media: advantages, disadvantages, privacy issues, e-commerce, advantages of e-commerce, survey of popular e-commerce sites.	10 Hrs	Transferable / Employable / Cognitive / Analytical Skills
2	Unit- II	Introduction to e-governance, stages of e-governance, advantages, challenges, International Status, Indian status, Need of E-Governance, E-assistance, E-Democracy, E-Administration, On-line Citizen Services - E-governance implementations: Software and Hardware required for E governance Implementation, E-governance in a Small Office, Web Portal for E-governance, E governance for Public utilities, E-governance in a Medium Enterprise, E-governance & Finance.	20 Hrs	
3	Unit- III	IT Act 2000/2008 salient features, Cyber laws, Cyber Laws in India: Need for cyber-laws, nature and scope of cyber laws, approaches to cyber laws, cyber – crimes, piracy, Convergence bill, Information Technology Legislation, digital signature, electronic signature, Cyber Appellate Tribunal, Adjudicator, offenses, and penalties.	15 Hrs	

Books for Reference:

1. Information Technology Amended Act. (2008). Ministry of Law and Justice, Government of India.
2. Tom Huskerson. (2014). Social Media, the Good, Bad, and Ugly: Volume 3.
3. RitendraGoel. (2008). e-commerce. New Age International Publishers,
4. Dougals E Comer. (2008). Computer Network and Internet. Pearson Education.

Web Resources:

1. https://www.tutorialspoint.com/information_security_cyber_law/introduction.htm
2. <https://www.studocu.com/my/document/multimedia-university/cyber-law/cyber-law-tutorial-1/>



MATRIX AND SYLLABUS

For the Programme Bachelor of Computer Applications (B.C.A)

NEP Based Curriculum (2021 onwards)

III Semester

NEP- Curriculum Framework

Bachelor of Computer Applications (B.C.A) - Course Matrix (w.e.f. 2021-22 onwards)

III SEMESTER							
Code	Course Code	Course	Teaching Hours	Course Components			Credits
				L	T	P	
AECC	B21KN 3.1/ B21HN 3.1/ B21AE 3.1	Language-1 (Kannada/Hindi/Additional English)	45	3	1	-	3
AECC	B21GE3.1	Language-2 (Generic English)	60	3	1	-	3
DSC3	B21DC3.1	Operating System	45	2	1	-	3
DSC3	B21DC3.2	Computer Networks	45	2	1	-	3
DSC3	B21DC3.3	Python Programming	45	2	1	-	3
DSC3	B21DC3.4	Computer Networks Lab	60	-	-	4	2
DSC3	B21DC3.5	Python Programming Lab	60	-	-	4	2
OE-3	B21OE 3.1	Computer Fundamentals and Program Concepts in C	45	2	1	-	3
SEC-SB	21SBC 3.1	PC Assembling and Troubleshooting	30	1	-	2	2
SEC-VB	21VBC 3.1	NCC/NSS/R&R/Cultural	30	-	-	2	1
SEC-VB	21VBC 3.2	Sports	30	-	-	2	1
Total							26

Note:

AECC- Ability Enhancement Compulsory Course

DSC - Discipline-Specific Course

OE- Open elective (course offered by the department to students of other stream)

DSE – Discipline-Specific Elective

SEC - VB Skill Enhancement Course -Value Based

SEC - SB Skill Enhancement Course -Skill Based

Continuous Internal Assessment – Scheme of Evaluation

For Theory Courses

End Semester Examination: 60%

Continuous Internal Assessment: 40%

Activities (CIA: 40 Marks)	Proposed and Approved Scheme		Total Marks
	IA-1	IA-2	
Session Test Maximum Marks	30	30	
1. Weightage (Marks)	10	10	20
2. Assignment (Marks)	20		20
i. Writing	10		
ii.Quiz / Presentation	05		
iii. Classroom participation	05		
Total			40

For Practical Courses

End Semester Examination: 50%

Continuous Internal Assessment: 50%

CIA (25 marks) + End Semester Exam (25 marks)

Activities	Total Marks
1. Lab Performance	10
2. Observation record	05
3. Internal exam	10
Total	25

**B21DC 3.1 : OPERATING SYSTEM
THEORY**
Total Teaching Hours: 45
No. of Hours per Week: 3
(3 credits)

CObj	Course Objectives
CObj_1	To provide knowledge of basic concepts and functions of operating systems
CObj_2	To instill an understanding of the different process scheduling algorithms and synchronization techniques to achieve better performance of a computer system
CObj_3	To familiarize the concepts of file management and secondary storage management.

CO	Course Outcomes
	After completion of this module, students should be able to:
CO1	Analyze different types of Operating Systems
CO2	Analyze process scheduling algorithms and synchronization techniques to achieve better performance of a computer system
CO3	Demonstrate an understanding of the Mutual exclusion concept, Deadlock detection and agreement protocols of an operating system
CO4	Develop an understanding of various memory management techniques in Operating system
CO5	Demonstrate an understanding of the various techniques of file management and secondary storage management

CO-PO Mapping

	PO_1	PO_2	PO_3	PO_4	PO_5
CO_1	*	*			
CO_2	*	*			
CO_3	*	*			
CO_4	*	*		*	
CO_5	*	*	*	*	*

Course Content

Sl. No.	Unit/chapter title	Content	Number of hours	Skills Developed
1	Unit- I	Introduction: Batch Systems, Concepts of Multiprogramming and Time Sharing, Parallel, Distributed and real time Systems, Operating System Structures, Components & Services, System calls, System programs, Virtual machines. Process Management: Process Concept, Process Scheduling, Co – Operating process, Threads, Inter process communication, CPU Scheduling Criteria, Scheduling algorithm, Multiple Processor Scheduling, Real time Scheduling, Algorithm evolution.	10 Hrs	Cognitive / Analytical / Synthesis Skills
2	Unit- II	Process Synchronization and deadlocks: The Critical Section Problem, Synchronization hardware, Semaphores, Classical problems of synchronization, Critical regions, monitors, Dead locks – system model, Characterization, Deadlock prevention, avoidance and detection, Recovery from deadlock, Combined approach to deadlock handling.	12 Hrs	Analytical / Cognitive / Synthesis Skills
3	Unit- III	Memory Management: Logical and Physical address space, Swapping, Contiguous allocation, Paging, Segmentation, Segmentation with paging in Mastics and Intel 386, Virtual memory-Demand paging and its performance, Page replacement algorithms, Allocation of frames, thrashing, page size and other considerations. Demand Segmentation	12 Hrs	Cognitive / Analytical Skills
4	Unit- IV	File management (Systems, Secondary Storage Structure): File Concepts, Access methods, Directory Structure, Protection and consistency, File system structure, Allocation methods, Free space management, Directory Implementation, Efficiency and Performance, Recovery. Disk Management (Structure, Disk Scheduling Methods): Disk Structure & Scheduling methods, Disk management, Swap – Space management.	11 Hrs	Cognitive / Analytical / Synthesis Skills

Books for Reference:

1. Abraham Silberschatz, Peter B. Galvin, Greg Gagne. (2018). Operating System Concepts. 10th Edition, Wiley.
2. H.M.Deitel. (2003). Operating Systems. 3rd Edition. Pearson Learning Solutions.
3. William Stallings. (2010). Operating Systems. 6th Edition, Pearson Education.
4. Stuart, Operating systems. (2008). Principles, Design and Implementation. 1st Edition. Cengage Learning India.
5. Andrew S Tanenbaum. (2015). Modern Operating System. 3rd Edition. Prentice Hall India.
6. D. M. Dhamdhere. (2008). Operating System : A concept based approach. Tata McGraw Hill.

Web Resource:

1. <https://www.geeksforgeeks.org/web-operating-system/>
2. <https://www.cse.iitb.ac.in/~mythili/os/>

B21DC 3.2: COMPUTER NETWORKS
THEORY
Total Teaching Hours: 45
No. of Hours per Week: 3
(3 credits)

CObj	Course Objectives
CObj_1	To provide an understanding of the fundamental concepts of computer networking
CObj_2	To impart knowledge of the basic concepts of layered models and fundamental protocols
CObj_3	To instill knowledge of implementation concepts in congestion control, error detection and routing

CO	Course Outcomes
	After completion of this module, students should be able to:
CO1	Assimilate the features of computer networks, protocols, and network design models
CO2	Comprehend the fundamental characteristics of the physical layer and analyze the design issues of data link layer, link layer protocols, bridges and switches
CO3	Evaluate different error detection and correction methods required for error control
CO4	Apply appropriate routing algorithms, congestion control techniques, and Quality of Service requirements for designing a network
CO5	Demonstrate an understanding of network topologies, functions and protocols of the OSI layers in order to design networks for given situations

CO-PO Mapping

	PO_1	PO_2	PO_3	PO_4	PO_5
CO_1	*	*			
CO_2	*	*			
CO_3	*	*		*	
CO_4	*	*	*	*	*
CO_5	*	*	*	*	*

Course Content

Sl. No.	Unit/chapter title	Content	Number of hours	Skills Developed
1	Unit- I	Introduction – Uses of computer networks, Network hardware, Network software. Reference models – The OSI reference model, The TCP/IP reference model, Comparison of OSI and TCP/IP reference models. Physical Layer – Modes of communication, Physical topologies, Signal encoding, Transmission media overview. Performance indicators – Bandwidth, Throughput, Latency, Queuing time, Bandwidth–Delay product	10 Hrs	Cognitive / Transferable Skills
2	Unit- II	Data link layer - Data link layer design issues, Error detection and correction, Sliding window protocols, High-Level Data Link Control(HDLC)protocol. Medium Access Control (MAC) sublayer –Channel allocation problem, Multiple access protocols, Ethernet, Wireless LANs - 802.11, Repeaters, Hubs, Bridges, Switches, Routers and Gateways.	12 Hrs	Cognitive / Evaluation / Synthesis Skills
3	Unit- III	Network layer. Routing algorithms - The Optimality Principle, Shortest path routing, Flooding, Distance Vector Routing, Link State Routing, Multicast routing, Routing for mobile hosts. Congestion control algorithms, IP protocol, IP addresses, Internet Control Message Protocol (ICMP), Address Resolution Protocol (ARP), Reverse Address Resolution Protocol (RARP), IPv6 header	12 Hrs	Cognitive / Analytical / Synthesis Skills
4	Unit- IV	Transport service – Services provided to the upper layers, Transport service primitives. User Datagram Protocol (UDP). Transmission Control Protocol (TCP) – Overview of TCP, TCP segment header, Connection establishment & release, Connection management modeling, TCP retransmission policy, TCP congestion control. Session Layer: functions , Presentation Layer:functions, Application Layer – File Transfer Protocol (FTP), Domain Name System (DNS), Electronic mail, Multipurpose Internet Mail Extension (MIME)	11 Hrs	Cognitive / Analytical Skills

Books for Reference:

1. Andrew S. Tanenbaum. (2018). Computer Networks.(4th edition). PHI (Prentice Hall India).
2. Behrouz A Forouzan. (2007).Data Communication and Networking. (4th edition). Tata McGraw Hill.
3. Larry L Peterson and Bruce S Dave. (2011). Computer Networks – A Systems Approach. (5th edition). Morgan Kaufmann Publishers.

4. Fred Halsall, Computer Networking and the Internet. (5th edition). Addison Wesley
5. James F. Kurose, Keith W. Ross. (2017). Computer Networking: A Top-Down Approach. (6th edition). Pearson.
6. Keshav. (1998). An Engineering Approach to Computer Networks, Addison Wesley.
7. W. Richard Stevens. (2011). TCP/IP Illustrated Volume 1. Addison-Wesley.
8. William Stallings. (2003). Computer Networking with Internet Protocols. Pearson Education India

Web Resource:

1. Request for Comments (RFC) Pages - IETF - <https://www.ietf.org/rfc.html>
2. <https://www.cs.vu.nl/~ast/CN5/>

**B21DC 3.3: PYTHON PROGRAMMING
THEORY**
Total Teaching Hours: 45
No. of Hours per Week: 3
(3 credits)

CObj	Course Objectives
CObj_1	To provide an Understanding of the features of Python Programming language
CObj_2	To instill the ability to implement file handling and database handling in python
CObj_3	To impart the knowledge to create projects using Python

CO	Course Outcomes
	After completion of this module, students should be able to:
CO1	Apply the concepts of lists, tuples, functions, and classes for various python applications
CO2	Analyze different python built in libraries and implement aspects like exceptions, regular expressions and functions.
CO3	Demonstrate an understanding of the database and file handling in python
CO4	Evaluate mathematical operations using NumPy and Pandas in python
CO5	Create file and database accessing applications using python.

CO-PO Mapping

	PO_1	PO_2	PO_3	PO_4	PO_5
CO_1	*	*		*	
CO_2	*	*		*	*
CO_3	*	*	*	*	*
CO_4	*	*	*	*	*
CO_5	*	*	*	*	*

Course Content

Sl. No.	Unit/chapter title	Content	Number of hours	Skills Developed
1	Unit- I	Installation and Working with Python-Understanding Python variables-Python basic Operators- Understanding python blocks-Declaring and using Numeric data types: int, float, complex. Using string data type and string operations. Defining list and list slicing -Use of Tuple data type and methods in tuples. List manipulation using in built methods-Dictionary manipulation -Programming using string, list and dictionary in built functions Conditional blocks using if, else and elif -Simple for loops in python-For loop using ranges, string, list and dictionaries-Use of while loops in python-Loop manipulation using pass, continue, break.	10 Hrs	Cognitive / Analytical / Synthesis Skills
2	Unit- II	Organizing python codes using functions-Organizing python projects into modules-Importing own module as well as external modules. Regular expression: Powerful pattern matching and searching-Power of pattern searching using regex in python, Pattern finding programs using regular expression. Files: reading and writing text files, reading and writing binary files using pickle module. Safeguarding file operation using exception handling	12 Hrs	Cognitive / Analytical / Synthesis Skills
3	Unit- III	Concept of class, object and instances-Constructor, class attributes and destructors-Inheritance, overlapping and overloading operators -Adding and retrieving dynamic attributes of classes Programming using OOps - exception handling - Safe guarding file operation using exception handling - Programming using Exception handling. Understanding threads- Forking threads - Synchronizing the threads-Programming using multithreading	11 Hrs	Cognitive / Analytical / Synthesis Skills
4	Unit- IV	Numpy:1 dim, 2 dim, max, min - row wise , column wise, linalg module - 5 functions. pandas: series, dataframes, read_csv, read_excel, data cleaning methods, 1 dim, 2 dim, max, min - row wise , column wise, linalg module - 5 functions. Pandas: series, dataframes, read_csv, read_excel, data cleaning methods, accessing specific rows and columns. Using Databases in Python: Python MySQL Database Access -Install the MySQLdb and other	12 Hrs	Cognitive / Analytical / Synthesis Skills

		Packages -Create Database Connection - CREATE, INSERT, READ, UPDATE and DELETE Operation- DML and DDL operation with Databases -Performing Transactions- Handling Database Errors.		

Books for Reference:

1. Ashok Namdev Kamthane, Amit Ashok Kamthane. (2020). Programming And Problem Solving With Python. (2nd edition). McGraw Hill.
2. Gowrishankar S, Veena A. (2019). Introduction to Python Programming. (1st Edition). CRC Press.
3. Charles R. Severance. (2016). Python for Everybody: Exploring Data Using Python 3. (1st Edition). CreateSpace Independent Publishing Platform
4. Jake VanderPlas. (2016). Python Data Science Handbook: Essential Tools for Working with Data. (1st Edition). O'Reilly Media.

Web Resource:

1. <https://www.programiz.com/python-programming>
2. <https://www.w3schools.com/python/>

B21DC 3.4 : COMPUTER NETWORKS LAB
PRACTICAL
Total Teaching Hours: 60
No. of Hours per Week: 4
(2 credits)

Course Content

List of Programs	Skills Developed
PART A Simulation experiments using NS2/ NS3/ OPNET/ NCTUNS/ NetSim/QualNet or any other equivalent tool 1. Simulate a three nodes point-to-point network with duplex links between them. Set the queue size, vary the bandwidth and find the number of packets dropped. 2. Implement a four node point to point network with links n0-n2, n1-n2 and n2-n3. Apply TCP agent between n0-n3 and UDP between n1-n3. Apply relevant applications over TCP and UDP agents changing the parameter and determine the number of packets sent by TCP/UDP. 3. Implement Ethernet LAN using n (6-10) nodes. Compare the throughput by changing the error rate and data rate. 4. Simulate the different types of Internet traffic such as FTP, a TELNET over a network and analyse the throughput. 5. Simulate the transmission of ping messages over a network topology consisting of 6 nodes and find the number of packets dropped due to congestion 6. Simulate an Ethernet LAN using N nodes and set multiple traffic nodes and plot congestion windows for different sources/destinations. PART B 1. The following experiments shall be conducted using C/C++/Java. 2. Implement the data link layer framing methods such as character-stuffing and bit stuffing. 3. Write a program for error detecting code using CRC-CCITT (16-bits). 4. Implement Dijkstra's algorithm to compute the shortest path through a network. 5. Write a program for distance vector algorithm to find suitable path for transmission 6. Write a program for Hamming code generation for error detection and correction. 7. Write a program for congestion control using Leaky bucket algorithm	Employable / Analytical / Cognitive Skills

B21DC 3.5: PYTHON PROGRAMMING LAB**PRACTICAL****Total Teaching Hours: 60****No. of Hours per Week: 4****(2 credits)****Course Content**

List of Programs	Skills Developed
1. Write a program to demonstrate lists in python. 2. Write a program to demonstrate tuples in python. 3. Write a program to count the numbers of characters in the string and store them in a dictionary data structure. 4. Python program to remove all the lines that contain the character `a` in a file and write it to another file. 5. Write a Python function to evaluate $\exp(x)$ using Taylor's expansion series. 6. Write a Python program to a random number generator that generates random numbers between 1 and 6 (simulates a dice). 7. Write a Python program to implement a stack and queue using a list data-structure. 8. Write a Python program to create a line plot. 9. Write a Python program to copy odd lines of one file to another file in Python 10. Write a Python program to create Histogram using Pyplot in Python 11. Write a Python program to create an Employee table, insert 5 tuples and delete a particular employee from the table. 12. Write a Python program to create a student table and find the min, max, sum, and average of the marks in a student marks table. 13. Write a Python program to create a customer table and find the total number of customers from each country in the table (customer ID, customer name, country) using group by.	Employable / Analytical / Cognitive Skills

21SBC 3.1: PC ASSEMBLING AND TROUBLESHOOTING**Total Teaching Hours: 30****No. of Hours per Week: 2
(2 credits)**

CObj	Course Objectives
CObj_1	To impart basic knowledge in computer hardware and peripherals installation and PC assembly
CObj_2	To provide the skills in troubleshooting and maintenance
CObj_3	To impart knowledge in system management, backup and disaster prevention

CO	Course Outcomes
	After completion of this module, students should be able to:
CO1	Acquire hands-on experience in PC assembling
CO2	Demonstrate an understanding of Linux and Windows Operating systems installation
CO3	Comprehend PC maintenance and troubleshooting
CO4	Perform backup and recovery of files
CO5	Demonstrate an understanding of system management and disaster prevention

CO-PO Mapping

	PO_1	PO_2	PO_3	PO_4	PO_5
CO_1	*	*			
CO_2	*	*			*
CO_3	*	*	*	*	
CO_4	*	*	*	*	
CO_5	*	*	*	*	*

Course Content

This skill based course is conducted only through Practical sessions. The topics to be covered are as follows:

Sl. No.	Content	Number of hours
1	Introduction to PC Hardware	3 Hrs
2	Hardware installation and configuration	7 Hrs
3	PC debugging , troubleshooting and Maintenance	7 Hrs
4	Software installation and Configuration	7 Hrs
5	Backup and recovery	6 Hrs

Books for Reference:

1. Craig Zacker, John Rourke. (2017). PC Hardware: The Complete Reference. (1st edition).Mc Graw Hill Education.
2. Robert Bruce Thompson, Barbara Fritchman Thompson. (2003).PC Hardware in A Nutshell, a Desktop Quick reference.(3rd edition). O'Reilly.
3. C. Campbell. (2022). Computer Hardware. Complete Hardware Guide ,Troubleshooting,Maintenance. Code Academy.
4. Cheryl A.Schmidt. (2002). The Complete Computer Upgrade & Repair Textbook. Dream tech press.

Web Resources:

1. <https://artofpc.com/how-to-assemble-and-troubleshoot-pc/>
2. <https://www.studocu.com/in/document/i-k-gujral-punjab-technical-university/pc-assembly-and-troubleshooting/pc-assembly-full-notes-ptu-bca-3/33990652>



MATRIX AND SYLLABUS

For the Programme Bachelor of Computer Applications (B.C.A)

NEP Based Curriculum (2021 onwards)

IV Semester

NEP- Curriculum Framework

Bachelor of Computer Applications (B.C.A) - Course Matrix (w.e.f. 2021-22 onwards)

IV SEMESTER							
Code	Course Code	Course	Teaching Hours	Course Components			Credits
				L	T	P	
AECC	B21KN 4.1/ B21HN 4.1/ B21AE 4.1	Language-1 (Kannada/Hindi/Additional English)	45	3	1	-	3
AECC	B21GE4.1	Language-2 (Generic English)	60	3	1	-	3
AECC	21SBC 4.1	Constitution of India	45	2	1	-	3
DSC4	B21DC4.1	Software Engineering	45	2	1	-	3
DSC4	B21DC4.2	Artificial Intelligence	45	2	1	-	3
DSC4	B21DC4.3	Internet Technologies and Web Designing	45	1	2	-	3
DSC4	B21DC4.4	Artificial Intelligence Lab	60	-	-	4	2
DSC4	B21DC4.5	Internet Technologies and Web Designing Lab	60	-	-	4	2
OE-4	B21OE 4.1	Web Designing	45	2	1	-	3
SEC-VB	21VBC 4.1	NCC/NSS/R&R/Cultural	30	-	-	2	1
SEC-VB	21VBC 4.2	Sports	30	-	-	2	1
Total							26

Note:

AECC- Ability Enhancement Compulsory Course

DSC - Discipline-Specific Course

OE- Open elective (course offered by the department to students of other stream)

DSE – Discipline-Specific Elective

SEC - VB Skill Enhancement Course -Value Based

SEC - SB Skill Enhancement Course -Skill Based

Continuous Internal Assessment – Scheme of Evaluation

For Theory Courses

End Semester Examination: 60%

Continuous Internal Assessment: 40%

Activities (CIA: 40 Marks)	Proposed and Approved Scheme		Total Marks
	IA-1	IA-2	
Session Test Maximum Marks	30	30	
1. Weightage (Marks)	10	10	20
2. Assignment (Marks)	20		20
i. Writing	10		
ii.Quiz / Presentation	05		
iii. Classroom participation	05		
Total			40

For Practical Courses

End Semester Examination: 50%

Continuous Internal Assessment: 50%

CIA (25 marks) + End Semester Exam (25 marks)

Activities	Total Marks
1. Lab Performance	10
2. Observation record	05
3. Internal exam	10
Total	25

**B21DC 4.1: SOFTWARE ENGINEERING
THEORY**
Total Teaching Hours: 45
No. of Hours per Week: 3
(3 credits)

CObj	Course Objectives
CObj_1	To provide the idea of decomposing the given problem into Analysis, Design, Implementation, Testing and Maintenance phases.
CObj_2	To provide an idea of using various process models in the software industry according to given circumstances
CObj_3	To provide an Understanding of the role of project management including planning, scheduling, risk management, etc.

CO	Course Outcomes
	After completion of this module, students should be able to:
CO1	Demonstrate an understanding of the process models of the Software Development Life Cycle (SDLC) and implement appropriate models to develop projects to solve real world problems.
CO2	Analyze the concept of Design architecture, Design principles, Design quality and software prototyping.
CO3	Develop applications using Object Oriented and Function oriented approach
CO4	Gain expertise in designing User Interfaces, adopting reuse-driven approaches in software development, and ensuring software reliability.
CO5	Apply the knowledge gained on testing process to test software products

CO-PO Mapping

	PO_1	PO_2	PO_3	PO_4	PO_5
CO_1	*	*	*	*	*
CO_2		*	*		
CO_3	*	*	*	*	*
CO_4	*	*		*	
CO_5	*	*	*	*	*

Course Content

Sl. No.	Unit/chapter title	Content	Number of hours	Skills Developed
1	Unit- I	Introduction: Software Products and Software process, Process models: Waterfall model, Evolutionary Development, Bohemia"s Spiral model, RAD Model, Agile Model, Overview of risk management, Process Visibility, Professional responsibility. Computer based System Engineering: Systems and their environment, System Procurement, System Engineering Process, System architecture modelling. Human Factors, System reliability Engineering. Requirements and Specification: The requirement Engineering Process, The Software requirement document, Validation of Evolution of requirements, Viewpoint – oriented & method based analysis , system contexts , Social & organizational factors. Data flow , Semantic, Objects, models , Requirement Specification, Functional and Nonfunctional requirement.	10 Hrs	Cognitive / Analytical / Synthesis Skills
2	Unit- II	Software Prototyping: Prototyping in software process, Prototyping techniques, User interface prototyping. Software Design: Design Process, Design Strategies, Design Quality , System Structuring control models, Modular decomposition , Domain Specific architecture. Object Oriented & function oriented design: Objects, object Classes and inheritance Object identification, An object oriented design example, Concurrent Objects, Data flow design Structural decomposition, Detailed Design, A Comparison of design Strategies. User interface design: Design Principles, User System interaction, Information Presentation, User Guidance, Interface Evaluation.	12 Hrs	Cognitive / Synthesis Skills
3	Unit- III	Software Reliability and reusability : Software reliability metrics , Software reliability Specification , Statistical testing ,Reliability Growth modeling, Fault avoidance & tolerance, Exception handling & defensive programming , Software development with reuse, Software" development for reuse , Generator based reuse, Application System Portability.	10 Hrs	Cognitive / Synthesis Skills

4	Unit- IV	Software Verification and Validation : The testing Process , Test Planning & Strategies, Black Box , Structural, interface testing , Program inspections , Mathematically based verification, Static analysis tools, Cleanroom software development. Management Issues: Project management, Quality management, Software cost estimation, Project Scheduling- work tasks, timeline charts and CPM, PERT , Software maintenance.	13 Hrs	Cognitive / Analytical / Synthesis Skills

Books for Reference:

1. Ian Sommerville. (2010). Software Engineering. (9th Edition). Pearson Education Ltd.
2. Roger S. Pressman. (2010). Software Engineering- A Practitioner's approach. (7th Edition). McGraw-Hill Publication.
3. Pankaj Jalote. (2013). An integrated approach to Software Engineering. (3rd Edition). Narosa Publishing House.

Web Resources:

1. <http://ww25.softwareengineering-9.com/>
2. <https://www.theforage.com/blog/careers/software-engineering-resources>

**B21DC 4.2: ARTIFICIAL INTELLIGENCE
THEORY**
Total Teaching Hours: 45
No. of Hours per Week: 3
(3 credits)

CObj	Course Objectives
CObj_1	To impart knowledge about Artificial Intelligence and understand the basic principles of Artificial Intelligence in various applications
CObj_2	To understand the various approaches of knowledge representations and to enable computers to perform such intellectual tasks as decision making, problem solving
CObj_3	To provide knowledge on Expert systems and to implement the AI concepts using prolog

CO	Course Outcomes
	After completion of this module, students should be able to:
CO1	Demonstrate an understanding of Artificial intelligence concepts and techniques
CO2	Apply basic principles of AI in solutions that require problem solving
CO3	Apply knowledge on representing simple facts by predicate logic
CO4	Design and implement expert systems to solve real world problems
CO5	Comprehend Prolog for implementation of Artificial intelligence concepts

CO-PO Mapping

	PO_1	PO_2	PO_3	PO_4	PO_5
CO_1	*	*	*		
CO_2	*	*		*	
CO_3	*	*		*	
CO_4	*	*	*	*	*
CO_5	*	*	*	*	*

Course Content

Sl. No.	Unit/chapter title	Content	Number of hours	Skills Developed
1	Unit- I	Overview of AI: Introduction to AI, Importance of AI, AI and its related field, AI techniques, Criteria for success. Problems, problem space and search: Defining the problem as a state space search, Production system and its characteristics, Issues in the design of the search problem. Heuristic search techniques: Generate and test, hill climbing, best first search technique, mean and end analysis, A* and AO* Algorithms.	11 Hrs	Evaluation / Synthesis Skills
2	Unit- II	Knowledge Representation: Definition and importance of knowledge, Knowledge representation, various approaches used in knowledge representation, Issues in knowledge representation. Predicate Logic: Representing Simple Facts in logic, representing instances and is-a relationship, Computable function and predicate. Planning: block world, strips, Implementation using goal stack, Non linear planning with goal stacks	10 Hrs	Analytical Skills
3	Unit- III	Natural language processing: Introduction syntactic processing, Semantic processing, Discourse and pragmatic processing Learning: Introduction learning, Rote learning, learning by taking advice, learning in problem solving, learning from example-induction, Explanation based learning.	10 Hrs	Cognitive Skills
4	Unit- IV	Expert System: Introduction: Representing using domain specific knowledge, Architecture of expert system, knowledge representation Expert system shells, case studies on expert systems. Prolog -Basics, Relations, Data objects, operators, Decision making, recursion, built-in predicates, conjunction and disjunction	14 Hrs	Cognitive / Analytical / Synthesis Skills

Books for Reference:

1. Elaine Rich, Kevin Knight. Artificial Intelligence. Tata McGraw Hill.
2. David W. Rolston. Principles of Artificial Intelligence and Expert System Development. McGraw Hill.
3. Ivan Bratko. Prolog Programming for Artificial Intelligence. (4th Edition). Addison-Wesley.
4. Russel & Norvig. Artificial Intelligence: A Modern Approach. Pearson Education.

Web Resources:

1. <https://www.datacamp.com/blog/how-to-learn-ai>
2. <https://www.freecodecamp.org/news/how-to-get-the-best-artificial-intelligence-education-for-free-21af8c47e36b/>

B21DC 4.3: INTERNET AND WEB TECHNOLOGIES**THEORY****Total Teaching Hours: 45****No. of Hours per Week: 3****(3 credits)**

CObj	Course Objectives
CObj_1	To impart knowledge on Web & Internet technologies
CObj_2	To provide an understanding of the fundamental tools and technologies for web design
CObj_3	To instill knowledge on client/server relationships in the context of the Internet

CO	Course Outcomes
	After completion of this module, students should be able to:
CO1	Demonstrate an understanding of the technological foundations of the Internet and core Internet protocols
CO2	Demonstrate an understanding of the basic working scheme of the Internet and World Wide Web
CO3	Integrate suitable JavaScript functions and develop real time web application
CO4	Apply CSS and design attractive web applications
CO5	Create XML documents and Schemas

CO-PO Mapping

	PO_1	PO_2	PO_3	PO_4	PO_5
CO_1	*	*			
CO_2	*	*			
CO_3	*	*	*	*	*
CO_4	*	*	*	*	*
CO_5	*	*	*	*	*

Course Content

Sl. No.	Unit/chapter title	Content	Number of hours	Skills Developed
1	Unit- I	Internet, Growth of Internet, Owners of the Internet, Anatomy of Internet, ARPANET and Internet history of the World Wide Web, basic Internet Terminology, Net etiquette. Internet Applications – Commerce on the Internet, Governance on the Internet, Impact of Internet on Society – Crime on/through the Internet. Overview of Internet Security, Firewalls, Information Privacy and Copyright Issues Software requirement, modem configuration, Addressing in Internet: DNS, Domain Name and their organization, understanding the Internet Protocol Address, Internet Addressing Scheme	10 Hrs	Cognitive / Diagnostic Skills
2	Unit- II	Internet accounts by ISP: Telephone line options, Protocol options, Service options Telephone line options – Dialup connections through the telephone system, dedicated connections through the telephone system, ISDN Protocol options – Shell, SLIP, PPP Services on Internet (Definition and Functions): WWW, Telnet, FTP, IRC, Search and Meta Search Engines Electronic Mail: Email Networks and Servers, Email protocols –SMTP, POP3, IMAP, MIME, Structure of an Email – Email Address, Email Header, Body and Attachments Email Clients: Netscape mail Clients, Outlook Express, Web based E-mail. Email encryption- Address Book, Signature File. Languages, Internet Phone, Internet Video, collaborative computing	12 Hrs	Analytical / Employable skills
3	Unit- III	Web Publishing and Browsing Overview, Web Browsers, and Web Servers, URLs, HTTP, Security, The Web Programmers Toolbox. Publishing Tools, SGML, Web hosting, Documents Interchange Standards, Components of Web Publishing, Document management, Web Page Design Consideration and Principles XHTML: Origins and evolution of HTML and XHTML, HTML Programming Basics HTML page structure, HTML Text, HTML links, HTML document tables, HTML Images, multimedia, Lists, Forms, Frames in HTML and XHTML, Syntactic differences between HTML and XHTML.	12 Hrs	Analytical / Employable / Evaluation / Synthesis Skills

		CSS: Introduction, Levels of style sheets, Style specification formats, Selector forms, Property value forms, Font properties, List properties, Color, Alignment of text, The Box model, Background images, The and tags, Conflict resolution. Introduction to Bootstrap		
4	Unit- IV	Java Script: Overview of JavaScript, General syntactic characteristics, Primitives, Operations, and expressions, Screen output and keyboard input, Control statements, Arrays, Functions, The Document Object Model, Element access in JavaScript, Introduction to Events and event handling Dynamic Documents with JavaScript: Introduction to dynamic documents; Positioning elements; Moving elements; Element visibility; Changing colors and fonts; Dynamic content; Stacking elements; Locating the mouse cursor; Reacting to a mouse click; Slow movement of elements; Dragging and dropping elements. XML: Introduction; Syntax; Document structure; Document Type definitions; Namespaces; XML schemas; Displaying raw XML documents; Displaying XML documents with CSS; XSLT style sheets; XML Processors; Web service.	11 Hrs	Employable / Evaluation / Synthesis Skills

Books for Reference:

1. Greenlaw R and Hepp E. (2007). Fundamentals of the Internet and www. (2nd Edition). Tata McGrawHill.
2. Ivan Bayross. HTML, DHTML, JavaScript, Perl CGI. (3rd Edition). BPB Publications.
3. D. Comer. (2009). The Internet Book. Pearson Education.
4. M.Deitel, P.J.Deitel, A.B.Goldberg. (2004). Internet & World Wide Web How to program. (3rd Edition). Pearson Education / PHI.
5. Chris Bates. (2006). Web Programming Building Internet Applications. (3rd Edition). Wiley India.

Web Resources:

1. <https://www.geeksforgeeks.org/the-internet-and-the-web/>
2. https://kp.kiit.ac.in/pdf_files/02/Study-Materials_CSE_-5th_-IWT_AK-Panda-1.pdf

**B21DC 4.4 : ARTIFICIAL INTELLIGENCE LAB
PRACTICALS**

Total Teaching Hours: 60

**No. of Hours per Week: 4
(2 credits)**

Course Content

List of Programs	Skills Developed
1. Write a Program to Implement Best First Search. 2. Write a Program to Implement Hill climbing. 3. Write a Program to Implement A* search algorithm. 4. Write a Program to Implement AO* search algorithm. 5. Write predicates One converts centigrade temperatures to Fahrenheit, the other checks if a temperature is below freezing. 6. Write a Program to Implement the Tower of Hanoi. 7. Write a Program to solve a 4-queen problem. 8. Write a Program to implement factorials of a given number. 9. Write a Program to implement fibonacci series. 10. Write a Program to find the frequency distribution of words in a text file. 11. Write a Program to demonstrate monkey and banana problems. 12. Write a Program to Count the number of words that contain "tion" in a given list. 13. Write a Program to implement tree data structure.	Employable / Analytical / Cognitive Skills

B21DC 4.5: INTERNET AND WEB TECHNOLOGIES LAB**PRACTICALS****Total Teaching Hours: 60****No. of Hours per Week: 4****(2 credits)****Course Content**

List of Programs	Skills Developed
1. Design a web page using CSS 2. Print table of numbers from 5 to 15 and print their squares and cubes using alert. 3. Enter positive number terminated by zero and find sum and average 4. Write a JavaScript code to find the sum of N natural Numbers. (Use user-defined function) 5. Find factorial of a number using java script 6. Read n numbers count positive, negative and zeros in the list 7. Display Fibonacci series using java script 8. Create a form having a number of elements (Textboxes, Radio buttons, Checkboxes, and so on). Write JavaScript code to count the number of elements in a form 9. Create a HTML form that has a number of Textboxes. When the form runs in the Browser fill the textboxes with data. Write JavaScript code that verifies that all textboxes have been filled. If a textbox has been left empty, popup an alert indicating which textbox has been left empty. 10. Develop a HTML Form, which accepts any Mathematical expression. Write JavaScript code to Evaluate the expression and Displays the result. 11. Write a JavaScript code block using arrays and generate the current date in words, this should include the day, month and year. 12. Create a form for Student information. Write JavaScript code to find Total, Average, Result and Grade. 13. Create a form for Employee information. Write JavaScript code to find DA, HRA, PF, TAX, Gross pay, Deduction and Net pay. 14. Create a form consists of a two Multiple choice lists and one single choice list a. The first multiple choice list, displays the Major dishes available b. The second multiple choice list, displays the Starters available. c. The single choice list displays the Soft drinks available. 15. Create a page with dynamic effects. Write the code to include layers and basic animation.	Employable / Analytical / Cognitive Skills



MATRIX AND SYLLABUS

For the Programme Bachelor of Computer Applications (B.C.A)

NEP Based Curriculum (2021 onwards)

V Semester

NEP- Curriculum Framework

Bachelor of Computer Applications (B.C.A) - Course Matrix (w.e.f. 2021-22 onwards)

V SEMESTER							
Code	Course Code	Course	Teaching Hours	Course Components			Credits
				L	T	P	
DSC5	B21DC5.1	Design and Analysis of Algorithms	60	2	2	-	4
DSC5	B21DC5.2	Data Analytics	60	2	2	-	4
DSC5	B21DC5.3	Web Programming	60	2	2	-	4
DSC5	B21DC5.4	Data Analytics Lab	60	-	-	4	2
DSC5	B21DC5.5	Web Programming Lab	60	-	-	4	2
ELEC-1	B21DCE5.6	Elective I: Data Mining	45	2	1	-	3
	B21DCE5.7	Computer Graphics					
VOC-1	21VOC5.1	Vocation Course I: Accounting and Financial Management	45	2	1	-	3
SEC-SB	21SBC5.1	Cyber Crime, and Cyber Law	30	1	1	-	2
Total							24

Note:

AECC- Ability Enhancement Compulsory Course

DSC - Discipline-Specific Course

OE- Open elective (course offered by the department to students of other stream)

DSE – Discipline-Specific Elective

SEC - VB Skill Enhancement Course -Value Based

SEC - SB Skill Enhancement Course -Skill Based

Continuous Internal Assessment – Scheme of Evaluation

For Theory Courses

End Semester Examination: 60%

Continuous Internal Assessment: 40%

Activities (CIA: 40 Marks)	Proposed and Approved Scheme		Total Marks
	IA-1	IA-2	
Session Test Maximum Marks	30	30	
1. Weightage (Marks)	10	10	20
2. Assignment (Marks)	20		20
i. Writing	10		
ii.Quiz / Presentation	05		
iii. Classroom participation	05		
Total			40

For Practical Courses

End Semester Examination: 50%

Continuous Internal Assessment: 50%

CIA (25 marks) + End Semester Exam (25 marks)

Activities	Total Marks
1. Lab Performance	10
2. Observation record	05
3. Internal exam	10
Total	25

B21DC 5.1: DESIGN AND ANALYSIS OF ALGORITHMS
THEORY
Total Teaching Hours: 60
No. of Hours per Week: 4
(4 credits)

CObj	Course Objectives
CObj_1	To gain ability to compute the time and space complexity of algorithms
CObj_2	To identify most suitable algorithm for a given task by comparing the time and space complexities of various algorithms
CObj_3	To impart knowledge on various algorithm design techniques and applications

CO	Course Outcomes
	After completion of this module, students should be able to:
CO1	Comprehend the computation of time and space complexities of algorithms.
CO2	Demonstrate an understanding of various designing paradigms in formulating algorithms.
CO3	Analyze various sorting, searching and traversal techniques.
CO4	Solve graph related problems using design techniques and also apply design techniques to solve real world problems
CO5	Create effective algorithms based on different design techniques

CO-PO Mapping

	PO_1	PO_2	PO_3	PO_4	PO_5
CO_1	*			*	
CO_2	*	*	*	*	*
CO_3	*	*		*	
CO_4	*	*	*	*	*
CO_5	*	*	*	*	*

Course Content

Sl. No.	Unit/chapter title	Content	Number of hours	Skills Developed
1	Unit- I	Introduction: Definition of algorithm, Characteristics of algorithm, Different control structures, Writing structured programs, Analysis of Algorithms: Fundamentals of the Analysis of Algorithm Efficiency Analysis Framework, Asymptotic Notations. Selection Sort and Bubble Sort, Sequential Search and Brute -Force String Matching – Naïve Algorithm. Divide and Conquer: General method, Master theorem, Binary Search, Finding maximum and minimum, Merge Sort, Quick Sort	20 Hrs	Analytical / Employable / Cognitive Skills
2	Unit- II	Greedy Method: General method, Knapsack problem, Job sequencing with deadlines, Minimum-Cost Spanning Trees, Single-Source Shortest Paths – Dijkstra's algorithm, Huffman coding	12 Hrs	Analytical / Employable / Cognitive Skills
3	Unit- III	Dynamic Programming: Introduction to Graphs, Definitions, Terms related to graphs, General method, Multi stage graphs, All pairs Shortest Path Problem, 0/1 Knapsack, Travelling SalesPerson problem, Flow shop scheduling.	15 Hrs	Analytical / Employable / Cognitive Skills
4	Unit- IV	Basic Traversal & Search Techniques, Backtracking: Search and Traversal techniques for trees, Search and traversal techniques for graphs. Backtracking: General method, The 4-Queens problem, Sum of Subsets, Graph coloring, Hamiltonian cycle.	13 Hrs	Analytical / Employable / Cognitive Skills

Books for Reference:

1. Anany Levitin. (2017). Introduction to Design & Analysis of Algorithms. (3rd Edition). Pearson Education.
2. Alfred.V.Aho, John E.Hopcroft, Jeffrey.D Ullman. (2009). The Design & Analysis of Computer Algorithms. (1st Edition, 4th reprint). Pearson Education.
3. Sara Baase, Allen Van Gelder. (2008). Computer Algorithms, Introduction to design and Analysis. (3rd Edition, 9th reprint). Pearson Education.
4. Ellis Horowitz, Sartaj Sahni, Sanguthevar Rajasekaran. (2018). Fundamentals of Computer Algorithms. (2nd Edition). University Press.
5. Thomas H. Cormen, Charles E. Leiserson, Ronal L. Rivest, Clifford Stein, 2009, Introduction to Algorithms. (3rd Edition). The MIT Press.
6. S.Sridhar. (2014). Design & Analysis of Computer Algorithms.(1stEdition). Oxford University Press.

Web Resources:

1. <https://cs.lmu.edu/~ray/notes/alganalysis/>
2. <https://www.javatpoint.com/daa-tutorial>
3. <https://www.geeksforgeeks.org/design-and-analysis-of-algorithms/>
4. <https://aofa.cs.princeton.edu/10analysis/>

**B21DC 5.2 DATA ANALYTICS
THEORY**
Total Teaching Hours: 60
No. of Hours per Week: 4
(4 credits)

CObj	Course Objectives
CObj_1	To provide a strong understanding of techniques used for data analysis
CObj_2	To impart knowledge on statistical tools and techniques
CObj_3	To instill the capability to collect, transform, and organise data in order to make informed business decisions

CO	Course Outcomes
	After completion of this module, students should be able to:
CO1	Demonstrate an understanding of the basics of data and the statistical knowledge required in the field of data analytics
CO2	APPLY various inferential statistical analysis techniques to describe data sets and make useful predictions
CO3	Analyze the data analytics techniques using various tools
CO4	Perform prediction using regression analysis
CO5	Competently identify advanced techniques to perform insightful analysis and interpret the results

CO-PO Mapping

	PO_1	PO_2	PO_3	PO_4	PO_5
CO_1	*	*		*	
CO_2		*		*	
CO_3	*		*	*	*
CO_4	*			*	
CO_5		*	*	*	*

Course Content

Sl. No.	Unit/chapter title	Content	Number of hours	Skills Developed
1	Unit- I	Introduction to Data Analytics: Importance of data analytics, different types of data analysis, role of a data analyst, the data analysis process, data analytics tools and techniques, skills needed to become a data analyst. Describing the Distribution of a Single Variable: Introduction, Basic Concepts, Descriptive Measures for Categorical Variables, Descriptive Measures for Numerical Variables, Outliers and Missing Values, Time series Analysis- Secular trend, Seasonal variations, Cyclical variations, Irregular variations, measurement of Secular trend: Free Hand Curve Method: Semi – Average Method, Moving Average Method, Least Square Method.	16 Hrs	Cognitive / Analytical Skills
2	Unit- II	Data Wrangling, Sampling : Data Wrangling: Finding Relationships among Variables: Introduction, Relationships among Categorical Variables, Relationships among Categorical Variables and a Numerical Variable, Relationships among Numerical Variables. Combining and Merging Data Sets, Database style DataFrame Merges, Merging on Index, Concatenating Along an Axis, Combining Data with Overlap , Reshaping and Pivoting, Reshaping with Hierarchical Indexing, Data Transformation, Removing Duplicates, Replacing Values, String Manipulation Sampling: Introduction, Sampling Terminology, Methods for Selecting Random Samples - Simple Random Sampling, Systematic Sampling, Stratified Sampling, Cluster Sampling, Multistage Sampling Schemes	16 Hrs	Analytical / Cognitive Skills
3	Unit- III	Regression Analysis: Simple Linear Regression. Estimating Relationships: Introduction, Scatterplots, Correlations: types, Karl pearson's coefficient of correlation, problems in univariate, bivariate, Spearman's rank correlation Hypothesis Testing: Introduction, Concepts in Hypothesis Testing, Hypothesis Tests for a Population Mean, Tests for Normality, Chi-Square Test for Independence	18 Hrs	Analytical / Cognitive / Synthesis Skills

4	Unit- IV	Data Visualization: Tableau, Features, environment setup, Connect to a Data Source, Data Types, Data analysis, Custom Data View, Extracting Data, Charts: Line chart, Bar chart, Histograms and box plot, Forecasting, Trend Lines , Interactive dashboards	10 Hrs	Cognitive / Analytical skills

Books for Reference:

1. Fabio Nelli. (2018). Python Data Analytics, Apress.
2. S C Albright and W L Winston, Business analytics: data analysis and decision making. (7th Edition). Cengage Learning.
3. Wes McKinney. (2022). Python for Data Analysis. (3rd edition). O'reilly.
4. Rachel Schutt & O'neil, (2013). Doing Data Science. (1st edition). o'reilly.
5. Joel Grus. (2019). Data Science from Scratch: First Principles with Python. (2nd edition). o'reilly.
6. Matt Harrison. (2016). Learning the Pandas Library: Python Tools for Data Munging, Analysis, and Visualization. O'reilly.

Web Resources:

1. <https://www.pdfdrive.com/python-data-analytics-with-pandas-numpy-and-matplotlib-e183971250.html>
2. https://www.booksfree.org/wp-content/uploads/2022/06/Business-Analytics-Data-Analysis-and-Decision-Making-5th-Edition-by-Albright-and-Winston-pdf-free-download-booksfree.org_.pdf
3. <https://bedford-computing.co.uk/learning/wp-content/uploads/2015/10/Python-for-Data-Analysis.pdf>
4. https://www.m-fozouni.ir/wp-content/uploads/2020/08/Joel_Grus_Data_Science_from_Scratch_First_Princ.pdf
5. <https://www.pdfdrive.com/learning-the-pandas-library-python-tools-for-data-munging-analysis-and-visualization-e93057903.html>
6. <https://www.pdfdrive.com/big-data-analytics-a-hands-on-approach-e158549112.html>
7. <https://www.tutorialspoint.com/tableau/index.htm>

**B21DC 5.3: WEB PROGRAMMING
THEORY**
Total Teaching Hours: 60
No. of Hours per Week: 4
(4 credits)

CObj	Course Objectives
CObj_1	To provide a strong foundation of the concepts used in creating an effective web page including an in-depth knowledge of web application architecture
CObj_2	To impart knowledge on server-side scripting language, PHP
CObj_3	To create a strong base in web application development with Database connectivity

CO	Course Outcomes
	After completion of this module, students should be able to:
CO1	Demonstrate an understanding of the web application architecture and its components
CO2	Analyze the different data types and control structures in PHP and use them appropriately while designing web applications
CO3	Apply the knowledge of object oriented programming concepts on server side scripting languages
CO4	Design and develop web applications with database connectivity
CO5	Create dynamic web pages using server side scripting languages

CO-PO Mapping

	PO_1	PO_2	PO_3	PO_4	PO_5
CO_1	*				
CO_2	*	*			
CO_3	*	*			
CO_4	*	*	*	*	*
CO_5	*	*	*	*	*

Course Content

Sl. No.	Unit/chapter title	Content	Number of hours	Skills Developed
1	Unit- I	Introduction: Web Application Architecture, components, layers, Types of web pages; Types of servers: Application server, web servers, Database server; serverless architecture, client side scripts, Server side scripts, web development with PHP, Difference between PHP and other web development language, Basic Syntax, variables, constants, PHP echo/print, PHP Data types, Operators and Expressions. Flow Control and Looping. Arrays: Anatomy of an Array, Creating and accessing index based and Associative array, Element Looping with Index based array, Looping with associative array using each () and foreach(), Some useful array Library function, Strings: String Creating and accessing, Searching & Replacing String, Formatting String, String Related Library function.	14 Hrs	Analytical / Employable / Cognitive Skills
2	Unit- II	Functions, Classes and Objects: User defined functions, Call by value and Call by reference, Recursive functions. Reading and writing files, displaying data from file into a HTML table, loading an array from a file, loading an array from a directory, Classes and Objects, Create and use classes, How to code class constants, properties, and methods, Pattern Matching, Finding Text With Regular Expressions, finding Simple Patterns Using Regular Expressions, Date() and Time() functions	14 Hrs	Analytical / Employable / Cognitive Skills
3	Unit- III	PHP include, PHP Superglobals Handling Html Form with PHP: Capturing Form, Data Dealing with Multi-value field, Generating File uploaded form, Form Validation, Validating Form Fields With JavaScript, From URL/Email redirecting a form after submission. Form complete example Database Connectivity with PHP and MySQL	18 Hrs	Analytical / Employable / Cognitive Skills

		Session and Cookie: Introduction to Session Control, Session Functionality, Registering Session variables, Destroying the variables and Session Introduction to Cookie, Setting Cookies with PHP. Using Cookies with Sessions, Deleting Cookies.		
4	Unit- IV	Servlets and JSP: Introduction, Servlet: HTTP Protocols and HTTP Methods, Servlet Interface, Generic Servlet, Http Servlet, Servlet life cycle, Servlet communication, Session tracking mechanisms. JSP: JSP life cycle, JSP Implicit objects, JSP Directives, JSP Scripting Elements, JSP actions, JSTL & tag library. Database connectivity with Servlet and JDBC	14 Hrs	Analytical / Employable / Cognitive Skills

Books for Reference:

1. Larry Ullman. (2011). PHP and MySQL for Dynamic Web Sites, Visual QuickPro Guide. (4th Edition). Peachpit Press.
2. Bramer Max. (2015). Web Programming With PHP and MySQL. Springer International Publishing.
3. Luke Welling , Laura Thompson. (2016). PHP & MySQL Web Development. (4th Edition). Addison Wesley.
4. Robert W. Sebesta. (2012). Programming the World Wide Web. (4th Edition). Pearson Education.

Web ResourceS:

1. <https://www.phptutorial.net/>
2. <https://www.w3schools.com/php/>
3. <https://www.tutorialspoint.com/php/index.htm>
4. <https://www.javatpoint.com/php-tutorial>
5. <https://www.geeksforgeeks.org/php-tutorials/>
6. <https://www.youtube.com/watch?v=t0syDUSbdfE>

B21DC 5.4: DATA ANALYTICS LAB**PRACTICALS****Total Teaching Hours: 60****No. of Hours per Week: 4****(2 credits)****Course Content**

List of Programs	Skills Developed
1. Create flexible data aggregations using pivot tables and Represent data visually using pivot charts 2. Read different types of datasets(.csv,.xlsx) and create DataFrame using pandas 3. Use any standard data set and perform the following a. Use any standard data set for performing the Univariate analysis: Frequency, Mean, Median, Mode, Variance, Standard Deviation b. Apply the basis of Data cleanup operation on the given dataset 4. Use any standard data set and perform the following a. Find the data distributions using box and scatter plot. b. Find the outliers using plot. c. Plot the histogram, bar chart and pie chart on sample data. 5. Import any CSV file to Pandas DataFrame and perform the following: a. Visualize the first and last 10 records b. Do required statistical operations on the given columns. c. Find the count and uniqueness of the given categorical values. 6. Import any CSV file to Pandas DataFrame and perform the following: a. Handle missing data by detecting and dropping/ filling missing values. b. Transform data using map() method. c. Detect and filter outliers. d. Visualize data using Line chart, Bar chart, Histograms, Density chart and Scatter chart. 7. Develop the python script to import excel data into a Pandas data frame and process the following: a. Get the data types of the given excel data b. Fill in the missing values. c. Perform univariate analysis 8. Develop the python script to import excel data into a Pandas data frame and process the following: a. Check duplicates and missing data b. Eliminate Mismatches c. Cleans line breaks, spaces, and special characters 9. Perform time series analysis in python. 10. Perform correlation analysis of all variables in python. 11. Perform regression analysis in python. 12. Perform data analysis on titanic dataset. 13. Perform data analysis on iris dataset.	Employable / Analytical / Cognitive Skills

B21DC 5.5: WEB PROGRAMMING LAB
PRACTICALS
Total Teaching Hours: 60
No. of Hours per Week: 4
(2 credits)

Course Content

List of Programs	Skills Developed
1. Write a PHP program to compute the sum of the prime numbers less than 100. 2. Write a PHP program to sort an array. 3. Write a PHP script that inserts a new item in an array in any position. 4. Write a PHP program to store current date-time in a COOKIE and display the 'Last visited on' date-time on the web page upon reopening of the same page. 5. Write a PHP program that displays a different message based on time of day. For example, a page should display "Good Morning" if it is accessed in the morning. 6. Write a PHP Program to create a simple Registration form. 7. Write a PHP program to process the form data. 8. Develop a web application for registration form with the fields Name, Password, Email, Country. 9. Develop a web application using PHP and MySQL, to record the EMPLOYEE DETAILS such as Empid, Emp name, Designation and Basic pay. Calculate the DA, HRA, Deduction and Gross Salary (make necessary assumption). 10. Create a form with Name, Address Line 1, Address Line 2, and E-mail text fields. On submitting, store the values in MySQL table. Retrieve and display the data based on Name. 11. Develop a program using PHP and MySQL, to accept book information viz. Accession number, title, authors, edition and publisher from a web page and store the information in a database and to search for a book with the title specified by the user and to display the search results with proper headings. 12. Write a PHP Program to Store an image in Database. 13. Using PHP and MySQL, develop an application for AIRLINE RESERVATION on a system which allows the user to book a ticket on a particular date for a particular type of class. At the end, once the ticket is booked, it should display a boarding pass indicating the person's seat number, type of class and total fare. Input validation should be done properly. 14. Write a PHP program to read student data from an XML file and store into the MYSQL database. Retrieve and display.	Employable / Analytical / Cognitive Skills

21VOC5.1: ACCOUNTING AND FINANCIAL MANAGEMENT
THEORY
Total Teaching Hours: 45
No. of Hours per Week: 3
(3 credits)

CObj	Course Objectives
CObj_1	To impart knowledge on the basics of accounting concepts and its functions.
CObj_2	To provide knowledge on the Financial Accounting process.
CObj_3	To instill skills on working on trading, profit and loss, balance sheets.

CO	Course Outcomes
	After completion of this course, students should be able to:
CO1	Comprehend accounting concepts and its functions.
CO2	Demonstrate an understanding of the financial accounting process.
CO3	Develop an understanding of the preparation of Final accounts and apply it.
CO4	Prepare trial balance.
CO5	Apply the accounting process in accounting packages.

CO-PO Mapping

	PO_1	PO_2	PO_3	PO_4	PO_5
CO_1	*	*			
CO_2	*	*	*		*
CO_3	*	*	*		*
CO_4	*	*	*		*
CO_5	*	*	*		*

Course Content

Sl. No.	Unit/chapter title	Content	Number of hours	Skills Developed
1	Unit- I	Introduction: History and Development of Accounting –Meaning Objectives and functions of Accounting-Book-keeping V/s Accounting –Users of accounting data – systems of book-keeping and accounting – branches of accounting –advantages and limitations of accounting. Accounting Concepts and conventions: Meaning need and classification, Accounting standards –meaning, need and classification of Indian accounting standards. Accounting principles V/s Accounting standards.	10 Hrs	Analytical / Cognitive Skills
2	Unit- II	Financial Accounting Process: Classification of accounting transaction and accounts, rules of debit and credit as per Double Entry System. Journalisation and Ledger position Preparation of different subsidiary books: Purchase Day Book Sales Day Book, Purchase Returns Day Books, Sales Returns Day Book, and Cash Book. Bank Reconciliation Statement: Meaning, Need, Definition, preparation of BRS.	10 Hrs	Analytical / Cognitive / Employable Skills
3	Unit- III	Trial Balance: Meaning, Definition, Need and Importance, Format - Problems Preparation of Final accounts: Meaning, need and classification, Preparation of Manufacturing, Trading, Profit and loss account and Balance-Sheet of sale –traders and partnership firms.	13 Hrs	Analytical / Cognitive / Employable Skills
4	Unit- IV	Accounting Package- Tally: Creation of Accounts, trial balance, balance sheets, problems	12 Hrs	Analytical / Cognitive / Employable Skills

Books for Reference:

1. S.Ramesh, B.S.Chandrashekar. (2014). A Text Book of Accountancy. (2nd Edition). Pearson Education.
2. V.A.Patil and J.S.Korlahalli. (2014). Book-Keeping and Accounting. (2nd Edition). R. Chand and Co, Delhi.
3. R.S.Singhal. (2014). Principles of Accountancy. (2nd Edition). Nageen Prakash pvt.Ltd, Meerut.
4. B.S.Raman. (2018). Financial Accounting. (2nd Edition). United Publishers & Distributors.

Web Resources:

1. <https://bcastudyguide.com/unit-1-financial-accounting-overview/>
2. <https://sites.google.com/site/bcasource/financial-accounting/notes>
3. <https://www.pucnotes-solutions.com/1st-pu-accountancy-notes/>
4. <https://kannadadeevige.in/1st-puc-accountancy-chapter-10-notes/>

B21DCE5.6: DATA MINING

THEORY

Total Teaching Hours: 45

No. of Hours per Week: 3
(3 credits)

CObj	Course Objectives
CObj_1	To provide a strong understanding of data mining and preprocessing techniques
CObj_2	To impart knowledge on various classification and clustering techniques
CObj_3	To instill the capability to collect, transform, and organize data in order to make informed business decisions

CO	Course Outcomes
	After completion of this module, students should be able to:
CO1	Demonstrate an understanding of the concepts of data mining and gain the ability to extract interesting patterns from large amounts of data
CO2	Apply preprocessing methods for any given dataset.
CO3	Explore various clustering techniques and employ appropriate method to group the unknown data.
CO4	Compare classification techniques and apply in classification of real time datasets.
CO5	Comprehend the kinds of patterns that can be discovered by association rule mining

CO-PO Mapping

	PO_1	PO_2	PO_3	PO_4	PO_5
CO_1	*	*			
CO_2	*			*	
CO_3	*			*	
CO_4			*	*	*
CO_5			*	*	*

Course Content

Sl. No.	Unit/chapter title	Content	Number of hours	Skills Developed
1	Unit- I	Introduction to Data Mining – Data Mining Tasks – Components of Data Mining Algorithms – Data Mining supporting Techniques – Major Issues in Data Mining – Measurement and Data – Data Pre-processing – Data sets	10 Hrs	Analytical / Cognitive / Employable Skills
2	Unit- II	Classification and Predictions: What is classification and prediction, Issues regarding Classification and prediction –Decision Tree induction – Bayes Classification Methods – Rule Based Classification– Model Evaluation and Selection – Techniques to Improve Classification Accuracy –Classification: Advanced concepts – Bayesian Belief Networks- Classification by Back Propagation – Support Vector Machine – Classification using frequent patterns.	11 Hrs	Analytical / Cognitive / Employable Skills
3	Unit- III	Cluster Analysis: Basic concepts and Methods – Cluster Analysis – Partitioning methods – Hierarchical methods – Density Based Methods – Grid Based Methods – Evaluation of Clustering – Advanced Cluster Analysis: Probabilistic model-based clustering – Clustering High – Dimensional Data	12 Hrs	Analytical / Cognitive / Employable Skills
4	Unit- IV	Mining frequent patterns, Associations and correlations: Basic concepts, Frequent mining methods, pattern Evaluation methods, Pattern mining in Multilevel multidimensional space, Mining Association Rules in Large Databases, Association rule mining, mining Single-Dimensional Boolean Association rules from Transactional Databases– Apriori Algorithm, Mining Multilevel Association rules from Transaction Databases and Mining Multidimensional Association rules from Relational Databases.	12 Hrs	Analytical / Cognitive / Employable Skills

Books for Reference:

1. Jiawei Han, Michelin Kamber, Jian Pei. (2022). Data Mining: Concepts and Techniques, 4th Edition, Morgan Kaufmann.
2. Robert Layton. (2015). Learning Data Mining with Python. (2nd edition). packet publishing.
3. Charu C Aggarwal. (2015). Data Mining. (1st edition). springer.
4. Pang- Ning Tan and Micheal Steinbach. Z. (2021). Introduction to Data Mining. (2nd edition). Pearson Education.
5. M.H. Dunham. (2013). Data Mining: Introductory and Advanced Topics. (1st edition). Pearson Education.

Web Resources:

1. www.tutorialpoint.com
2. www.javapoint.com
3. <https://www.mygreatlearning.com/blog/data-mining-tutorial/>.

B21DCE5.7 : COMPUTER GRAPHICS**THEORY****Total Teaching Hours: 45****No. of Hours per Week: 3****(3 credits)**

CObj	Course Objectives
CObj_1	To impart knowledge on the fundamental concepts and theory of computer graphics
CObj_2	To provide a good understanding of graphics input techniques and output primitives
CObj_3	To introduce to students the concept of 2D and 3D transformations

CO	Course Outcomes
	After completion of this module, students should be able to:
CO1	Demonstrate an understanding of the graphics system and applications of computer graphics
CO2	Apply and compare the algorithms for drawing 2D images.
CO3	Apply 2D transformations to solve problems.
CO4	Analyze and apply clipping algorithms and transformation on 2D images
CO5	Apply 3D transformations to design applications.

CO-PO Mapping

	PO_1	PO_2	PO_3	PO_4	PO_5
CO_1	*	*		*	*
CO_2	*	*		*	*
CO_3	*	*		*	*
CO_4	*	*	*	*	*
CO_5	*	*	*	*	*

Course Content

Sl. No.	Unit/chapter title	Content	Number of hours	Skills Developed
1	Unit- I	Graphics Systems: Application of CG, CG classification-Graphic softwares- CRT Functioning- Factors Affecting CRT- Raster scan System- Shadow mask method, Display Processor with raster system- Raster co-ordinate system color mapping- Instruction set and Raster System applications. Graphical input Devices:Keyboards, Mouse, Joystick, Touch Panels, Track ball.	11 Hrs	Analytical / Cognitive Skills
2	Unit- II	Output Primitives: Line drawing methods-Direct, DDA and Bresenhams, Line attributes, - Circle drawing- Direct and midpoint circle drawing- Ellipse Drawing – Bresenhams Ellipse Algorithm- Area filling-scan line area filling and character attributes.	10 Hrs	Analytical / Cognitive Skills
3	Unit- III	Two-dimensional Transformation: Basic Transformation, Translation, Rotation, Reflection and Shear matrix representations- Homogeneous coordinates- composite transformation- Raster methods for transformation. Graphical Input Techniques: Positioning Techniques, Positional Constraints, Rubber band Techniques	11 Hrs	Analytical / Cognitive Skills
4	Unit- IV	Windowing and Clipping: Viewing Transformations, Clipping process, Point clipping, Line Clipping, Cohen Sutherland line clipping algorithm, Midpoint Subdivision algorithm, Area Clipping. Three Dimensional Graphics: 3D-coordinate system, 3D-Display techniques, Polygon surfaces, Octrees, Bezier curves, Hidden surface removal, Depth buffer and scan Line method.	13 Hrs	Analytical / Cognitive / Employable Skills

Books for Reference:

1. William M. Newman, Robert F. Sproull. (2007). Principles of Interactive Computer Graphics. (2nd Edition). McGraw Hill Education.
2. Donald Hearn, M. Pauline Baker, Warren R. Carithers. (2011). Computer Graphics with OpenGL. (4th Edition). Pearson Education.
3. Asthana and Sinha. (2007). Computer Graphics for Scientists and Engineers. (2nd Edition). New Age International Publishers

Web ResourceS:

1. <https://www.cs.helsinki.fi/group/goa/sisallys.html>
2. <https://www.javatpoint.com/computer-graphics-tutorial>
3. https://www.tutorialspoint.com/computer_graphics/computer_graphics_quick_guide.htm
4. <https://www.edx.org/course/computer-graphics-2>

21SBC5.1: CYBER CRIME AND CYBER LAW

THEORY

Total Teaching Hours: 30

No. of Hours per Week: 2

(2 credits)

CObj	Course Objectives
CObj_1	To provide an understanding of the cyber world and cyber law in general
CObj_2	To provide an understanding about the various dimensions/aspects of cyber crimes and cyber laws
CObj_3	To create an awareness on IT Act 2000/2008

CO	Course Outcomes
	After completion of this module, students should be able to:
CO1	Demonstrate an understanding of the various types of cyber crimes.
CO2	Comprehend the various types of cyber-attack.
CO3	Demonstrate an understanding of types and techniques of credit frauds and attacks on mobile devices.
CO4	Develop an understanding of the cyber laws and IT Act 2000/2008.
CO5	Demonstrate an understanding of the procedure and investigation of cyber crimes.

CO-PO Mapping

	PO_1	PO_2	PO_3	PO_4	PO_5
CO_1	*		*		*
CO_2	*		*		*
CO_3	*		*		*
CO_4	*		*	*	*
CO_5	*		*	*	*

Course Content

Sl. No.	Unit/chapter title	Content	Number of hours	Skills Developed
1	Unit- I	Understanding Cyber Crimes and Cyber Offences, Crime in context of Internet, Types of Crime in Internet, Crimes targeting Computers: Definition of Cyber Crime & Computer related Crimes, History, Development and Reasons for Growth of Cyber Crimes, Social Media and its Role in Cyber World, Fake News, Defamation, Online Advertising. Cyber criminals and its types	4 Hrs	Transferable / Employable / Cognitive Skills
2	Unit- II	Crime- Internal and External Attacks, Attack Vectors. Cybercrimes against Individuals – E-mail spoofing and online frauds, Phishing and its forms, Spamming, Cyber-defamation, Cyberstalking, Cyber Bullying and harassment, Computer Sabotage, Pornographic offenses, Password Sniffing. Keyloggers and Screen loggers. Cyber Crimes against Women and Children. Cybercrime in Mobile and Wireless devices-proliferation of mobile and wireless devices, trends in mobility. Types and techniques of Credit card frauds, security challenges posed by mobile devices, Registry settings for mobile devices. Attacks on mobile /cell phones-phone theft, virus, mishing, vishing, smishing, hacking Bluetooth. Importance of security policies and prevention of cyber crimes	10 Hrs	Transferable / Employable / Cognitive Skills
3	Unit- III	IT Act 2000/2008 salient features of Cyber laws, Critical analysis & loopholes of the IT Act, latest amendments in the IT Act and IT rules, Need for cyber laws, nature and scope of cyber laws, approaches to cyber laws, convergence bill, information technology legislation, digital signature, electronic signature. Cyber Law: International Perspective: EDI- Concept and legal Issues. Role of ICANN	8 Hrs	Transferable / Employable / Cognitive Skills
4	Unit- IV	Investigation of Cyber Crimes. Investigation of malicious applications, Agencies for investigation in India, their powers and their constitution, Procedures followed by First Responders, Search and Seizure Procedures of Digital Evidence, Securing the Scene, Documenting the Scene, Evidence Collection and Transportation (a) Data Acquisition (b) Data Analysis (c) Reporting.	8 Hrs	Transferable / Employable / Cognitive Skills

Books for Reference:

1. Nina Godbole and Sunit Belapore. (2011). Cyber Security: Understanding Cyber Crimes, Computer Forensics and Legal Perspectives. Wiley Publications.
2. Pawan Duggal. (2016). Text Book on Cyber Law. (2nd edition). Universal Law Publishing.
3. Aparna Viswanathan. (2012). Cyber Law- Indian And International Perspectives On Key Topics Including Data Security, E-Commerce, Cloud Computing And Cyber Crimes.
4. Prashant Mali. (2017). Cyber Law & Cyber Crimes Sumplified. (7th edition). Cyber Infomedia Publisher.
5. Justice Yatindra Singh. (2016). Cyber Laws. (1st edition). Universal Law Publishing.
6. V.Sithannan. (2022). Police Investigation: Powers, Tacties and Techniques. (4th edition). Jeywin Publications.

Web ResourceS:

1. <https://pavanduggalonmobilelaw.wordpress.com/kinds-of-mobile-crimes/>
2. <https://infosecawareness.in/cyber-laws-of-india>
3. <https://www.meity.gov.in/content/cyber-laws>
4. Information Technology Amended Act,2008:
[https://police.py.gov.in/Information%20Technology%20Act%202000%20-%202008%20\(amendment\).pdf](https://police.py.gov.in/Information%20Technology%20Act%202000%20-%202008%20(amendment).pdf)



MATRIX AND SYLLABUS

For the Programme Bachelor of Computer Applications (B.C.A)

NEP Based Curriculum (2021 onwards)

VI Semester

NEP- Curriculum Framework

Bachelor of Computer Applications (B.C.A) - Course Matrix (w.e.f. 2021-22 onwards)

VI SEMESTER							
Code	Course Code	Course	Teaching Hours	Course Components			Credits
				L	T	P	
DSC6	B21DC6.1	Theory of Computation	60	2	2	-	4
DSC6	B21DC6.2	Machine Learning	60	2	2	-	4
DSC6	B21DC6.3	Mobile Application Development	60	2	2	-	4
DSC6	B21DC6.4	Machine Learning Lab	60	-	-	4	2
DSC6	B21DC6.5	Project Lab	60	-	-	4	2
ELEC-2	B21DCE6.6	Elective II: a. Operations Research	45	2	1	-	3
	B21DCE6.7	b. Image Processing					
VOC-2	21VOC6.1	Vocation Course II: Computer Animation	45	2	-	1	3
SEC-SB	21SBC6.1	Professional and Business Communication	30	1	1	-	2
Total							24

Note:

AECC- Ability Enhancement Compulsory Course

DSC - Discipline-Specific Course

OE- Open elective (course offered by the department to students of other stream)

DSE – Discipline-Specific Elective

SEC - VB Skill Enhancement Course -Value Based

SEC - SB Skill Enhancement Course -Skill Based

Continuous Internal Assessment – Scheme of Evaluation

For Theory Courses

End Semester Examination: 60%

Continuous Internal Assessment: 40%

Activities (CIA: 40 Marks)	Proposed and Approved Scheme		Total Marks
	IA-1	IA-2	
Session Test Maximum Marks	30	30	
1. Weightage (Marks)	10	10	20
2. Assignment (Marks)	20		20
i. Writing	10		
ii.Quiz / Presentation	05		
iii. Classroom participation	05		
Total			40

For Practical Courses

End Semester Examination: 50%

Continuous Internal Assessment: 50%

CIA (25 marks) + End Semester Exam (25 marks)

Activities	Total Marks
1. Lab Performance	10
2. Observation record	05
3. Internal exam	10
Total	25

For Project Lab

Activities	Total Marks
1. Lab Performance	10
2. Project Presentation	10
3. Viva-voce	05
Total	25

B21DC 6.1: THEORY OF COMPUTATION**THEORY****Total Teaching Hours: 60****No. of Hours per Week: 4****(4 credits)**

CObj	Course Objectives
CObj_1	To impart knowledge of the concept of machines: finite automata, pushdown automata, and Turing machines.
CObj_2	To provide a strong foundation on the formal languages and grammars
CObj_3	To instill the ability to design Turing machines for any computational problem.

CO	Course Outcomes
	After completion of this module, students should be able to:
CO1	Comprehend the central concepts of Automata theory and design different finite automata models for Regular languages.
CO2	Define regular languages, apply regular expressions, and demonstrate the ability to prove non-regular languages using the Pumping Lemma.
CO3	Apply different grammar rules to derive required strings and design parse trees to check ambiguity in grammar.
CO4	Design pushdown automata for context free languages and demonstrate the ability to prove non-context-free languages using the Pumping Lemma.
CO5	Create Turing machines, develop an understanding of the programming techniques for Turing Machines and limitations of computational problems that have no solutions.

CO-PO Mapping

	PO_1	PO_2	PO_3	PO_4	PO_5
CO_1	*			*	
CO_2	*	*	*	*	*
CO_3	*	*		*	
CO_4	*	*	*	*	*
CO_5	*	*	*	*	*

Course Content

Sl. No.	Unit/chapter title	Content	Number of hours	Skills Developed
1	Unit- I	Introduction to Finite Automata: The central concepts of Automata theory; Deterministic finite automata; Nondeterministic finite automata. An application of finite automata, Finite automata with Epsilon transitions	17 Hrs	Analytical / Cognitive / Employable Skills
2	Unit- II	Regular Expressions: Finite Automata and Regular Expressions Applications of Regular Expressions. Regular languages; Pumping Lemma: Proving language is not a regular language; Closure properties of regular languages; Decision properties of regular languages; Equivalence and minimization of automata.	15 Hrs	Analytical / Cognitive / Employable Skills
3	Unit- III	Context-free grammars: Parse trees; Applications; Ambiguity in grammars and Languages. Definition of the Pushdown automata; the languages of a PDA; Equivalence of PDA's and CFG's. Deterministic Pushdown Automata: Normal forms for CFGs; The pumping lemma for CFGs; Closure properties of CFLs. Problems that Computers cannot solve	18 Hrs	Analytical / Cognitive / Employable Skills
4	Unit- IV	Turing machine: Programming techniques for Turing Machines. Undecidability, A Language that is not recursively enumerable; An Undecidable problem that is RE; Post's Correspondence problem	10 Hrs	Analytical / Cognitive / Employable Skills

Books for Reference:

1. John E. Hopcroft, Rajeev Motwani, Jeffrey D.Ullman. (2011). Introduction to Automata Theory, Languages and Computation. (3rd Edition). Pearson Education.
2. John C Martin. (2007). Introduction to Languages and Automata Theory. (3rd Edition). Tata McGraw-Hill.
3. Daniel I.A. Cohen. (2009). Introduction to Computer Theory.(2nd Edition). John Wiley & Sons.
4. A.M. Padma Reddy. (2011). Finite Automata and Formal Languages. (1st edition). Pearson Education.
5. Anuradha.A.Puntambekar. (2019). Theory of Automata and Formal Languages - A Conceptual Approach. (3rd Edition). Technical Publications.
6. Dr. Varsha.h. patil, Dr. Vaishali.S.Pawar. (2022). Theory of Computation Simplified: Simulate Real-world Computing Machines and Problems with Strong Principles of Computation. (1st edition). BPB.

Web Resources:

1. <https://www.gatevidyalay.com/theory-of-automata-computation/>
2. <https://www.geeksforgeeks.org/introduction-of-theory-of-computation/>
3. <https://www.javatpoint.com/automata-tutorial>

B21DC 6.2: MACHINE LEARNING**THEORY****Total Teaching Hours: 60****No. of Hours per Week: 4****(4 credits)**

CObj	Course Objectives
CObj_1	To provide a strong concepts of different types of learning
CObj_2	To impart critical understanding of classification and regression models
CObj_3	To provide strong knowledge of dimensionality reduction techniques

CO	Course Outcomes After completion of this module, students should be able to:
CO1	Comprehend supervised, unsupervised and reinforcement learning.
CO2	Apply the appropriate machine learning strategy for any given problem.
CO3	Design machine learning algorithms to improve classification efficiency.
CO4	Create Ensemble models to improve performance of the classifier.
CO5	Apply dimensionality reduction on high dimensional datasets.

CO-PO Mapping

	PO_1	PO_2	PO_3	PO_4	PO_5
CO_1	*	*			
CO_2	*	*	*	*	*
CO_3	*	*	*	*	*
CO_4	*	*	*	*	*
CO_5	*	*	*	*	*

Course Content

Sl. No.	Unit/chapter title	Content	Number of hours	Skills Developed
1	Unit- I	Learning – Machine Learning-Types of machine Learning-Supervised Learning, unsupervised learning-, reinforcement learning. Issues in Machine Learning.ML Technique overview: build model, Train, validate, Test, evaluate. -Cross-Validations -confusion matrix, Evaluation metrics: precision, recall, f1 score, accuracy, ROC, AUC, sensitivity, specificity, MSE, MAE.	12 Hrs	Analytical / Logical Skills
2	Unit- II	Curse of dimensionality –Dimensionality Reduction- Techniques for Dimensionality Reduction. Feature Selection Methods: filter methods- chi square, correlation, wrapper methods, Embedded method, ,Feature Transformation Techniques in Machine Learning, Difference Between Feature Selection and Feature Extraction	12 Hrs	Analytical / Logical Skills
3	Unit- III	Linear Regression, Logistic Regression, Classifiers: K-Nearest Neighbors - Naïve Bayes Classifier - Support Vector Machines- Classifier and Regressor, Decision Tree. Neural networks: Neuron models: biological neuron, Artificial neuron. Perceptron, Feed forward networks, Back Propagation networks.	18 Hrs	Cognitive / Logical Skills
4	Unit- IV	Association rules- Market Basket Analysis. Different clustering methods: Distance, Density, Hierarchical. Dealing with continuous, categorical values in K-Means, K-Medoids clustering - Measures of quality of clustering. Introduction to Ensemble models: Bagging - boosting -stacking- impact on bias and variance. Reinforcement Learning: Introduction, Learning Task, Q Learning	18 Hrs	Research / Logical Skills

Books for Reference:

1. Tom M. Mitchell. (2017). Machine Learning.(1st edition). McGraw Hill Education.
2. Trevor Hastie, Robert Tibshirani, Jerome Friedman. (2017). The Elements of Statistical Learning. (2nd edition). springer series in statistics.
3. Ethem Alpaydin. (2014). Introduction to Machine Learning 3e (Adaptive Computation and Machine Learning Series). (3rd Edition). MIT Press,
4. Christopher M. Bishop. (2006). Pattern Recognition and Machine Learning. (1st edition). Springer.
5. Stephen Marshland. (2006). Machine Learning – An Algorithmic Perspective. (2nd edition). Chapman and Hall/CRC

Web Resources:

1. www.tutorialpoint.com
2. www.javapoint.com
3. www.W3school.com
4. <https://www.geeksforgeeks.org/machine-learning/>

B21DC 6.3: MOBILE APPLICATION DEVELOPMENT**THEORY****Total Teaching Hours: 60****No. of Hours per Week: 4****(4 credits)**

CObj	Course Objectives
CObj_1	Focuses on developing applications for modern Smartphone operating systems such as Google's Android and Microsoft's Windows.
CObj_2	Provide rapid application development techniques are covered, as well as setup of the development environment, real-world testing, and deployment.
CObj_3	Provide a practical approach to Android mobile application development and theoretical knowledge.

CO	Course Outcomes
	After completion of this module, students should be able to:
CO1	Comprehend the concepts in mobile applications development
CO2	Build user interface for mobile applications.
CO3	Design mobile applications with different views and build apps useful for society.
CO4	Implement the knowledge gained to access and store data in files from a mobile application in providing solutions to real world problems.
CO5	Apply the acquired knowledge on database access to create mobile applications accessing databases.

CO-PO Mapping

	PO_1	PO_2	PO_3	PO_4	PO_5
CO_1	*	*			
CO_2	*				
CO_3	*	*	*		*
CO_4	*	*	*		*
CO_5	*	*	*	*	*

Course Content

Sl. No.	Unit/chapter title	Content	Number of hours	Skills Developed
1	Unit- I	Introduction to Android What is Android? Setting up development environment, Dalvik Virtual Machine &.apk file extension, Fundamentals: Basic Building blocks - Activities, Services, Broadcast Receivers & Content providers, UI Components - Views & notifications, Components for communication -Intents & Intent Filters, Android API levels (versions & version names) Application Structure (in detail) AndroidManifest.xml, uses-permission & uses-sdk, Resources, Layouts & Drawable Resources, Activities and Activity lifecycle First sample Application	14 Hrs	Cognitive / Analytical / Employable Skills
2	Unit- II	Emulator-Android Virtual Device Launching emulator, Editing emulator settings, Emulator shortcuts, Logcat usage Introduction to DDMS, Second Application:- (switching between activities) Basic UI design: Form widgets, Text Fields, Layouts, [dip, dp, sip, sp] versus px, Examples Preferences: SharedPreferences, Preferences from xml, Examples Menu: Option menu, Context menu, Sub menu, menu from xml, menu via code, Examples Intents (in detail): Explicit Intents, Implicit intents, Examples	16 Hrs	Cognitive / Analytical / Employable Skills
3	Unit- III	UI design: Time and Date, Images and media, Composite, AlertDialogs & Toast, Popup, Examples Tabs and Tab Activity: Examples Styles & Themes: styles.xml, drawable resources for shapes, gradients (selectors), style attribute in layout file, Applying themes via code and manifest file, Examples Content Providers: SQLite Programming, SQLiteOpenHelper, SQLiteDatabase, Cursor, Reading and updating Contacts, Reading bookmarks, Example	18 Hrs	Cognitive / Analytical / Employable Skills
4	Unit- IV	Notifications: Broadcast Receivers, Services and notifications, Toast, Alarms, Examples Advanced Tools: Maps, GPS, Location based Services, Accessing Phone services (Call, SMS, MMS), Network connectivity services	12 Hrs	Cognitive / Analytical / Employable Skills

Books for Reference:

1. Wei-Meng Lee. (2016). Beginning Android 4 Application Development. (1st edition). John Wiley & Sons, Inc.
2. Grant Allen,. (2012). Beginning Android 4. Apress.
3. Dr. Madhu Goel, Chetna Sharma. (2020). Mobile Application Development, Ishan Publications.
4. Ed Burnette. (2015). Hello, Android: Introducing Google's Mobile Development Platform. Pragmatic Bookshelf.
5. Barry Burd, John Paul Mueller. (2021). Android Application Development All-In-One for Dummies. (3rd edition). wiley.
6. Jerome (J.F) DiMarzio. (2010). Android - A programmer's Guide. McGraw Hill

Web Resources:

1. https://www.tutorialspoint.com/mobile_development_tutorials.htm
2. <https://developer.ibm.com/technologies/mobile/tutorials/>
3. <https://www.udemy.com/course/create-an-android-app-in-12-minutes-with-android-studio/>
4. <https://www.javatpoint.com/android-tutorial>
5. <https://www.netsolutions.com/insights/android-app-development-tutorial-learn-basic-concepts/>
6. <https://www.geeksforgeeks.org/android-tutorial/>

B21DC6.4: MACHINE LEARNING LAB

PRACTICALS

Total Teaching Hours: 60

No. of Hours per Week: 4

(2 credits)

Course Content

List of Programs	Skills Developed
1. Study of Machine Learning libraries in python 2. Data exploration and pre-processing in machine learning 3. Evaluate the classifier using various performance measures 4. Implement k-nearest neighbors classification using python 5. Dimensionality reduction using PCA 6. Regression Analysis using Linear regression 7. Classification using Logistic Regression 8. Classification using Decision tree 9. Classification using Support vector machine 10. Classification Techniques- Naïve Bayes 11. Clustering using K- Means clustering 12. Ensemble method- Bagging 13. Ensemble method- Boosting 14. Ensemble method- Stacking	Employable / Analytical / Cognitive Skills

21VBC6.1 : COMPUTER ANIMATION

THEORY

Total Teaching Hours: 45

No. of Hours per Week: 3

(3 credits)

CObj	Course Objectives
CObj_1	To instill the principles and fundamentals of Animation
CObj_2	To provide an understanding of motion and 2D animation.
CObj_3	To impart knowledge on 3D modeling

CO	Course Outcomes After completion of this module, students should be able to:
CO1	Comprehend the fundamentals of animation and roles of an animator.
CO2	Demonstrate an understanding of the principles and tools of animation.
CO3	Develop an understanding of motion studies and 2D animations.
CO4	Create various 3D models.
CO5	Become proficient to create 2D and 3D animations.

CO-PO Mapping

	PO_1	PO_2	PO_3	PO_4	PO_5
CO_1	*			*	
CO_2	*	*	*	*	*
CO_3	*	*		*	
CO_4	*	*	*	*	*
CO_5	*	*	*	*	*

Course Content

Sl. No.	Unit/chapter title	Content	Number of hours	Skills Developed
1	Unit- I	Animation- definition, history, Basics of Animation, Methods / Techniques: Frame by Frame (Traditional Method), Procedural, Behavioral, Key Framing, Motion Capture, Dynamics, Dawn of Digital Animation, Digital effects of 3D Animation, Rotoscope to Motion Capture, Becoming an Animator, Becoming an Actor, Becoming a Storyteller, Becoming a Creative Practitioner, Applications of Animation: Entertainment, Advertisement, Education, Medical Practise and Engineering. Types of Animation: 3D, Traditional, stop motion, motion graphics, vector.	10 Hrs	Cognitive / Analytical / Employable Skills
2	Unit- II	Basic Principles in animation: Squash and stretch, Anticipation, Staging, Straight ahead and pose to pose, Follow through and overlapping action, Slow in and slow out, Arcs, Secondary action, Timing, Exaggeration, Solid drawing, Appeal. Animation process: 11 steps, Mass and weight, Character acting, Volume, Line of action, Path of action, Walk cycles-animal and human. Tools of Animation: The use of Live Action in Animation: Humans and Animals-Quick Studies from real life, Sequential movement drawing, Caricaturing the Action, Thumbnails, Drama and psychological effect	11 Hrs	Cognitive / Analytical / Employable Skills
3	Unit- III	Motion Studies, Drawing for motion, The Body language, Facial expressions and Lip sync, Introduction to traditional and digital equipment-The animator's drawing tools, The animation table (light box, Field charts, Exercises and warm ups on pegging sheet, Line tests, The exposure sheet (X" sheet). 2D animation and its features, Drawing tools, types of panels, transformation, property panel, working with objects, group, bitmap, Controlling Movie Clips with code, Working with Dynamic Text fields and Input Text Fields, Loading external content and other flash movies, Dynamic preloaders, Interactivity with code.	11 Hrs	Cognitive / Analytical / Employable Skills

4	Unit- IV	3D Modelling: Introduction to various 3D modelling, working with symmetry, Editing components in orthographic view, editing components in perspective view, Poly editing techniques- Extruding, Bridging, Adding polygon to mesh, Split polygon faces, edge loops, Mirror copying a mesh, Creasing and hardening edges on mesh, Sculpt a polygon mesh Poly Normal, Edge & bevel, Separating & combining geometry, NURBS, sub-D's. 3D Animation Pipeline Pre- production- Idea, Story, R&D, Script to screenplay, Storyboards. Production-Layout,Texturing(Surfacing), Rigging/setup, Animation, 3D Visual effects, Lighting and Rendering and Post production – Colour Correction, Audio Video Editing, Final Output.	13 Hrs	Cognitive / Analytical / Employable Skills

Books for Reference:

1. Richard Williams. (2015). The Animator's Survival Kit: A Manual of Methods, Principles and Formulas for Classical, Computer, Games, Stop Motion and Internet Animators. Faber & Faber Publication.
2. Pakhira Malay K. (2010). Computer Graphics, Multimedia and Animation. (2nd edition). PHI.
3. Chris patmore. (2003). The Complete Animation Course: The Principles, Practice, and Techniques of Successful Animation. Barrons educational series inc.
4. Gruddy Leette. (2001). Flash 5 For Dummies. Willy.
5. Adam Watkins. (2007). Introduction to 3d graphics & animation using Maya w/cd. Cengage Learning.
6. John M. Blain. (2019). The Complete Guide to Blender Graphics. (5th edition). CRC Press
7. Eric Goldberg. (2008). Character Animation Crash Course. Silman-James Press.

Web Resources:

1. <https://www.adobe.com/creativecloud/animation/discover/principles-of-animation.html>
2. <https://www.blopanimation.com/animation-foundations/>
3. <https://www.blopanimation.com/animation-for-beginners/#animation-process>

**B21DCE6.5 : OPERATIONS RESEARCH
THEORY**
Total Teaching Hours: 45
No. of Hours per Week: 3
(3 credits)

CObj	Course Objectives
CObj_1	To provide knowledge of Linear Programming and Assignment problems
CObj_2	To impart knowledge on different transportation problems
CObj_3	To instill skills on applying strategies used in game theory and perform project evaluation

CO	Course Outcomes
	After completion of this module, students should be able to:
CO1	Become competent in solving linear programming problems.
CO2	Analyze and apply transportation problems in real world scenarios.
CO3	Analyze and apply assignment problems in real world scenarios.
CO4	Become proficient in project evaluation and review techniques.
CO5	Apply strategies used in game theory to solve real world problems.

CO-PO Mapping

	PO_1	PO_2	PO_3	PO_4	PO_5
CO_1	*	*			
CO_2		*		*	
CO_3	*	*			
CO_4	*	*	*	*	
CO_5		*	*	*	*

Course Content

Sl. No.	Unit/chapter title	Content	Number of hours	Skills Developed
1	Unit- I	Linear Programming Problems: Origin and development of operations research, Linear Programming Problem –formulation of Linear Programming problem, Graphical solution. Theory of simplex method. Use of artificial variables and their solution.	10 Hrs	Analytical / Cognitive Skills
2	Unit- II	Transportation Problem: Mathematical formulation of transportation problem, Initial basic Feasible solution, North West corner rule, Matrix minima method, Vogel's approximation method, MODI method to find optimal solution.	12 Hrs	Analytical / Logical Skills
3	Unit- III	Assignment Problem: Mathematical formulation of an Assignment problem, Assignment algorithm, Hungarian Method to solve Assignment Problem.	12 Hrs	Analytical / Logical / Research Skills
4	Unit- IV	Network Analysis: Basic components of Network, Rules for drawing Network diagram Time calculation in Networks. Critical Path Method and PROJECT Evaluation and Review Techniques. Algorithm and flowchart for CPM and PERT. Theory of Games: Two –person Zero –sum Games, the maximin and Minimax principle, Saddle point and value of the Game. Game without saddle points, mixed strategies	11 Hrs	Analytical / Logical Skills

Books for Reference:

1. Taha. (2007). Operations Research. (7th edition). Pearson Education.
2. K. Rajagopal. (2012). Operations Research. (1st edition). PHI learning.
3. Hamady A.Taha,. (2022). Operations Research. (7th edition). Pearson Education.
4. K. Chandrasekhara Rao. (2012). Operations Research. Alpha Science International Limited (UK).

Web Resources:

1. <https://www.techtarget.com/whatis/definition/operations-research-OR>
2. <https://stemez.com/subjects/science/1HOperationsReseach/1HOperationsReseach.php>
3. <https://www.lix.polytechnique.fr/~liberti/teaching/isic/isc612-06/exercices-solutions.pdf>

**B21DCE6.6 : IMAGE PROCESSING
THEORY**
Total Teaching Hours: 45
No. of Hours per Week: 3
(3 credits)

CObj	Course Objectives
CObj_1	To provide knowledge of image processing fundamentals
CObj_2	To impart knowledge on various image enhancement techniques
CObj_3	To instill skills on different image restoration techniques and methods used in digital image processing

CO	Course Outcomes
	After completion of this module, students should be able to:
CO1	Demonstrate an understanding of sensing, acquisition, and storage of digital images
CO2	Develop an understanding of the image processing fundamentals and mathematical transforms necessary for it.
CO3	Apply image enhancement techniques wisely.
CO4	Demonstrate an understanding of the noise and filters in image processing and implement the filters wisely on images.
CO5	Demonstrate an understanding of the image segmentation concepts.

CO-PO Mapping

	PO_1	PO_2	PO_3	PO_4	PO_5
CO_1	*	*			
CO_2		*		*	
CO_3	*	*			
CO_4	*	*	*	*	
CO_5		*	*	*	*

Course Content

Sl. No.	Unit/chapter title	Content	Number of hours	Skills Developed
1	Unit- I	Introduction of Coordinate representation and Pixel, Fundamentals, Applications, A simple image formation model, Fundamental steps in image processing, Image processing system components, Image sensing and acquisition, Sampling and quantization, Neighbours of pixel adjacency connectivity, regions and boundaries , Distance measures.	10 Hrs	Analytical / Cognitive Skills
2	Unit- II	Image Enhancement, Grey level transformation, histogram processing, Spatial filtering, smoothing, Image enhancement in frequency domain, smoothing frequency-domain filters, sharpening frequency domain filters, Harmonic filtering	12 Hrs	Analytical / Cognitive Skills
3	Unit- III	Image restoration, A model of image degradation/restoration process, Noise models , linear spatial filter, non linear spatial filters ,mean filters ,arithmetic mean filter, Order statistics filters, Adaptive filters, Inverse Filtering, Minimum Mean Square Error (Wiener) Filtering	12 Hrs	Logical / Cognitive / Research Skills
4	Unit- IV	Image segmentation techniques: Point, line, edge detection, Background Basic Edge detection, Thresholding, Foundation Basic global thresholding, Region based segmentation	11 Hrs	Analytical / Logical skills

Books for Reference:

1. Rafael C. Gonzalez and Richard E. Woods. (2010). Digital Image Processing. (2nd edition). Pearson Education
2. Anil K.Jain. (2002). Fundamental of Image Processing, Prentice Hall of India.
3. S. Sridhar, 2016. Digital Image Processing. (2nd edition). Oxford University Press.
4. William K. Pratt, John Wiley & Sons. (2004). Digital Image Processing. (2nd edition).

Web Resources:

1. <https://www.simplilearn.com/image-processing-article>
2. <https://www.javatpoint.com/digital-image-processing-tutorial>
3. <https://www.geeksforgeeks.org/digital-image-processing-basics/>
4. <https://www.mygreatlearning.com/blog/digital-image-processing-explained/>

B21DC 6.5 : PROJECT LAB
PRACTICAL
Total Teaching Hours: 60
No. of Hours per Week: 4
(2 credits)

A team of maximum three students is allowed to develop a project. Students should implement their project in college in any programming language. The students can collect data outside practical hours but must be implemented in the college. Internal marks can be awarded by the guide by evaluating the performance of the students during the course of project work. In viva-voce the questions must be directed only on the project work to assess the involvement and understanding of the problem by the students.

CIA is 25 marks.

The project carries 25 marks for external examination and is distributed as follows:

Activities	Total Marks
Demonstration and Presentation	10 Marks
Validation	05 Marks
Viva-Voce	05 Marks
Report	05 Marks
Total	25 Marks



MATRIX AND SYLLABUS

For the Programme Bachelor of Science-

Mathematics/Physics/Electronics and Computer Science

NEP Based Curriculum (2021 onwards)

PEO_ID	BSc (CSc)-Programme Educational Objectives
PEO1	To instill a strong foundation of fundamental concepts in Mathematics and Computer science and demonstrate an independent thinking ability and knowledge to apply in various domains
PEO2	To impart knowledge on analyzing complex scientific problems and develop solutions using the principles of mathematics and Computer Science
PEO3	To develop robust communication skills as well as social, ethical and professional values and collaborate effectively with team members belonging to various domains
PEO4	To inculcate strong interest in research and focus on solving problems with the methods imbibed from various disciplines of study
PEO5	To develop entrepreneurs and Computer Science professionals by inculcating the practice of life-long learning for continuous personal enrichment and professional development

PO_ID	BSc (CSc)-Programme Outcomes
PO1	Scientific knowledge: Apply the knowledge of mathematics and Computer Science to solve problems in various fields of science both in industry and research
PO2	Problem analysis: Identify, formulate and analyze complex scientific problems and develop substantiated solutions using the principles of Mathematics and Computer Science
PO3	Ethics, Individual and team work: Acquire strong oral and written communication skills and function effectively as an individual, and as a member or leader in diverse teams in multidisciplinary scenarios by maintaining professional ethics, responsibilities and norms of scientific practice
PO4	Research interest: Apply the techniques embraced from various disciplines and develop solutions to the research problems which would benefit mankind
PO5	Life-long learning: Become competent to engage in independent and life-long learning and become successful entrepreneurs or Computer Science professionals

NEP- Curriculum Framework
B.Sc. (Electronics & Computer Science)
Course Matrix (w.e.f. 2024-25 onwards)

I Semester							
Code	Course Code	Course	Teaching Hours	Course Components			Credits
				L	T	P	
AECC	S21KN 1.1/ S21HN 1.1/ S21AE 1.1	Language I (Kannada/ Hindi/ Additional English)	45	3	1	-	3
AECC	S21GE 1.1	Language II (Generic English)	60	3	1	-	3
DSC1	S21EL1.1	Electronic Devices And Circuits	60	4	-	-	4
DSC1	S21EL1.2	Electronic Devices And Circuits – Lab	60	-	-	4	2
DSC1	S21CS1.1	Problem Solving Techniques	60	4	-	-	4
DSC1	S21CS1.2	C Programming Lab	60	-	-	4	2
OE-1	S21OE/ B21OE/	Open Elective (Domestic Equipment Maintenance / Office Automation and Design)	45	2	1	-	3
SEC-SB	21SBC 1.1	Digital Fluency-I	30	1	-	2	2
SEC-VB	21VBC 1.1	Health and Well-being	30	-	-	2	1
SEC-VB	21VBC 1.2	Yoga	30	-	-	2	1
Total							25

Note:

AECC- Ability Enhancement Compulsory Course

DSC - Discipline-Specific Course

OE- Open elective (course offered by the department to students of other stream)

DSE – Discipline-Specific Elective

SEC - VB Skill Enhancement Course -Value Based

SEC - SB Skill Enhancement Course -Skill Based

SEMESTER – I**S21CS 1.1 : PROBLEM SOLVING TECHNIQUES USING C****THEORY****Total Teaching Hours: 60****No. of Hours per Week: 4****(4 credits)**

CObj	Course Objectives
CObj_1	To inculcate necessary skills to design algorithms and flowcharts for developing applications in order to solve real world problems
CObj_2	To provide good knowledge of structured programming concepts using C apply the concepts wisely
CObj_3	To possess the ability to develop modular programs in C and subsequently develop small projects in C

CO	Course Outcomes After completion of this module, students should be able to:
CO1	Gain knowledge to devise algorithms and draw flow charts in order to design solutions to problems
CO2	Develop efficient C programs by using the program constructs wisely
CO3	Apply proper data structure to efficiently store and retrieve data in memory
CO4	Gain ability to design modular programs to solve real world problems
CO5	Capability to create C programs for real world applications by applying suitable constructs and modularity

CO-PO Mapping

	PO_1	PO_2	PO_3	PO_4	PO_5	PSO_1	PSO_2	PSO_3	PSO_4	PSO_5
CO_1	*	*	*	*		*	*		*	
CO_2	*	*	*	*		*	*	*	*	
CO_3	*	*	*	*		*	*		*	
CO_4	*	*	*	*	*	*	*	*	*	*
CO_5	*	*	*	*	*	*	*	*	*	

Course Content

Sl. No.	Unit/chapter title	Content	Number of hours	Skills developed
1	Unit- I	Introduction: The Role of Algorithms in Computing, Algorithms as a technology, analyzing algorithms, Designing algorithms, Growth of Functions, Asymptotic notation, Standard notations and common functions. Fundamental Algorithms: Exchanging the values of two variables, Counting, Summation of a set of numbers, Factorial Computation, Generating of the Fibonacci sequence, Reversing the digits of an integer, Base Conversion, Character to number conversion.	15 Hrs	Cognitive Skills
2	Unit- II	C Programming: Getting Started, Variables and Arithmetic expressions. Input and Output: Standard input and output, formatted output-printf, variable length argument list, formatted input-scanf. Control Flow: Statements and Blocks, If-else, else-if, switch, loops: while loop, for loop, do while, break and continue, goto labels. Functions in C: Types of Functions, Passing arguments to functions, Nested and recursive functions in C. (topic expanded) Pointers: pointers and addresses. Pointers as function arguments. Command line arguments.	15 Hrs	Analytical Skills, Cognitive Skills, Employable Skills

3	Unit- III	Factoring Methods: Finding the square root of a number, the smallest Divisor of an integer, the greatest common divisor of two integers, generating prime numbers, computing the prime factors of an integer, generation of pseudo random numbers, raising a number to a large power, computing the nth Fibonacci Number. Arrays: Definition, Linear arrays, Traversing Linear arrays, Inserting and deleting, Multi-dimensional arrays,(shifted from Unit 2). Matrices and Sparse matrices. Array Techniques: Array order Reversal, Finding the maximum number in a set, removal of duplicates from an ordered array, partitioning an array, Finding the kth smallest element, multiplication of two matrices.	15 Hrs	Cognitive Skills, Employable Skills Synthesis Skills
4	Unit- IV	Merging: the two-way merge. Sorting: Sorting by selection, sorting by exchange, sorting by insertion, sorting by diminishing increment, sorting by partitioning. Searching: binary search, hash search. Text processing and Pattern searching: text line length adjustment, left and right justification of text, keyword searching in text, text line editing, linear pattern search, sublinear pattern search	15 Hrs	Analytical Skills, Cognitive Skills, Employable Skills Synthesis Skills

Books for Reference:

1. R.G.Dromey. (2008). How to Solve it by Computer. Pearson Education India.
2. Thomas H. Cormen, Charles E. Leiserson. (2009). Ronald L. Rivest, Clifford Stein, Introduction to Algorithms. 3rd Edition, The MIT Press Cambridge, Massachusetts London, England.
3. Brain M. Kernighan, and Dennis M. Ritchie. (2012). The C Programming Language. (2nd edition). Princeton Hall Software Series.
4. E. Balagurusamy. (2019). Programming in ANSI C. 8th Edition, McGrawHill
5. Steven S. Skiena. (2008). The Algorithm Design Module. 2nd Edition, Springer-Verlag London Limited.
6. Donald E. Knuth. (1997). The Art of Computer Programming. Volume 1: Fundamental Algorithms, 3rd Edition, Addison Wesley Longman.
7. Donald E. Knuth. (1998). "The Art of Computer Programming. Volume 2: Seminumerical Algorithms, 3rd Edition, Addison Wesley Longman.
8. Greg Perry and Dean Miller. (2014). C programming Absolute Beginner's Guide. (3rd edition). Pearson Education, Inc.
9. Ashok N. Kamthane. (2006). Programming with ANSI and Turbo C. Pearson Education.

Web Resource:

1. <http://algorithmsforinterviews.com> Algorithms for Interviews

S21CS 1.2 : C PROGRAMMING LAB**PRACTICAL****Total Teaching Hours: 60****No. of Hours per Week: 4****(2 credits)**

CObj	Course Objectives
CObj_1	To impart practical knowledge of structured programming concepts using C
CObj_2	To provide the ability to implement the derived data types using C language
CObj_3	To inculcate the ability to develop modular programs in C

CO	Course Outcomes
	After completion of this module, students should be able to:
CO1	Become competent to develop C programs by gaining a thorough understanding of control structures.
CO2	Capability to wisely use the program constructs and develop efficient C programs
CO3	Acquire practical knowledge of efficiently storing data in memory and retrieving it through a careful analysis of suitable data structures.
CO4	Capability to design modular programs to solve real world problems
CO5	Capability to develop C programs for real world applications by applying suitable constructs and modularity

CO-PO Mapping

	PO_1	PO_2	PO_3	PO_4	PO_5	PSO_1	PSO_2	PSO_3	PSO_4	PSO_5
CO_1	*	*				*	*		*	
CO_2	*	*				*	*	*	*	
CO_3	*	*		*	*	*	*		*	
CO_4	*	*		*	*	*	*	*	*	*
CO_5	*	*		*	*	*	*	*	*	*

Programs	Skills Developed
Write and execute C program for the following: 1. to read radius of a circle and to find area and circumference 2. to read three numbers and find the biggest of three 3. to check whether the number is prime or not 4. to read a number, find the sum of the digits, reverse the number and check it for palindrome 5. to read numbers from keyboard continuously till the user presses 999 and to find the sum of only positive numbers 6. to read percentage of marks and to display appropriate message (Demonstration of else-if ladder) 7. to find the roots of quadratic equation 8. to read marks scored by n students and find the average of marks (Demonstration of single dimensional array) 9. to remove Duplicate Element in a single dimensional Array 10. to perform addition and subtraction of Matrices 11. to find factorial of a number 12. to generate fibonacci series 13. to find the length of a string without using built in function 14. to demonstrate string functions 15. to read, display and add two m x n matrices using functions	Employable Skills, Analytical Skills

16. to read a string and to find the number of alphabets, digits, vowels, consonants, spaces and special characters.

17. to Swap Two Numbers using Pointers

18. to demonstrate student structure to read & display records of n students

19. to demonstrate the difference between structure & union.

NEP- Curriculum Framework
B.Sc. (Electronics & Computer Science)
Course Matrix (w.e.f. 2024-25 onwards)

II Semester							
Code	Course Code	Course	Teaching Hours	Course Components			Credits
				L	T	P	
AECC	S21KN 2.1/ S21HN 2.1/ S21AE 2.1	Language I (Kannada/Hindi/Additional English)	45	3	1	-	3
AECC	S21GE 2.1	Language II (Generic English)	60	3	1	-	3
AECC	21SBC 2.1	Environmental Studies	45	2	1	-	3
DSC2	S21EL2.1	Analog and Digital Electronics	60	4	-	-	4
DSC2	S21EL2.2	Analog and Digital Electronics - Lab	60	-	-	4	2
DSC2	S21CS2.1	Data Structures	60	4	-	-	4
DSC2	S21CS2.2	Data Structures Lab	60	-	-	4	2
OE-2	S21OE/ B21OE	Open Elective (Consumer Electronics / Cyber Space)	45	2	1	-	3
SEC-VB	21VBC 2.1	NCC/NSS/Cultural	30	-	-	2	1
SEC-VB	21VBC 2.2	Sports	30	-	-	2	1
Total							26

Note:

AECC- Ability Enhancement Compulsory Course

DSC - Discipline-Specific Course

OE- Open elective (course offered by the department to students of other stream)

DSE – Discipline-Specific Elective

SEC - VB Skill Enhancement Course -Value Based

SEC - SB Skill Enhancement Course -Skill Based

(4 credits)

CO	Course Outcomes After completion of this module, students should be able to:
CO1	Gain good understanding of the concepts, types and operations of data structures
CO2	Acquire skills to implement sorting, searching and implementation of higher order data structure using arrays
CO3	Understand the concept of dynamic memory allocation, types of linked lists and gain the ability to use linked list in developing solutions to real world problems
CO4	Apply the concept of Stacks and Queues in real world applications
CO5	Analyze and apply graph and tree data structure in the problems where non-linear data structures are required

[illegible]

Course Content

Sl. No.	Unit/chapter title	Content	Number of hours	Skills Developed
1	Unit- I	Introduction and Overview: Definition, Elementary data organization, Data Structures, data Structures operations, Abstract data types, algorithms complexity, time-space trade off. Preliminaries: Mathematical notations and functions, Algorithmic notations, control structures, Complexity of algorithms, asymptotic notations for complexity of algorithms. String Processing: Definition, Storing Strings, String as ADT, String operations, word/text processing, Pattern Matching algorithms. Arrays: Definition, Linear arrays, arrays as ADT, Representation of Linear Arrays in Memory	15 Hrs	Cognitive Skills
2	Unit- II	Linked list: Definition, Representation of Singly Linked List in memory, traversing a Singly linked list, searching in a Singly linked list, Memory allocation, Garbage collection, Insertion into a singly linked list, Deletion from a singly linked list; Doubly linked list, Header linked list, Circular linked list. Stacks: Definition, Array representation of stacks, Linked representation of stacks, Stack as ADT, Arithmetic Expressions: Polish Notation, Conversion of infix expression to postfix expression, Evaluation of Postfix expression, Application of Stacks, Recursion, Towers of Hanoi, Implementation of recursive procedures by stack. Queues: Definition, Array representation of queue, Linked list representation of queues. Types of queue: Simple queue, Circular queue, Double-ended queue, Priority queue, Operations on Queues, Applications of queues.	15 Hrs	Analytical Skills, Cognitive Skills
3	Unit- III	Binary Trees: Definitions, Tree Search, Traversal of Binary Tree, Tree Sort, Building a Binary Search Tree, Height Balance: AVL Trees, Contiguous Representation of Binary Trees: Heaps, Applications of Trees. Graphs: Computer Representation, Graph Traversal, Greedy Algorithm, Graphs as Data Structure.	15 Hrs	Cognitive Skills, Synthesis Skills
4	Unit- IV	Searching: Introduction and Notation, Sequential Search, Binary Search, Comparison of Methods. Sorting: Introduction and Notation, Insertion Sort, Selection Sort, Shell Sort, Divide and Conquer,	15 Hrs	Cognitive skills, Analytical skills,

		Merge sort for Linked List, Quick sort for Contiguous List. Hashing: Sparse Tables, Choosing a Hash function, Collision Resolution with Open Addressing, Collision Resolution by Chaining.		Synthesis skills

Books for Reference:

1. Seymour Lipschutz. (2011). Data Structures with C. Schaum's outLines, Tata Mc Graw Hill,.
2. Robert Kruse. (2009). C.L.Tondo, Bruce Leung, Shashi Mogalla, Data Structures and Program Design using C. Pearson Education.
3. Mark Allen Weiss. (2013). Data Structures and Algorithm Analysis in C. Second Edition, Pearson Education.
4. Forouzan. (2008). A Structured Programming Approach using C. 2nd Edition, Cengage Learning India.
5. Ellis Horowitz. (2008). Fundamentals of Data Structures in C". Second Edition, Universities Press.

S21CS 2.2 : DATA STRUCTURES LAB

PRACTICAL

Total Teaching Hours: 60

No. of Hours per Week: 4

(2 credits)

CObj	Course Objectives
CObj_1	To provide practical knowledge of storing and managing data in various structures
CObj_2	To understand the importance of data structures and practically implementing efficient algorithms
CObj_3	To instill the ability to practically implement the operations on different data structures and their applications

CO	Course Outcomes After completion of this module, students should be able to:
CO1	Implement memory-efficient data structures.
CO2	Apply recursion to solve problems related to data structures.
CO3	Develop problem-solving skills by applying data structures to solve algorithmic challenges.
CO4	Apply appropriate data structures to solve real-world problems and algorithms
CO5	Analyze and apply graph and tree data structure in the problems where non-linear data structures are required

CO-PO Mapping

[illegible]

Course Content

List of Programs	Skills Developed
1. Write a program to implement Linear search 2. Write a program to implement Binary search 3. Write a program to implement Bubble Sort Algorithm 4. Write a program to implement Selection Sort Algorithm 5. Write a program to implement Stack data structure 6. Write a program to convert an infix expression to its postfix expression 7. Write a program to evaluate a postfix expression 8. Write a recursive program to find GCD of three numbers. 9. Write a program to insert the elements into a linear queue and delete elements from the list. Display your list after each insertion and deletion. 10. Write a program to insert the elements into a circular queue and delete elements from the queue. Display your queue after each insertion and deletion. 11. Write a program to insert the elements into a singly linked list and delete elements from the list. Display your list after each insertion and deletion. 12. Write a program to create a binary tree and find the height of the tree 13. Write a program to create a binary search tree with the elements and perform inorder, preorder and post order traversal. 14. Write a program to Sort the following elements using heap sort 15. Given two strings perform the following: I. Find the length of the string II. Concatenate the strings III. Extract the substring IV. Replace a string with another string	Employable Skills, Analytical Skills, Cognitive Skills

NEP- Curriculum Framework
B.Sc. (Electronics & Computer Science)
Course Matrix (w.e.f. 2024-25 onwards)

III Semester							
Code	Course Code	Course	Teaching Hours	Course Components			Credits
				L	T	P	
AECC	S21KN 3.1/ S21HN 3.1/ S21AE 3.1	Language I (Kannada/Hindi/Additional English)	45	3	1	-	3
AECC	S21GE 3.1	Language II (Generic English)	60	3	1	-	3
DSC3	S21EL3.1	Digital Design Using Verilog and VHDL Programming	60	4	-	-	4
DSC3	S21EL3.2	Digital Design Using Verilog and VHDL Programming - Lab	60	-	-	4	2
DSC3	S21CS3.1	Object Oriented Programming Using Java	60	4	-	-	4
DSC3	S21CS3.2	Java Lab	60	-	-	4	2
OE-3	S21OE/ B21OE	Open Elective: Medical Electronics / Computer Fundamentals and Programming Concepts in C	45	2	1	-	3
SEC-SB	21SBC3.1	Digital Fluency-II	30	1	-	2	2
SEC-VB	21VBC 3.2	NCC/NSS/Cultural	30	-	-	2	1
SEC-VB	21VBC 3.3	Sports	30	-	-	2	1
Total							25

Note:

AECC- Ability Enhancement Compulsory Course

DSC - Discipline-Specific Course

OE- Open elective (course offered by the department to students of other stream)

DSE – Discipline-Specific Elective

SEC - VB Skill Enhancement Course -Value Based

SEC - SB Skill Enhancement Course -Skill Based

SEMESTER – III**S21CS 3.1: OBJECT ORIENTED PROGRAMMING USING JAVA****THEORY****Total Teaching Hours: 60****No. of Hours per Week: 4****(4 credits)**

CObj	Course Objectives
CObj_1	To impart knowledge of object-oriented programming concepts using Java
CObj_2	To instill the skills to create graphical user interface using graphical tools
CObj_3	To provide the knowledge to design and implement both console based and GUI based Java applications

CO	Course Outcomes After completion of this module, students should be able to:
CO1	Gain good knowledge of object oriented concepts using java
CO2	Acquire skills to design, write, and test Java programs to implement solutions to the given problem specifications
CO3	Ability to design and implement both console based and GUI based Java applications
CO4	Gain capability to develop multithreaded applications and animations in Java
CO5	Acquire skills to implement object-oriented projects using Java

CO-PO Mapping

	PO_1	PO_2	PO_3	PO_4	PO_5	PSO_1	PSO_2	PSO_3	PSO_4	PSO_5
CO_1	*	*			*	*			*	*
CO_2	*	*			*	*	*		*	*
CO_3	*	*			*	*	*	*	*	
CO_4	*	*			*	*	*		*	
CO_5	*	*			*	*	*			

Course Content

Sl. No.	Unit/chapter title	Content	Number of hours	Skills developed
1	Unit- I	Introduction to Java: Basics of Java programming, Data types, Variables, Operators, Control structures including selection, Looping, Java methods, Overloading, Math class, Arrays in java. Objects and Classes: Basics of objects and classes in java, Constructors, Finalizer, Visibility modifiers, Methods and objects, Inbuilt classes like String, Character, String Buffer, File, this reference	15 Hrs	Cognitive Skills
2	Unit- II	Inheritance and Polymorphism: Inheritance in java, Super and subclass, Overriding, Object class, Polymorphism, Dynamic binding, Generic programming, Casting objects, Instance of operator, Abstract class, Interface in java, Package in java, UTIL package.	15 Hrs	Analytical Skills, Cognitive Skills, Employable Skills
3	Unit- III	Event and GUI programming: Event handling in java, Event types, Mouse and key events, Frames, Layout Managers: Flow Layout, Border Layout, Grid Layout, GUI components like Buttons, Check Boxes, Radio Buttons, Labels, TextFields, Text Areas, Choice, Lists, Applet and its life cycle. Exception handling with try-catch-finally, multi-catch, Arithmetic Exception, NumberFormatException ArrayIndexOutOfBoundsException, Introduction to swing,	15 Hrs	Cognitive Skills, Synthesis Skills, Employable Skills
4	Unit- IV	Multithreading in java: Thread life cycle and methods, Runnable interface, Thread synchronization, Introduction to Collections in java, Introduction to JavaBeans and Network Programming. I/O programming: Text and Binary I/O, Binary I/O classes, Object I/O, Random Access Files. Reading and writing bytes from/to a file, Reading and writing characters from/to a file.	15 Hrs	Cognitive skills, Analytical skills, Synthesis Skills, Employable Skills

Books for Reference:

1. E. Balagurusamy. (2007). Programming with JAVA, McGraw Hill, New Delhi
2. Raj Kumar Buyya,. (2014). Object Oriented Programming with JAVA, McGraw Hill, 2009
3. Herbert Schildt, Java A Beginner's Guide – Create, Compile, and Run Java Programs Today, Sixth Edition, Oracle Press
4. Ken Arnold, James Gosling. (2005). The Java Programming Language, Fourth Edition, Addison Wisely
5. Herbert Schildt. (2007). 'The Complete Reference Java, 7th Edition, McGraw Hill

Web Resource:

1. <https://docs.oracle.com/javase/tutorial/>
2. <https://javabeginnerstutorial.com/core-java-tutorial/>

S21CS 3.2 : JAVA LAB**PRACTICAL****Total Teaching Hours: 60****No. of Hours per Week: 4****(2 credits)**

CObj	Course Objectives
CObj_1	To provide clarity on fundamentals of Java programming
CObj_2	To impart good knowledge of object-oriented concepts through programming
CObj_3	To instill the skills to design and implement GUI based Java applications

CO	Course Outcomes After completion of this module, students should be able to:
CO1	Attain a solid understanding of object-oriented concepts through the use of Java.
CO2	Analyze the real-world problem and solve it by implementing appropriate java constructs
CO3	Proficiency in implementing console-oriented and GUI-oriented designs and develop suitable java applications
CO4	Gain capability to develop multithreaded applications and animations in Java
CO5	Develop the competence to effectively manage and complete object-oriented projects using Java.

CO-PO Mapping

	PO_1	PO_2	PO_3	PO_4	PO_5	PSO_1	PSO_2	PSO_3	PSO_4	PSO_5
CO_1	*	*			*	*			*	*
CO_2	*	*			*	*	*		*	*
CO_3	*	*			*	*	*	*	*	
CO_4	*	*			*	*	*		*	
CO_5	*	*			*	*	*			

Course Content

List of Programs	Skills Developed
1. Write a simple java application, to print the message, "Welcome to java" 2. Write a program to display the month of a year. Months of the year should be held in an array. 3. Write a program to demonstrate a division by zero exception 4. Write a program to create a user defined exception say Pay Out of Bounds.. 5. Write a java program to add two integers and two float numbers. When no arguments are supplied, give a default value to calculate the sum. Use function overloading. 6. Write a program to perform mathematical operations. Create a class called AddSub with methods to add and subtract. Create another class called MulDiv that extends from AddSub class to use the member data of the super class. MulDiv should have methods to multiply and divide A main function should access the methods and perform the mathematical operations. 7. Write a program with a class variable that is available for all instances of a class. Use static variable declaration. Observe the changes that occur in the object's member variable values. 8. Write a java program to create a student class with following attributes: Enrollment_id: Name, Mark of sub1, Mark of sub2, mark of sub3, Total Marks. Total of the three marks must be calculated only when the student passes in all three subjects. The pass mark for each subject is 50. If a candidate fails in any one of the subjects his total mark must be declared as zero. Using this condition, write a constructor for this class. Write separate functions for accepting and displaying student details. In the main method create an array of three student objects and display the details. 9. In a college first year class are having the following attributesName of the class (BCA, BCom, BSc), Name of the staff No of the students in the class, Array of students in the class 10. Define a class called first year with above attributes and define a suitable constructor. Also write a method called best Student () which process a first-year object and return the student with the highest total mark. In the main method define a first-year object and find the best student of this class 11. Write a Java program to define a class called employee with the name and date of appointment. Create ten employee objects as an array and sort them as per their date of appointment. ie, print them as per their seniority. 12. Create a package ' student.Fulltime.BCA' in your current working directory a. Create a default class student in the above package with the following attributes: Name, age, sex. b. Have methods for storing as well as displaying 13. Write a small program to catch Negative Array Size Exception. This exception is caused when the array is initialized to negative values. 14. Write a program to handle Null Pointer Exception and use the "finally" method to display a message to the user. 15. Write a program which create and displays a message on the window 16. Write a program to draw several shapes in the created window 17. Write a program to create an applet and draw grid lines 18. Write a program which creates a frame with two buttons: father and mother. When we click the father button the name of the father, his age and designation must appear. When we click mother, similar details of mother also appear. 19. Create a frame which displays your personal details with respect to a button click	Employable Skills, Analytical Skills

20. Create a simple applet which reveals the personal information of yours. 21. Write a program to move different shapes according to the arrow key pressed. 22. Write a java Program to create a window when we press M or m the window displays Good Morning, A or a the window displays Good After Noon E or e the window displays Good Evening, N or n the window displays Good Night 23. Demonstrate the various mouse handling events using suitable example. 24. Write a program to create menu bar and pull-down menus.	

NEP- Curriculum Framework
B.Sc. (Electronics & Computer Science)
Course Matrix (w.e.f. 2024-25 onwards)

IV Semester							
Code	Course Code	Course	Teaching Hours	Course Components			Credits
				L	T	P	
AECC	S21KN 4.1/ S21HN4.1/ S21AE 4.1	Language I (Kannada/Hindi/Additional English)	45	3	1	-	3
AECC	S21GE4.1	Language II (Generic English)	60	3	1	-	3
AECC	21SBC 4.1	Constitution of India	45	2	1	-	3
DSC4	S21EL4.1	Electronic Communications – I	60	4	-	-	4
DSC4	S21EL4.2	Electronic Communications – I - Lab	60	-	-	4	2
DSC4	S21CS4.1	Operating System	60	4	-	-	4
DSC4	S21CS4.2	Unix Lab	60	-	-	4	2
OE-4	S21OE/ B21OE	Open Elective: Mobile Application Development / Web Designing	45	3	-	-	3
SEC-VB	VBC 4.1	NCC/NSS/Cultural	30	-	-	2	1
SEC-VB	VBC 4.2	Sports	30	-	-	2	1
Total							26

Note:

AECC- Ability Enhancement Compulsory Course

DSC - Discipline-Specific Course

OE- Open elective (course offered by the department to students of other stream)

DSE – Discipline-Specific Elective

SEC - VB Skill Enhancement Course -Value Based

SEC - SB Skill Enhancement Course -Skill Based

SEMESTER – IV
S21CS 4.1: OPERATING SYSTEM
THEORY

Total Teaching Hours: 60

No. of Hours per Week: 4

(4 credits)

CObj	Course Objectives
CObj_1	To provide strong knowledge of basic concepts and functions of operating systems
CObj_2	To instill an understanding of the different process scheduling algorithms and synchronization techniques to achieve better performance of a computer system
CObj_3	To comprehend file management and secondary storage management

CO	Course Outcomes
	After completion of this module, students should be able to:
CO1	Assimilate knowledge of the structure of OS and basic architectural components involved in OS design
CO2	Analyze different process scheduling algorithms and synchronization techniques to achieve better performance of a computer system.
CO3	Acquire Knowledge in Mutual exclusion, Deadlock detection and agreement protocols of an operating system
CO4	Acquire skills in file management and secondary storage management
CO5	Conceptualize the components involved in designing a contemporary OS

CO-PO Mapping

	PO_1	PO_2	PO_3	PO_4	PO_5	PSO_1	PSO_2	PSO_3	PSO_4	PSO_5
CO_1	*	*			*	*			*	
CO_2	*	*			*	*	*	*		
CO_3	*	*			*	*	*	*	*	*
CO_4	*	*			*	*	*		*	*
CO_5	*	*			*	*	*		*	

Course Content

Sl. No.	Unit/chapter title	Content	Number of hours	Skills Developed
1	Unit- I	Introduction: Batch Systems, Concepts of Multiprogramming and Time Sharing, Parallel, Distributed and real time Systems, Operating System Structures, Components & Services, System calls, System programs, Virtual machines. Process Management: Process Concept, Process Scheduling, Co – Operating process, Threads, Inter process communication, CPU Scheduling Criteria, Scheduling algorithm, Multiple Processor Scheduling, Real time Scheduling, Algorithm evolution.	15 Hrs	Cognitive Skills, Analytical skills, Synthesis skills
2	Unit- II	Process Synchronization and deadlocks: The Critical Section Problem, Synchronization hardware, Semaphores, Classical problems of synchronization, Critical regions, monitors, Dead locks – system model, Characterization, Deadlock prevention, avoidance and detection, Recovery from deadlock, Combined approach to deadlock handling.	15 Hrs	Analytical Skills, Cognitive Skills, Synthesis skills

3	Unit- III	Memory Management: Logical and Physical address space, Swapping, Contiguous allocation, Paging, Segmentation, Segmentation with paging in Mastics and Intel 386, Virtual memory-Demand paging and its performance, Page replacement algorithms, Allocation of frames, thrashing, page size and other considerations. Demand Segmentation	15 Hrs	Cognitive Skills, Analytical skills
4	Unit- IV	File management (Systems, Secondary Storage Structure): File Concepts, Access methods, Directory Structure, Protection and consistency, File system structure, Allocation methods, Free space management, Directory Implementation, Efficiency and Performance, Recovery. Disk Management (Structure, Disk Scheduling Methods): Disk Structure & Scheduling methods, Disk management, Swap – Space management. Protection and Security	15 Hrs	Cognitive skills, Analytical skills, Synthesis skills

Books for Reference:

1. Abraham Silberschatz and Peter Baer Galvin. (2002). Operating System Concepts. 7th Edition, Pearson Education.
2. H.M.Deitel, 2003 Operating Systems. Pearson Learning Solutions, 3rd Edition.
3. William Stallings. (2010). Operating Systems. 6th Edition, Pearson Education.
4. Stuart, Operating systems. (2008). Principles, Design and Implementation. 1st Edition Cengage Learning India
5. Andrew S Tanenbaum, Modern Operating System. Prentice Hall India, 3rd Edition
6. D. M. Dhamdhere, Operating System : A concept based approach. Tata McGraw Hill

S21CS 4.2 : UNIX LAB**PRACTICAL****Total Teaching Hours: 60****No. of Hours per Week: 4****(2 credits)**

CObj	Course Objectives
CObj_1	To impart knowledge on the features and functions of Unix operating system and shell commands
CObj_2	To instil the skills to develop Unix shell scripts
CObj_3	To provide the knowledges to perform backup and recovery and gain familiarity with system administrator's privileges

CO	Course Outcomes
	After completion of this module, students should be able to:
CO1	Comprehend the features of Unix operating system and become proficient in internal and external commands of Unix
CO2	Gain good knowledge of the Unix File system
CO3	Develop strong skills to create Unix shell scripts
CO4	Acquire skills to handle file operations in Unix
CO5	Gain knowledge of the role of system administrator and apply in personal PCs to perform system management

CO-PO Mapping

	PO_1	PO_2	PO_3	PO_4	PO_5	PSO_1	PSO_2	PSO_3	PSO_4	PSO_5
CO_1	*	*			*	*				*
CO_2	*	*			*	*	*	*	*	*
CO_3	*	*			*	*	*	*		*
CO_4	*	*			*	*	*	*	*	
CO_5	*	*			*	*	*			

Course Content

List of Programs	Skills Developed
Part- A 1. Shell script to find the factorial of a given number. 2. To print all prime numbers between m and n ($m < n$). 3. Reverse a given string and check whether it is palindrome or not. 4. Shell script to find the maximum and minimum of given set. 5. To count the number of vowels in a given string. 6. Write a program to calculate simple interest and compound interest. 7. Create a file containing the following fields : student no, student name, age, sex, height and weight. Print all the details in neat format. 8. Create an employee file containing empname, empno, dept and designation. 9. Display empname and empno of any particular dept and count of employees. 10. Display empname and empno of employees who or not manager. 11. Shell script to create two data files and compare them to display unique and common entries. 12. Shell script to display all the file types and file permissions. PART- B 13. Shell script to demonstrate gzip and gunzip 14. Shell script to demonstrate grep command 15. Shell script to demonstrate awk command 16. Shell script to demonstrate 5 filter commands 17. Shell script to demonstrate 5 internal and 5 external commands During practical examination the External and Internal examiners may prepare exam question papers related to theory syllabus apart from Part-A. (A minimum of 5 Programs has to be prepared).	Employable Skills, Analytical Skills

NEP- Curriculum Framework
B.Sc. (Electronics & Computer Science)
Course Matrix (w.e.f. 2024-25 onwards)

V Semester							
Code	Course Code	Course	Teaching Hours	Course Components			Credits
				L	T	P	
DSC5	S21EL5.1	Microcontroller 8051 and PIC	60	4	-	-	4
DSC5	S21EL5.2	Microcontroller 8051 and PIC - Lab	60	-	-	4	2
DSC6	S21EL6.1	Electronics Communication - II	60	4	-	-	4
DSC6	S21EL6.2	Electronics Communication – II - Lab	60	-	-	4	2
DSC5	S21CS5.1	Database Management System	60	4	-	-	4
DSC5	S21CS5.2	Database Management System Lab	60	-	-	4	2
DSC6	S21CS6.1	Artificial Intelligence	60	4	-	-	4
DSC6	S21CS6.2	Artificial Intelligence Lab	60	-	-	4	2
SEC-SB	21SBC 5.1	R-Programming – A practical approach	30	1	-	2	2
Total							26

Note:

AECC- Ability Enhancement Compulsory Course

DSC - Discipline-Specific Course

OE- Open elective (course offered by the department to students of other stream)

DSE – Discipline-Specific Elective

SEC - VB Skill Enhancement Course -Value Based

SEC - SB Skill Enhancement Course -Skill Based

SEMESTER – V**S21CS 5.1: DATABASE MANAGEMENT SYSTEMS****THEORY****Total Teaching Hours: 60****No. of Hours per Week: 4****(4 credits)**

CObj	Course Objectives
CObj_1	To provide knowledge on how to organize and maintain data in a database
CObj_2	To instill an understanding of the underlying mathematical principles and concepts implemented in DBMS
CObj_3	To impart knowledge on storing, manipulating and retrieving efficiently and effectively the data using DBMS

CO	Course Outcomes
	After completion of this module, students should be able to:
CO1	Gain good understanding of the fundamental elements of relational database management systems
CO2	Apply the knowledge gained on the concepts of relational data model, entity-relationship model, relational database design, relational algebra and SQL
CO3	Design ER-models to represent database applications to effectively solve societal problems
CO4	Be competent to formulate SQL queries to handle data in relational databases and apply the acquired skills to solve research problems
CO5	Create database designs by applying normalization and familiarize with transaction processing

CO-PO Mapping

	PO_1	PO_2	PO_3	PO_4	PO_5	PSO_1	PSO_2	PSO_3	PSO_4	PSO_5
CO_1	*	*				*		*	*	
CO_2	*	*				*		*	*	*
CO_3	*	*	*	*	*	*		*		*
CO_4	*	*	*	*	*		*	*		*
CO_5	*	*	*	*	*		*	*	*	

Course Content

Sl. No.	Unit/chapter title	Content	Number of hours	Skills developed
1	Unit- I	Databases and Database Users: Introduction, an example, Characteristics of the Database Approach, Actors on the Scene, Workers behind the Scene, Advantages of Using DBMS Approach, A Brief History of Database Applications, When Not to Use a DBMS. Database System Concepts and Architecture: Data Models, Schemas, and Instances, Three-schema Architecture and Data Independence, Database Languages and Interfaces, The Database System Environment, Centralized and Client-Server Architectures, Classification of Database Management Systems. Data Modeling Using Entity-Relationship Model: Using High-Level Conceptual Data Models for Database Design, An Example Database Application, Entity Types, Entity Sets, Attributes and Keys, Relationship Types, Relationship Sets, Roles and Structural Constraints, Weak Entity Types, Refining the ER Design Company Database Diagrams, Naming Conventions and Design. Issues, File organization and storage, secondary storage devices, type of single level ordered index, multi-level indexes, indexes on multiple keys, other types of indexes.	18 Hrs	Cognitive Skills
2	Unit- II	Relational Model and Relational Algebra: Relational Model Concepts, Relational Model Constraints and Relational Database Schemas, Update Operations, Transactions and Dealing with Constraint Violations, Unary Relational Operations: SELECT and PROJECT, Relational Algebra Operations from SET Theory, Binary Relational Operations: JOIN and DIVISION, Additional Relational Operations, Examples of Queries in Relational Algebra. Relational Database Design: Anomalies in a database, functional dependency, normal forms, lossless join and dependency, BCNF, normalization through synthesis, higher order normal forms. SQL- SQL Data Definition and Data Types, Specifying Constraints in SQL, Schema Change Statements in SQL, Basic Queries in SQL, More Complex SQL Queries, Insert, Delete and Update Statements in SQL, Specifying Constraints as Assertion and Trigger, Views(Virtual Tables) in SQL, Embedded SQL, Dynamic SQL	15 Hrs	Analytical Skills, Cognitive Skills, Employable Skills

3	Unit- III	PL\SQL-Introduction, Limitations of SQL, Advantages of PL/SQL, the generic PL\SQL block, character set, data types, variables, constants, comments, PL\SQL execution, displaying user message on the VDU screen, commonly Used SQL* plus commands, program control statements, PL\SQL Architecture, Program structure, packages, error handling, database triggers, cursors	14 Hrs	Cognitive Skills, Employable Skills Synthesis Skills
4	Unit- IV	Introduction to transaction processing, transaction and system concepts, desirable properties of transactions, transaction support in SQL. Concurrency control techniques: two-phase locking techniques, concurrency control based on timestamp ordering. Recovery techniques: recovery concepts, recovery in multi-database systems, database backup and recovery from catastrophic failures.	13 Hrs	Analytical Skills, Cognitive Skills, Employable Skills Synthesis Skills

Books for Reference:

1. Elmasri and Navathe. (2016). Fundamentals of Database Systems, 7th Edition, Addison -Wesley.
2. Silberschatz, Korth and Sudharshan. (2019).Data base System Concepts, 7th Edition, Tata McGraw Hill.
3. C.J. Date, A. Kannan, S. Swamynatham. (2009). An Introduction to Database Systems, 8th Edition, Pearson education
4. Raghu Ramakrishnan and Johannes. (2003).Gehrke Database Management Systems, 3rd Edition, McGraw- Hill.

Web Resource:

- 1.<https://www.javatpoint.com/dbms-tutorial>
- 2.<https://www.tutorialspoint.com/dbms/index.htm>
- 3.<https://www.guru99.com/dbms-tutorial.html>
- 4.<https://www.w3schools.in/dbms>

S21CS 5.2 : DATABASE MANAGEMENT SYSTEMS LAB**PRACTICAL****Total Teaching Hours: 60****No. of Hours per Week: 4****(2 credits)**

CObj	Course Objectives
CObj_1	To provide hands-on experience on how to organize and maintain data in a database
CObj_2	To instill the skills to implement relational algebra concepts while creating a database
CObj_3	To impart knowledge on how to store , manipulate and retrieve efficiently and effectively the data using DBMS

CO	Course Outcomes
	After completion of this module, students should be able to:
CO1	Gain hands on experience of designing relational database management system applications
CO2	Implement the relational algebra concepts and SQL
CO3	Capability to implement relationships in simple database application scenarios
CO4	Ability to convert the ER-model to relational tables, populate relational database and formulate SQL queries on data
CO5	Acquire skills to improve the database design by normalization and familiarize themselves with transaction processing

CO-PO Mapping

	PO_1	PO_2	PO_3	PO_4	PO_5	PSO_1	PSO_2	PSO_3	PSO_4	PSO_5
CO_1	*	*				*		*	*	
CO_2	*	*				*		*	*	*
CO_3	*	*	*	*	*	*		*		*
CO_4	*	*	*	*	*		*	*		*
CO_5	*	*	*	*	*		*	*	*	

Programs to be done using any DBMS software	Skills Developed
PART – A 1. Draw E-R diagram and convert entities and relationships to relation table for a given scenario. Two assignments shall be carried out i.e. consider two different scenarios (eg. bank, college) 2. Consider the Company database with following Schema EMPLOYEE (FNAME, MINIT, LNAME, SSN, BDATE, ADDRESS, SEX, SALARY, SUPERSSN, DNO) DEPARTMENT (DNAME, DNUMBER, MGRSSN, MSRSTARTDATE) DEPT_LOCATIONS (DNUMBER, DLOCATION) PROJECT (PNAME, PNUMBER, PLOCATION, DNUM) WORKS_ON (ESSN, PNO<HOURS) DEPENDENT (ESSN, DEPENDENT_NAME, SEX, BDATE, RELATIONSHIP) 3. Perform the following:	Employable Skills, Analytical Skills

Viewing all databases, Creating a Database, Viewing all Tables in a Database, Creating Tables (With and Without Constraints), Inserting/Updating/Deleting Records in a Table, Saving (Commit) and Undoing (rollback)

4. Perform the following:

Altering a Table, Dropping/Truncating/Renaming Tables, Backing up / Restoring a Database.

5. For a given set of relation schemes, create tables and perform the following Simple Queries, Simple Queries with Aggregate functions, Queries with Aggregate functions (group by and having clause).

6. Execute the following queries

How the resulting salaries if every employee working on the 'Research' Departments is given a 10% raise.

Find the sum of the salaries of all employees of the 'Accounts' department, as well as the maximum salary, the minimum salary, and the average salary in this department

7. Execute the following queries

Retrieve the name of each employee Controlled by Department number 5 (use EXISTS operator).

Retrieve the name of each dept and number of employees working in each Department which has at least 2 employees

8. Execute the following queries

For each project, retrieve the project number, the project name, and the number of employee who work on that project. (use GROUP BY)

Retrieve the name of employees who born in the year 1990's

For each Department that has more than five employees, retrieve the department number and number of employees who are making salary more than 40000.

For each project on which more than two employees work, retrieve the project number, project name and the number of employees who work on that project.

For a given set of relation tables perform the following: Creating Views (with and without check option), Dropping views, Selecting from a view

PART B

9. Create the following tables with properly specifying Primary keys, Foreign keys and solve the following queries.

BRANCH (Branchid, Branchname, HOD) STUDENT (USN, Name, Address, Branchid, sem)

BOOK (Bookid, Bookname, Authorid, Publisher, Branchid) AUTHOR (Authorid, Authorname, Country, age) BORROW (USN, Bookid, Borrowed_Date)

10. Perform the following:

Viewing all databases, Creating a Database, Viewing all Tables in a Database, Creating Tables (With and Without Constraints), Inserting/Updating/Deleting Records in a Table, Saving (Commit) and Undoing (rollback)

11. Execute the following Queries:

a. List the details of Students who are all studying in 2nd sem BCA.

b. List the students who are not borrowed any books.

12. a. Display the USN, Student name, Branch_name, Book_name, Author_name, Books_Borrowed_Date of 2nd sem BCA Students who borrowed books.

b. Display the number of books written by each Author.

13. a. Display the student details who borrowed more than two books.

b. Display the student details who borrowed books of more than one Author.

14. a. Display the Book names in descending order of their names.

b. List the details of students who borrowed the books which are all published by the same publisher.

15. Consider the following schema:

STUDENT (USN, name, date_of_birth, branch, mark1, mark2, mark3, total, GPA)

16. Perform the following:

Creating Tables (With and Without Constraints), Inserting/Updating/Deleting Records in a Table, Saving (Commit) and Undoing (rollback)

17. Execute the following queries:

Find the GPA score of all the students.

Find the students who born on a particular year of birth from the date_of_birth column.

a. List the students who are studying in a particular branch of study.

b. Find the maximum GPA score of the student branch-wise.

S21CS 6.1 : ARTIFICIAL INTELLIGENCE**THEORY****Total Teaching Hours: 60****No. of Hours per Week: 4****(4 credits)**

CObj	Course Objectives
CObj_1	To impart knowledge about Artificial Intelligence and understand the basic principles of Artificial Intelligence in various applications
CObj_2	To understand the various approaches of knowledge representations and to enable computers to perform such intellectual tasks as decision making, problem solving
CObj_3	To provide knowledge on Expert systems and to implement the AI concepts using prolog

CO	Course Outcomes
	After completion of this module, students should be able to:
CO1	Gain knowledge on Artificial intelligence concepts and techniques
CO2	Apply basic principles of AI in solutions that require problem solving
CO3	Understand and Apply knowledge on representing simple facts by predicate logic
CO4	Ability to understand, design and implement expert systems to solve complex problems and understand the case studies
CO5	Comprehend Prolog for implementation of Artificial intelligence concepts

CO-PO Mapping

	PO_1	PO_2	PO_3	PO_4	PO_5	PSO_1	PSO_2	PSO_3	PSO_4	PSO_5
CO_1	*	*	*					*		
CO_2	*	*		*		*	*	*	*	
CO_3	*	*		*		*		*	*	
CO_4	*	*	*	*	*	*		*	*	
CO_5	*	*	*	*	*	*		*	*	

Course Content

Sl. No.	Unit/chapter title	Content	Number of hours	Skills Developed
1	Unit- I	Overview of AI: Introduction to AI, Importance of AI, AI and its related field, AI techniques, Criteria for success. Problems, problem space and search: Defining the problem as a state space search, Production system and its characteristics, Issues in the design of the search problem. Heuristic search techniques: Generate and test, hill climbing, best first search technique, mean and end analysis, A* and AO* Algorithm.	12 Hrs	Evaluation Skills, Synthesis Skills
2	Unit- II	Knowledge Representation: Definition and importance of knowledge, Knowledge representation, various approaches used in knowledge representation, Issues in knowledge representation, Representing knowledge using rules. Weak Slot-and-filler Structure: Semantic Nets, frames, Conceptual Dependency, scripts Predicate Logic: Representing Simple Facts in logic, representing instances and is-a relationship, Computable function and predicate. Planning: Components of Planning systems, block world, strips, Implementation using goal stack, Non linear planning with goal stacks, Hierarchical Planning, Reactive systems	16 Hrs	Analytical Skills
3	Unit- III	Natural language processing: Introduction syntactic processing, Semantic processing, Discourse and pragmatic processing Learning: Introduction learning, Rote learning, learning by taking advice, learning in problem solving, learning from example-induction, Explanation based learning, Discovery, Analogy, Formal Learning Theory, Neural Net Learning and Genetic Learning. Connectionist Models: Hopfield Networks, Learning in Neural Networks	16 Hrs	Cognitive Skills
4	Unit- IV	Expert System: Introduction: Representing using domain specific knowledge, Architecture of expert system, knowledge representation Expert system shells, case studies on expert systems. Prolog -Basics, Relations, Data objects, operators, Decision making, recursion, built-in predicates, conjunction and disjunction	16 Hrs	Cognitive skills, Analytical skills, Synthesis skills

Books for Reference:

1. Elaine Rich, Kevin Knight. Artificial Intelligence. Tata McGraw Hill.
2. David W. Rolston. Principles of Artificial Intelligence and Expert System Development. McGraw Hill.
3. Ivan Bratko. Prolog Programming for Artificial Intelligence. (4th Edition). Addison-Wesley.
4. Russel & Norvig. Artificial Intelligence: A Modern Approach. Pearson Education.

S21CS 6.2 : ARTIFICIAL INTELLIGENCE LAB

PRACTICALS

Total Teaching Hours: 60

No. of Hours per Week: 4

(2 credits)

CObj	Course Objectives
CObj_1	To instill skills to design and analyze AI based algorithms.
CObj_2	To enable students to solve problems using heuristic search techniques
CObj_3	To provide skills to implement predicate logic

CO	Course Outcomes
	After completion of this module, students should be able to:
CO1	Ability to implement various heuristic search techniques.
CO2	Gain knowledge on Artificial intelligence concepts and techniques
CO3	Apply AI techniques in real world problems
CO4	Analyze and Implement basic AI algorithms for the given problems
CO5	Acquire skills to develop AI applications

CO-PO Mapping

	PO_1	PO_2	PO_3	PO_4	PO_5	PSO_1	PSO_2	PSO_3	PSO_4	PSO_5
CO_1	*	*		*	*		*			*
CO_2	*	*		*			*	*		*
CO_3	*	*	*	*	*		*	*	*	*
CO_4	*	*	*	*	*		*	*	*	*
CO_5	*	*	*	*	*				*	*

Course Content

List of Programs	Skills Developed
1. Write a Program to Implement Best First Search. 2. Write a Program to Implement Hill climbing. 3. Write a Program to Implement A* search algorithm. 4. Write a Program to Implement AO* search algorithm. 5. Write predicates One converts centigrade temperatures to Fahrenheit, the other checks if a temperature is below freezing. 6. Write a Program to Implement the Tower of Hanoi. 7. Write a Program to solve a 4-queen problem. 8. Write a Program to implement factorials of a given number. 9. Write a Program to implement fibonacci series. 10. Write a Program to find the frequency distribution of words in a text file. 11. Write a Program to demonstrate monkey and banana problems. 12. Write a Program to Count the number of words that contain "tion" in a given list. 13. Write a Program to implement tree data structure.	Employable Skills, Analytical Skills, Cognitive Skills

NEP- Curriculum Framework
B.Sc. (Electronics & Computer Science)
Course Matrix (w.e.f. 2024-25 onwards)

VI Semester							
Code	Course Code	Course	Teaching Hours	Course Components			Credits
				L	T	P	
DSC7	S21EL7.1	Electronics Instrumentation	60	4	-	-	4
DSC7	S21EL7.2	Electronics Instrumentation - Lab	60	-	-	4	2
DSC8	S21EL8.1	Internet Of Things (IOT)	60	4	-	-	4
DSC8	S21EL8.2	Internet Of Things (IOT) -Lab	60	-	-	4	2
DSC7	S21CS7.1	Python Programming	60	4	-	-	4
DSC7	S21CS7.2	Python Programming Lab	60	-	-	4	2
DSC8	S21CS8.1	Computer Networks	60	4	-	-	4
DSC8	S21CS8.2	Project Lab	60	-	-	4	2
SEC-SB	21SBC 6.1	Professional & Business Communication	30	1	-	2	2
Total							26

Note:

***AECC-** Ability Enhancement Compulsory Course*

***DSC -** Discipline-Specific Course*

***OE-** Open elective (course offered by the department to students of other stream)*

***DSE –** Discipline-Specific Elective*

***SEC -** VB Skill Enhancement Course -Value Based*

***SEC -** SB Skill Enhancement Course -Skill Based*

SEMESTER – VI
S21CS 7.1: PYTHON PROGRAMMING
THEORY

Total Teaching Hours: 60

No. of Hours per Week: 4

(4 credits)

CObj	Course Objectives
CObj_1	To provide an Understanding of the features of Python Programming language
CObj_2	To instill the ability to implement file handling and database handling in python
CObj_3	To impart the knowledge to create projects using Python

CO	Course Outcomes After completion of this module, students should be able to:
CO1	Apply the concepts of lists, tuples, functions, and classes for various python applications
CO2	Analyse different python built in libraries and implement in aspects like exception, file, regular expression, and database applications
CO3	Understand database application in python using MySql and other libraries
CO4	Evaluate mathematical operations using NumPy and Pandas in python
CO5	Create a real time application using python with a suitable database.

CO-PO Mapping

	PO_1	PO_2	PO_3	PO_4	PO_5	PSO_1	PSO_2	PSO_3	PSO_4	PSO_5
CO_1	*	*								
CO_2	*	*			*	*				
CO_3	*	*	*	*	*		*	*		*
CO_4	*	*	*	*	*			*	*	
CO_5	*	*	*	*	*			*	*	

Course Content

Sl. No.	Unit/chapter title	Content	Number of hours	Skills Developed
1	Unit- I	Introduction to Python - Understanding Python variables - Python basic Operators- Understanding python blocks Declaring and using Numeric data types: int, float, complex. Use of String data type, Defining list and list slicing, Use of Tuple data type, Dictionary data type Conditional blocks using if, else and elif - Simple for loops in python - For loop using ranges, Use of while loops in python - Loop manipulation using pass, continue, break.	15 Hrs	Cognitive skills, Analytical skills, Synthesis skills
2	Unit- II	Data Types, Functions, Regular Expressions Understanding string in built methods, Programming using strings List manipulation using in built methods - Programming using lists Tuple manipulation using inbuilt methods - Programming using tuples Programming using dictionary in built functions Organizing python codes using functions - Function parameters, variable arguments, lambda functions, Organizing python projects into modules - Importing own module as well as external modules. Regular expression: Power of pattern matching and searching using regex in python, Pattern finding programs using regular expression	15 Hrs	Cognitive skills, Analytical skills, Synthesis skills
3	Unit- III	OOPs concepts, Multithreading, Exception and File handling: Concept of class, object and instances - Constructor, class attributes and destructors - Inheritance, overloading operators - Adding and retrieving dynamic attributes of classes - Programming using Oops Exception handling - Programming using Exception handling, User defined exceptions. File Handling: File handling modes, reading and writing files, Handling file exceptions, with statement, Pickle module	15 Hrs	Cognitive skills, Analytical skills, Synthesis skills

		Understanding threads - Forking threads - Synchronizing the threads - Programming using multithreading		
4	Unit- IV	Numpy, Pandas, Accessing Databases: Numpy: ndarray - 1 dim, 2 dim, max, min - row wise, column wise, linalg module - 5 functions Pandas: series, dataframes, read_csv, read_excel, data cleaning. Data wrangling using pandas: Loading a dataset into a dataframe, Selecting Columns from a dataframe, Selecting Rows from a dataframe, Adding new data in a dataframe, Deleting data from a dataframe Introduction to Matplotlib: Scatter plot, Line plot, Bar chart, Histogram, Box plot Using Databases in Python: Python MySQL Database Access -Install the MySQLdb and other Packages -Create Database Connection - CREATE, INSERT, READ, UPDATE and DELETE Operation- DML and DDL operation with Databases -Performing Transactions- Handling Database Errors	15 Hrs	Cognitive skills, Analytical skills, Synthesis skills

Books for Reference:

1. Gowrishankar S, Veena A, Introduction to Python Programming. 1st Edition, CRC Press/Taylor & Francis, 2018. ISBN-13: 978-0815394372
2. Charles R. Severance, Python for Everybody: Exploring Data Using Python 3. 1st Edition, CreateSpace Independent Publishing Platform, 2016. (http://do1.drchuck.com/pythonlearn/EN_us/pythonlearn.pdf) (Chapters 1 – 13, 15)
3. Jake VanderPlas, Python Data Science Handbook: Essential Tools for Working with Data. 1st Edition, O'Reilly Media, 2016. ISBN-13: 978-149191205

Web Resource:

1. <https://www.python.org/about/gettingstarted/>
2. <https://www.w3schools.com/python/>
3. <https://www.programiz.com/python-programming>

B21DC 7.2: PYTHON PROGRAMMING LAB

PRACTICAL

Total Teaching Hours: 60

No. of Hours per Week: 4

(2 credits)

CObj	Course Objectives
CObj_1	To provide a practical Understanding of the features of Python Programming language
CObj_2	To instill the ability to implement file handling and database handling in python
CObj_3	To impart the practical knowledge to create projects using Python

CO	Course Outcomes After completion of this module, students should be able to:
CO1	Understand the usage of functions, list, dictionaries
CO2	Remember the creation and usage of Python libraries
CO3	Create file handling programs in Python with the application of exception handling
CO4	Analyze the database access through Python program
CO5	Become competent to evaluate and create projects using python

CO-PO Mapping

	PO_1	PO_2	PO_3	PO_4	PO_5	PSO_1	PSO_2	PSO_3	PSO_4	PSO_5
CO_1	*	*						*		
CO_2	*	*			*	*		*	*	
CO_3	*	*	*	*		*			*	*
CO_4	*	*	*	*		*	*		*	*
CO_5	*	*	*	*	*	*	*		*	*

Course Content

List of Programs	Skills Developed
1. Write a program to demonstrate lists in python. 2. Write a program to demonstrate tuples in python. 3. Write a program to count the numbers of characters in the string and store them in a dictionary data structure. 4. Python program to remove all the lines that contain the character 'a' in a file and write it to another file. 5. Write a Python function to evaluate $\exp(x)$ using Taylor's expansion series. 6. Write a Python program to a random number generator that generates random numbers between 1 and 6 (simulates a dice). 7. Write a Python program to implement a stack and queue using a list data-structure. 8. Write a Python program to create a line plot. 9. Write a Python program to copy odd lines of one file to another file in Python 10. Write a Python program to create Histogram using Pyplot in Python 11. Write a Python program to create an Employee table, insert 5 tuples and delete a particular employee from the table. 12. Write a Python program to create a student table and find the min, max, sum, and average of the marks in a student marks table. 13. Write a Python program to create a customer table and find the total number of customers from each country in the table (customer ID, customer name, country) using group by.	Employable Skills, Analytical Skills, Cognitive Skills

S21CS 8.1: COMPUTER NETWORKS

THEORY

Total Teaching Hours: 60

No. of Hours per Week: 4

(4 credits)

CObj	Course Objectives
CObj_1	To provide an understanding of the fundamental concepts of computer networking
CObj_2	To impart knowledge of the basic concepts of layered models and fundamental protocols
CObj_3	To instill knowledge of implementation concepts in congestion control, error detection and routing

CO	Course Outcomes
	After completion of this module, students should be able to:
CO1	Assimilate the features of computer networks, protocols, and network design models
CO2	Comprehend the fundamental characteristics of the physical layer and analyze the design issues of data link layer, link layer protocols, bridges and switches
CO3	Evaluate different error detection and correction methods required for error control
CO4	Select and apply appropriate routing algorithms, congestion control techniques, and Quality of Service requirements for designing a network
CO5	Gain the knowledge of network topologies, functions and protocols of the OSI layers in order to design networks for given situations

CO-PO Mapping

	PO_1	PO_2	PO_3	PO_4	PO_5	PSO_1	PSO_2	PSO_3	PSO_4	PSO_5
CO_1	*	*					*			*
CO_2	*	*					*			*
CO_3	*	*		*			*		*	
CO_4	*	*	*	*	*		*		*	
CO_5	*	*	*	*	*		*		*	

Course Content

Sl. No.	Unit/chapter title	Content	Number of hours	Skills Developed
1	Unit- I	Introduction – Computer network, Growth of internet, Uses of computer networks, Network hardware, Network software. Reference models – The OSI reference model, The TCP/IP reference model, Comparison of OSI and TCP/IP reference models. Physical Layer – Modes of communication, Topologies, Signal encoding, Transmission media - Copper wires, glass fibers, radio, satellite, geosynchronous satellites, Performance indicators – Bandwidth, Throughput, Latency, Queuing time, Bandwidth–Delay product, the need for asynchronous communications, Half and Full duplex asynchronous communication, the effect of noise on communication .carrier frequencies and Multiplexing, baseband and broadband technologies, wavelength division multiplexing, spread spectrum, time division multiplexing.	15 Hrs	Cognitive skills, Transferable Skills
2	Unit- II	Data link layer - Data link layer design issues, Error detection and correction- hamming code, Cyclic redundancy check, Burst errors. Sliding window protocols, High-Level Data Link Control(HDLC)protocol. Medium Access Control (MAC) sublayer –Channel allocation problem, Multiple access protocols LAN technologies: Ethernet,Aloha: Pure aloha, slotted Aloha, CSMA/CD, Self- healing token passing networks, ATM. Wireless LANs - 802.11, Repeaters, Hubs, Bridges, Switches, Routers and Gateways. Frame filtering	15 Hrs	Cognitive Skills, Evaluation Skills, Synthesis Skills
3	Unit- III	Network layer. Routing algorithms - The Optimality Principle, Shortest path routing, Flooding, Distance Vector Routing, Link State Routing, Multicast routing, Routing for mobile hosts. Congestion control algorithms- leaky bucket, flow bucket, IP header, IP addresses, Internet Control Message Protocol (ICMP), Address Resolution Protocol (ARP), Reverse Address Resolution Protocol (RARP), IPv6 header, Network Characteristics: Network ownership, Network performance characteristics	15 Hrs	Cognitive skills, Analytical Skills, Synthesis Skills

4	Unit- IV	Transport service – Services provided to the upper layers, Transport service primitives. User Datagram Protocol (UDP). Transmission Control Protocol (TCP) – Overview of TCP, TCP segment header, Connection establishment & release, Connection management modeling, TCP retransmission policy, TCP congestion control. Session Layer: functions. Presentation Layer: functions, Application Layer –File Transfer Protocol (FTP), Domain Name System (DNS), Electronic mail, Multipurpose Internet Mail Extension (MIME).	15 Hrs	Cognitive Skills, Analytical Skills

Books for Reference:

1. Andrew S. Tanenbaum, Computer Networks, 4/e, PHI (Prentice Hall India).
2. Behrouz A Forouzan, Data Communication and Networking, 4/e, Tata McGraw Hill
3. Larry L Peterson and Bruce S Dave, Computer Networks – A Systems Approach, 5/e, Morgan Kaufmann.
4. Fred Halsall, Computer Networking and the Internet, 5/e.
5. James F. Kurose, Keith W. Ross, Computer Networking: A Top-Down Approach, 6/e.
6. William Stallings, Computer Networking with Internet Protocols, Prentice-Hall, 2004.

Web Resource:

1. <https://www.javatpoint.com/computer-network-tutorial>
2. <https://www.geeksforgeeks.org/computer-network-tutorials/>
3. <https://www.guru99.com/data-communication-computer-network-tutorial.html>

PRACTICAL

No. of Hours per Week: 4

CObj	Course Objectives
CObj_1	To understand and select the task based on the individual's core skills
CObj_2	To acquire the knowledge about analytical skills for solving the selected task
CObj_3	To gain confidence for implementing the task and solving the real time problems

CO-PO Mapping

[illegible]

A team of maximum three students is allowed to develop a project. Students should implement their project in college in any programming language. The students can collect data outside practical hours but must be implemented in the college. Internal marks can be awarded by the guide by evaluating the performance of the students during the course of project work. In viva-voce the questions must be directed only on the project work to assess the involvement and understanding of the problem by the students.

CIA is 25 marks.

The project carries 25 marks for external examination and is distributed as follows:

Activities	Total Marks
Demonstration and Presentation	10 Marks
Validation	05 Marks
Viva-Voce	05 Marks
Report	05 Marks
Total	25 Marks



PROGRAMME MATRIX

for

B.Sc. Data Science

NEP Based Curriculum

w.e.f 2022-23 onwards

I to VI Semester

Why study this Programme B.Sc Data Science - Programme Information

This Programme Information provides the definitive record of the designated Programme

General Programme Information

Programme Title	B.Sc Data Science
Qualification	B.Sc (Hons)
Semesters	Six
Awarding Institution	Benguluru North University
Location of Delivery	Indian Academy Degree College – Autonomous
Exit options	After completion of the First Year, Certificate in Data Science After completion of the Second Year, Diploma in Data Science After completion of the Third Year, B.Sc Degree in Data Science After completing the Fourth Year, B.Sc Honors in Data Science
External Benchmarking	Local, National, and international institutions

Today's world generates enormous data, and businesses rely on it for further development. Immense unstructured/structured data needs to be processed and prepared to make it an asset for industries. Data-driven technology is transforming our daily lives and businesses.

Data science aims to drill the data to discover hidden potential and to bring value. It has been an integral part of businesses at all levels. The irreplaceable demand for data analysis secures a niche for data scientists in businesses.

To build a career in data science, one must understand data science tools and technologies. One should also be able to interpret data, develop data models and build data analytics solutions. In addition, he/she must possess strong problem-solving skills, excellent communication abilities, and a drive to find insights into data.

A student of the B.Sc Data Science programme at Indian Academy Degree College Autonomous, would be provided excellent training in the tools and techniques used to discover patterns in the hidden data as well as gain insights in the high dimensional data and thereby build a career in Data Science. The courses in the programme would be handled by faculty members who are highly experienced and had done research in Data Mining/Data Science.

Educational Aims

The curriculum structure is designed to provide an opportunity for students to gain appropriate knowledge of Data Science. It further explores specialized areas in Data engineering, Analytics and Visualization.

Future Scope

The role of a data scientist is set to grow even more in importance as data becomes increasingly crucial for businesses. As data grows larger, more complex, and more accessible through big data analytics tools, more data scientists will be required to gain insights of the data. This increases data science scope in the future and makes it an incredibly lucrative career option.

With data science technology rapidly advancing and data becoming ever more valuable, data scientist is one of the most in-demand professions today. Data scientists work to understand data, interpret it, and use it for informed decision-making in companies, government departments, and other organizations.

Career Opportunities and Job Prospects of B.Sc Data Science

The B.Sc. Data Science programme provides students with a variety of options when it comes to career prospects. Graduates of this program can become a Data Engineer/Data scientist/ Data Analyst working in a variety of settings.

With a Bachelor of Data Science, a student can specialize in Data science / Data Analytics. This will broaden his/her knowledge of the field. There is a high demand for Data scientists.

Eligibility

- a) Candidates who have passed, securing a minimum of 35% marks, the two-years Pre-University Examination conducted by the Pre-University Education board in Karnataka State or 10+2 education from a recognized board such as ISC/ CBSE or any equivalent board are eligible for admission into this programme.
- b) Candidate who has passed three years Diploma in Engineering of Government of Karnataka or any other examination considered as equivalent thereto shall be eligible for admission.

PEO_ID	B.Sc DataScience-Programme Educational Objectives
PEO1	To instill an in-depth understanding of the key technologies in Data Science
PEO2	To provide an understanding of data and train students to design integrated solutions to problems by applying principles of Data Science
PEO3	To impart strong core training both theoretically and practically to create adept data scientist
PEO4	To provide an exposure to real world problems in order to adapt easily to the industry demands
PEO5	To encourage students to practice continuous learning in order to achieve professional and personal excellence
PO_ID	B.Sc DataScience -Programme Outcomes
	On successful completion of B.Sc Data Science program, the student will be able to:
PO1	Proficiently handle and manipulate data by applying mathematics,statistics and computing techniques to clean, transform, and preprocess data for analysis.
PO2	Apply statistical, mathematical and computing knowledge as well as employ cutting edge tools and technologies to analyze, drive insights and forecast from large datasets.
PO3	Demonstrate effective communication and leadership abilities while collaborating within interdisciplinary teams, utilizing domain expertise to address real-world challenges through data-driven methodologies grounded in legal and ethical standards.
PO4	Pursue quality research in Data Science by applying Quantitative modeling and Data analysis techniques to solve real-world problems, communicate findings, and effectively present results.
PO5	Continuously engage in lifelong learning to adapt to evolving technologies, striving for professional excellence, and fostering success as entrepreneurs or professionals who make meaningful contributions to society.

NEP- Curriculum Framework

B.Sc. Data Science- Matrix for I Semester (w.e.f. 2023-24 onwards)

I Semester							
Code	Course Code	Course	Teaching Hours	Course Components			Credits
				L	T	P	
AECC	D23KN 1.1/ D23HN 1.1/ D23AE 1.1	Language I (Kannada/Hindi/Additional English)	45	3	1	-	3
AECC	D23GE 1.1	Language II (Generic English)	60	3	1	-	3
DSC1	D23DC 1.1	Fundamentals of Descriptive Statistics	45	2	1	-	3
DSC 1	D23DC 1.2	Fundamentals of Data Science	45	2	1	-	3
DSC 1	D23DC 1.3	Python Programming	45	2	1	-	3
DSC 1	D23DC 1.4	Data Analysis and Visualization Lab	60	-	-	4	2
DSC1	D23DC 1.3	Python Programming Lab	60	-	-	4	2
OE-1	B21OE1.1	Office Automation and Designing	45	2	1	-	3
SEC-SB	21SBC 1.2	Office Management Tools	30	-	-	2	2
SEC-VB	21VBC 1.1	Health and Well-being	30	-	-	2	1
SEC-VB	21VBC 1.2	Yoga	30	-	-	2	1
Total							26

Note:

AECC- Ability Enhancement Compulsory Course

DSC - Discipline-Specific Course

OE- Open elective (course offered by the department to students of other stream)

DSE – Discipline-Specific Elective

SEC - VB Skill Enhancement Course -Value Based

SEC - SB Skill Enhancement Course -Skill Based

NEP- Curriculum Framework

B.Sc. (Data Science) - Matrix for II Semester (w.e.f. 2023-24 onwards)

II Semester							
Code	Course Code	Course	Teaching Hours	Course Components			Credits
				L	T	P	
AECC	D23KN 2.1/ D23HN 2.1/ D23AE 2.1	Language I (Kannada/Hindi/Additional English)	45	3	1	-	3
AECC	D23GE 2.1	Language II (Generic English)	60	3	1	-	3
AECC	21SBC 2.1	Environmental Studies	45	2	1	-	3
DSC2	D23DC2.1	Mathematical foundations in Data Science-I	45	2	1	-	3
DSC2	D23DC2.2	Database Management System	45	2	1	-	3
DSC2	D23DC2.3	Data Structures	45	2	1	-	3
DSC2	D23DC2.4	Database Management System Lab	60	-	-	4	2
DSC2	D23DC2.5	Data Structure Lab	60	-	-	4	2
OE-2	B21OE2.1	Cyber Space	45	2	1	-	3
SEC-VB	21VBC 2.1	NCC/NSS/Cultural	30	-	-	2	1
SEC-VB	21VBC 2.2	Sports	30	-	-	2	1
Total							27

Note:

AECC- Ability Enhancement Compulsory Course

DSC - Discipline-Specific Course

OE- Open elective (course offered by the department to students of other stream)

DSE – Discipline-Specific Elective

SEC - VB Skill Enhancement Course -Value Based

SEC - SB Skill Enhancement Course -Skill Based

NEP- Curriculum Framework for Approval

B.Sc. (Data Science) - Matrix for III Semester (w.e.f. 2023-24 onwards)

III Semester							
Code	Course Code	Course	Teaching Hours	Course Components			Credits
				L	T	P	
AECC	D23KN 3.1/ D23HN 3.1/ D23AE 1.1	Language I (Kannada/Hindi/Additional English)	45	3	1	-	3
AECC	D23GE 3.1	Language II (Generic English)	60	3	1	-	3
DSC3	D23DC3.1	Mathematical foundation for Data Science- II	45	2	1	-	3
DSC3	D23DC3.2	Web Programming	45	2	1	-	3
DSC3	D23DC3.3	Artificial Intelligence	45	2	1	-	3
DSC3	D23DC3.4	Web Programming Lab	60	-	-	4	2
DSC3	D23DC3.5	Artificial Intelligence Lab	60	-	-	4	2
OE-3	B21OE3.1	Computer Fundamentals and Programming Concepts in C*	45	2	1	-	3
SEC- SB	21SBC 3.1	Digital fluency-II	30	1	-	2	2
SEC-VB	21VBC 3.1	NCC/NSS/Cultural	30	-	-	2	1
SEC-VB	21VBC 3.2	Sports	30	-	-	2	1
Total							26

Note:

AECC- Ability Enhancement Compulsory Course

DSC - Discipline-Specific Course

***OE-** Open elective (course offered by the department to students of other stream)

DSE – Discipline-Specific Elective

SEC - VB Skill Enhancement Course -Value Based

SEC - SB Skill Enhancement Course -Skill Based

NEP- Curriculum Framework for Approval

B.Sc. (Data Science) - Matrix for IV Semester (w.e.f. 2023-24 onwards)

IV Semester							
Code	Course Code	Course	Teaching Hours	Course Components			Credits
				L	T	P	
AECC	D23KN 4.1/ D23HN4.1/ D23AE 4.1	Language I (Kannada/Hindi/Additional English)	45	3	1	-	3
AECC	D23GE4.1	Language II (Generic English)	60	3	1	-	3
AECC	21SBC 4.1	Constitution of India	45	2	1	-	3
DSC4	D23DC4.1	Probability and Inferential Statistics	45	2	1	-	3
DSC4	D23DC4.2	Data Analytics	45	2	1	-	3
DSC4	D23DC4.3	Machine Learning	45	2	1	-	3
DSC4	D23DC4.4	Data Analytics Lab	60	-	-	4	2
DSC4	D23DC4.5	Machine Learning Lab	60	-	-	4	2
OE-4	B21OE4.1	Web Designing	45	2	1	-	3
SEC-VB	21VBC 4.1	NCC/NSS/Cultural	30	-	-	2	1
SEC-VB	21VBC 4.2	Sports	30	-	-	2	1
Total							26

Note:

AECC- Ability Enhancement Compulsory Course

DSC - Discipline-Specific Course

OE- Open elective (course offered by the department to students of other stream)

DSE – Discipline-Specific Elective

SEC - VB Skill Enhancement Course -Value Based

SEC - SB Skill Enhancement Course -Skill Based

NEP- Curriculum Framework for Approval

B.Sc. (Data Science)- Matrix for V Semester (w.e.f. 2023-24 onwards)

V SEMESTER							
Code	Course Code	Course	Teaching hours	Course Components			Credits
				L	T	P	
DSC5	D23DC5.1	Optimization Techniques	60	2	2	-	4
DSC5	D23DC5.2	Deep Learning	60	2	2	-	4
DSC5	D23DC5.3	R Programming	60	2	2	-	4
DSC5	D23DC5.4	Deep Learning Lab	60	-	-	4	2
DSC5	D23DC5.5	R Programming Lab	60	-	-	4	2
DSE5	23DCE5.6 23DCE5.7	Elective I: a. Data Mining b. Natural Language Processing	45	2	1	-	3
VOC-1	23VOC5.1	Vocation Course I: Accounting and Financial Management	45	2	1	-	3
SEC-SB	21SBC5.1	Cyber Crime, and Cyber Law	30	2	-	-	2
Total							24

Note:

AECC- Ability Enhancement Compulsory Course

DSC - Discipline-Specific Course

OE- Open elective (course offered by the department to students of other stream)

DSE – Discipline-Specific Elective

SEC - VB Skill Enhancement Course -Value Based

SEC - SB Skill Enhancement Course -Skill Based

NEP- Curriculum Framework for Approval
B.Sc. (Data Science)- Matrix for VI Semester (w.e.f. 2023-24 onwards)

VI SEMESTER							
Code	Course Code	Course	Teaching hours	Course Components			Credits
				L	T	P	
DSC6	D23DC6.1	Design and Analysis of Algorithms	60	2	2	-	4
DSC6	D23DC6.2	Big Data Analytics	60	2	2	-	4
DSC6	D23DC6.3	Mobile Application Development	60	2	2	-	4
DSC6	D23DC6.4	Big Data Analytics Lab	60	-	-	4	2
DSC6	D23DC6.5	Project Lab	60	-	-	4	2
DSE6	23DCE6.6 23DCE6.7	Elective II: a. Operations Research b. Image Processing	45	2	1	-	3
DSC6	23VOC6.1	Vocation Course II: Computer Animation	45	2	-	1	3
SEC- SB	21SBC 6.1	Professional & Business Communication	45	1	-	2	2
TOTAL							24

Note:

AECC- Ability Enhancement Compulsory Course

DSC - Discipline-Specific Course

OE- Open elective (course offered by the department to students of other stream)

DSE – Discipline-Specific Elective

SEC - VB Skill Enhancement Course -Value Based

SEC - SB Skill Enhancement Course -Skill Based

At the end of year	Exit Award	Outcomes Achieved	Credits
1 st Year	Certificate in Data Science	PO1	52
2 nd Year	Diploma in in Data Science	PO1,PO2,PO3	104
3 rd Year	Bachelor's Degree in Data Science	PO1,PO2,PO3,PO4	153

**Continuous Internal Assessment – Scheme of Evaluation
For Theory Courses**
End Semester Examination: 60%
Continuous Internal Assessment: 40%

Activities (CIA: 40 Marks)	Proposed and Approved Scheme		Total Marks (40)
	IA-1	IA-2	
1. Internal Test (Maximum Marks:30)	10	10	20
2. Assignment (Marks):			20
i. Writing	10		
ii.Quiz / Presentation / Creating diagrams /charts / Classwork / Case study / Viva / Field work etc.	05		
iii. Classroom participation	05		
Total			40

**Continuous Internal Assessment – Scheme of Evaluation
For Practical Courses**

End-Semester Examination: 50%
Continuous Internal Assessment: 50%
CIA (25 marks) + End Semester Exam (25 marks)

1. Lab Performance	10
2. Observation record	05
3. Internal exam	10
Total (Marks)	25

FIRST SEMESTER

BDC1.1: Fundamentals of Descriptive Statistics

Total Teaching Hours: 45

No. of Hours per Week: 3
(3 credits)

CObj	Course Objectives
CObj_1	To impart knowledge on the significance and computational aspects of statistical analysis
CObj_2	To create an understanding of the patterns of distribution of data
CObj_3	To familiarise the concepts of predictive analytics

CO	Course Outcomes
CO1	Understand the scope and necessity of Statistics and the representation of data
CO2	Tabulate and represent the data in diagrams and graphs
CO3	Apply the formula and calculate descriptive measures of statistics
CO4	Analyze the nature of data and interpret the measures
CO5	Analyze the data and predict the future values using regression

CO-PO MAPPING

	PO_1	PO_2	PO_3	PO_4	PO_5
CO_1	*	*			
CO_2	*	*			
CO_3	*	*	*	*	*
CO_4	*	*	*	*	*
CO_5	*	*	*	*	*

Course Content

S. No	Unit title	Course Content	Number of Hours	Skills Developed
1	UNIT I	Collection of data, Classification, Tabulation and graphical representation: Statistics -scope, definition, limitations of Statistics, Data- Primary and Secondary Data, Methods of data Collection. Classification of data, preparation of tables, Diagrammatic representation of data: One dimensional and Two dimensional diagrams- Line graph, Frequency polygon, Frequency curve, Histogram	12 hrs	Cognitive, Analytical, Synthesis skills
2	UNIT II	Measures of Central Tendency: Mean, Median, Mode, Geometric Mean and Harmonic Mean, Properties with Merits and Demerits- Empirical Relation between means. Partition values: Quartiles, Deciles and Percentiles.	11 hrs	Cognitive, Analytical, Synthesis skills
3	UNIT III	Measures of Dispersion: Absolute and Relative Measures Range, Mean deviation, Quartile deviation and Standard deviation – Measures of Skewness - Pearson's and Bowley's Coefficient of Skewness, Coefficient of Skewness based on moments – Kurtosis and its significance. Measures of Variation : Standard, Mean and Quartile deviations-Co efficient of variation.	11 hrs	Cognitive, Analytical, Synthesis skills
4	UNIT IV	Correlation and Regression: Correlation- types, Karl Pearson's Co-efficient of correlation: univariate, bivariate Spearman's Rank correlation, Linear Regression.	13 hrs	Cognitive, Analytical, Synthesis skills

Reference Books:

- 1) Agarwal, B. L. (2021). *Basic Statistics*. New Delhi, India :New Age International Private Limited.
- 2) Gupta, S.C. Kappor, V. K. (2020). *Fundamentals of Mathematical Statistics*, 12th Edition, New Delhi, India: Sultan Chand & Sons.
- 3) Holcomb, Z. C. (2017). *Fundamentals of Descriptive Statistics*, New York, US: Routledge.

Web reference:

- 1) <https://nptel.ac.in/courses/111/104/111104120/>
- 2) https://www.iiserpune.ac.in/~bhasbapat/phy221_files/curvefitting.pdf

BDS1.2: FUNDAMENTALS OF DATA SCIENCE

Total Teaching Hours: 45

No. of Hours per Week: 3

(3 credits)

CObj	Course Objectives
CObj_1	To provide in-depth knowledge of principles of Data Science, techniques and applications
CObj_2	To understand the applications of Data Science
CObj_3	To gain an insight into data driven programming

CO	Course Outcomes
CO1	Gain ability to explore data and prepare the data for analysis
CO2	Gain knowledge to apply Data-Driven Insights to Business and Industry
CO3	Acquire ability to analyze Data through Visualizations
CO4	Acquire knowledge to build Models that operate on Internet-of-Things Devices
CO5	Acquire skills to use tools to analyze and solve real world problems

CO-PO MAPPING

	PO_1	PO_2	PO_3	PO_4	PO_5
CO_1	*	*			
CO_2	*	*		*	*
CO_3	*	*	*	*	*
CO_4	*	*	*	*	*
CO_5	*	*	*	*	*

Course Contents

S. No	Unit title	Course Content	Number of Hours	Skills Developed
1	UNIT I	Getting Started with Data Science – Facets of Data-structured data, Unstructured data, Natural language, Machine-generated data, Graph based or network data, Audio, image, video streaming data. Data Science Process: setting research goal-retrieving data- Data Preparation, Data Exploration, Data modelling or model building- Presentation and Automation Analyzing the Pieces of the Data Science Puzzle, Applications of Data Science	12 hrs	Cognitive skills, Analytical skills, Synthesis skills,
2	UNIT II	Exploring Data Engineering - Pipelines and Infrastructure -Grasping the Difference between Data Science and Data Engineering- Identifying Big Data Sources-Making Sense of Data in Hadoop-Identifying Alternative Big Data Solutions. Applying Data-Driven Insights to Business - Defining Business-Centric Data Science -Differentiating between Business and Data Driven Business- Benefiting from Business-Centric Data Science - Converting Raw Data into Actionable Insights with Data Analytic -Taking Action on Business Insights - Distinguishing between Business Intelligence and Data Science.	11 hrs	Cognitive skills, Analytical skills, Synthesis skills,
3		Using Data Science to Extract Meaning from Your Data: Machine Learning - Learning from Data with Your		Cognitive skills, Analytical

	UNIT III	Machine, Defining Machine Learning and Its Processes Considering Learning Styles. Building Models That Operate Internet-of-Things Devices – IOT, technologies and models employed in IOT, Data Science Approaches in IOT, advantages, limitations, Advancing Artificial Intelligence Innovation	11 hrs	skills, Synthesis skills,
4	UNIT IV	Creating Data Visualizations: Following the Principles of Data Visualization Design, Data Visualizations - The Big Three Designing principles, Picking the Most Appropriate Design Style, Choosing to Add Context, Selecting the Appropriate Data Graphic Type, Choosing a Data Graphic. D3.js for Data Visualization - Introducing the D3.js Library- -Getting Started in D3.js-Implementing More Advanced Concepts. Doing Data Science with Excel and Knime – Data analysis with Excel, Using KNIME for Advanced Data Analytics. Applying Domain Expertise to Solve Real World Problems Using Data Science - Data Science for driving growth in e-commerce.	11 hrs	Cognitive skills, Analytical skills, Synthesis skills,

Reference Books:

1. Davy Cielen, Arno Meysman and Ali, M. (2016). *Introducing data science : big data, machine learning, and more, using Python tools*. Shelter Island, Ny: Manning Publications.
2. Pierson, L. (2021). *Data Science For Dummies*. S.L.: John Wiley & Sons.
3. Saltz, J.S. and Stanton, J.M. (2017). *An Introduction to Data Science*. SAGE Publications.
4. Chirag Shah (2020). *A hands-on introduction to data science*. Cambridge, United Kingdom ; New York, Ny, USA Cambridge University Press.

BDC1.3 : Python Programming

Total Teaching Hours: 45

No. of Hours per Week: 3

(3 credits)

CObj	Course Objectives
CObj_1	To provide an Understanding of the features of Python Programming language
CObj_2	To instill the ability to implement file handling and database handling in python
CObj_3	To impart the knowledge to create projects using Python
CO1	Comprehend the concepts of functions, list, dictionaries
CO2	Analyze the usage of Python libraries and apply them appropriately
CO3	Become competent in file handling using Python
CO4	Create Python programs to access databases
CO5	Become competent to create projects using python

CO-PO MAPPING

	PO_1	PO_2	PO_3	PO_4	PO_5
CO_1	*	*			
CO_2	*	*			
CO_3	*	*	*	*	
CO_4	*	*	*	*	
CO_5	*	*	*	*	*

Course Content

S. No	Unit title	Course Content	Number of Hours	Skills Developed
1	UNIT I	Python features- Understanding Python variables-Python basic Operators- Understanding python blocks - Declaring and using Numeric data types: int, float, complex. Defining list and list slicing - Use of Tuple data type. List manipulation using in built methods - Programming using lists, Tuple manipulation using inbuilt methods - Programming using tuples. Understanding string in built methods - Programming using strings, set – in built methods, set operations (union, difference, intersection) using built-in methods, Dictionary manipulation - Programming using dictionary in built functions. Conditional blocks using if, else and elif - Simple for loops in python - For loop using ranges, Use of while loops in python - Loop manipulation using pass, continue, break.	10 hrs	Cognitive skills, Analytical skills, Synthesis skills,
2	UNIT II	Organizing python codes using functions – Types of function arguments, Importing user defined module as well as library modules. Regular expression: Power of pattern matching and searching using regex in python, Pattern finding programs using regular expression. Files: reading and writing text files, reading and writing binary files, pickle module.	12 hrs	Cognitive skills, Analytical skills, Synthesis skills,
3	UNIT III	Concept of class, objects- Constructor, class attributes and destructors - Inheritance, overloading operators - Adding and retrieving dynamic attributes	12 hrs	Cognitive skills, Analytical

		of classes - Programming using Oops.Exception handling - Programming using Exception handling, User defined exceptions. Understanding threads - Forking threads - Synchronizing the threads - Programming using multithreading.		skills, Synthesis skills,
4	UNIT IV	Numpy: ndarray - 1 dim, 2 dim, max, min - row wise , column wise, linalg module - 5 functions. Pandas: series, dataframes, read_csv, read_excel, data cleaning methods, accessing specific rows and columns. Using Databases in Python: Python MySQL Database Access -Install the MySQLdb and other Packages -Create Database Connection - CREATE, INSERT, READ, UPDATE and DELETE Operation- DML and DDL operation with Databases - Performing Transactions- Handling Database Errors.	11 hrs	Cognitive skills, Analytical skills, Synthesis skills,

Reference Books:

1. Gowrishankar S, Veena A, “**Introduction to Python Programming**”, 1st Edition, CRC Press/Taylor & Francis, 2018. ISBN-13: 978-0815394372
2. Charles R. Severance, “Python for Everybody: Exploring Data Using Python 3”, 1st Edition, CreateSpace Independent Publishing Platform, 2016. (http://do1.drchuck.com/pythonlearn/EN_us/pythonlearn.pdf) (Chapters 1 – 13, 15)
3. Jake VanderPlas, “**Python Data Science Handbook: Essential Tools for Working with Data**”, 1st Edition, O'Reilly Media, 2016. ISBN-13: 978-149191205

BDC1.4 : DATA ANALYSIS AND VISUALIZATION LAB

Total Teaching Hours: 60

No. of Hours per Week: 4

(2 credits)

CObj_ID	Course Objectives
CObj_1	To provide hands-on experience on how to organize and maintain data in a worksheet
CObj_2	To instill the skills to analyze data in a worksheet

CObj_3	To impart knowledge on how to visualize data efficiently and effectively

CO_ID	Course Outcomes
CO_1	Gain hands on experience of performing functions of descriptive statistics
CO_2	Acquire practical knowledge of conditional formatting, sorting and filtering data
CO_3	Capability to plot graphs to effectively visualize data
CO_4	Ability to analyze and summarise data
CO_5	Acquire skills to create interactive dashboards

CO-PO MAPPING:

	PO_1	PO_2	PO_3	PO_4	PO_5
CO_1	*	*		*	
CO_2	*	*		*	
CO_3	*	*		*	*
CO_4	*	*	*	*	*
CO_5	*	*			*

The following experiments are to be done using tableau	Skills developed
PART-A For the following questions use the dataset Sample-Superstore Subset. 1. A) What is the percent of total Sales for the 'Home Office' Customer Segment in July of 2014? B) Find the top 10 Product Names by Sales within each region. Which product is ranked #2 in both the Central & West regions?	Transferrable Skills, Employable Skills, Cognitive Skills

2. A) In the Technology Product Category, which unprofitable state is surrounded by only profitable states?
- B) If 2014 Sales numbers were expected to increase by 50% in the following year, what would be the total estimated sales for the Consumer Segment in 2015?
3. A) In which Region do all Product Categories fall beneath the overall average profit?
- B) Which Product Sub-Category has a Shipping Cost to Sales ratio of above 11.10%?
4. A) Find the customer with the lowest overall profit. What is his/her profit ratio?
- B) Determine which State in the Central Region has the highest distribution of profits using interquartile ranges.
5. A) Look at the sum of profits for each Product Sub-Category. Which sub-category is \$16,000 below the average profit across all categories?
- B) What percent of total profits do the top 10 customer by Sales represent?
6. A) What was the Moving Average of Sales in June of 2016, including six months prior and six months after?
- B) Create a histogram showing the number of Sales using Sales Bins of \$1,000. Which bins have profit ratios (profit as a percentage of sales) of more than 25%? (Select all that apply)
7. Plot standard charts such as line charts, pie charts, gantt charts and scatter charts – to visualize the input data.
8. Plot area charts, donut charts, and bubble charts.

PART-B

9. Demonstrate sorting and filtering of data.
10. Demonstrate basic filters, context and conditional Filters.
11. Demonstrate adding secondary data source and blending the data
12. Plot a waterfall chart.
13. Plot a funnel chart.
14. Create a dashboard and create responsive infographics.
15. Create Slicers for interactive dashboards.

16. Create a forecast for the given data	
17. Create a trend line for the given data.	

BDC1.5 : Python Programming Lab

Total Teaching Hours: 60

No. of Hours per Week: 4

(2 credits)

CObj	Course Objectives
CObj_1	To provide a practical Understanding of the features of Python Programming language
CObj_2	To instill the ability to implement file handling and database handling in python
CObj_3	To impart the practical knowledge to create projects using Python
CO	Course Outcomes
CO1	Gain knowledge of the concepts of functions, list, dictionaries
CO2	Analyze the usage of Python libraries and apply them appropriately
CO3	Comprehend file handling in Python
CO4	Gain skills to access database from Python program
CO5	Become competent to create projects using python

CO-PO MAPPING

	PO_1	PO_2	PO_3	PO_4	PO_5
CO_1	*	*			
CO_2	*	*			
CO_3	*	*	*	*	
CO_4	*	*	*	*	
CO_5	*	*	*	*	*

Programming Exercises	Skills Developed
1. Write a program to demonstrate lists in python. 2. Write a program to demonstrate tuples in python. 3. Write a program to count the numbers of characters in the string and store them in a dictionary data structure. 4. Python program to remove all the lines that contain the character 'a' in a file and write it to another file. 5. Write a Python function to evaluate $\exp(x)$ using Taylor's expansion series. 6. Write a Python program to a random number generator that generates random numbers between 1 and 6 (simulates a dice). 7. Write a Python program to implement a stack and queue using a list data-structure. 8. Write a Python program to create a line plot. 9. Write a Python program to copy odd lines of one file to another file in Python 10. Write a Python program to create Histogram using matplotlib in Python 11. Write a Python program to create an Employee table, insert 5 tuples and delete a particular employee from the table. 12. Write a Python program to create a student table and find the min, max, sum, and average of the marks in a student marks table. 13. Write a Python program to create a customer table and find the total number of customers from each country in the table (customer ID, customer name, country) using group by.	Transferrable Skills, Employable Skills, Cognitive Skills

SEC1.1: OFFICE MANAGEMENT TOOLS

Total Teaching Hours: 30

No. of Hours per Week: 2

(2 credits)

CObj_ID	Course Objectives
CObj_1	To provide hands-on experience on word processing
CObj_2	To impart the skills to work on data using spreadsheets
CObj_3	To equip the skills to design presentations
CO_ID	Course Outcomes
CO_1	Gain ability to create formatted documents
CO_2	Acquire skills to analyze data using spread sheets
CO_3	Gain the capability to design attractive presentations
CO_4	Acquire Skills to create charts in spreadsheets and visualize the data
CO_5	Gain knowledge of the usage of common shortcut keys in the office management tools

CO-PO MAPPING

CO_1	*	*		*	
CO_2	*	*		*	
CO_3	*	*	*	*	*
CO_4	*	*	*	*	*
CO_5	*	*	*	*	*

Course Content

S. No	Unit title	Module Content	Number of Hours	Skills Developed
1	UNIT I WORD PROCESSING	Working with Documents - Formatting page & setting Margins, Converting files to different formats, Importing & Exporting documents, Sending files to others, Using Tool bars, Ruler, Using Icons, using help, Formatting Documents - Setting Font styles, Font selection, Setting Paragraph style, Alignments, Indents, Line Space, Margins, Bullets & Numbering. Setting Page style - Formatting Page, Page tab, Margins, Layout settings, Paper tray, Border & Shading, Columns, Header & footer, Setting Footnotes & end notes – Shortcut Keys; Inserting manual page break, Creating sections & frames, Anchoring & Wrapping, Table of Contents, Index, Creating Master	10 HRS	Transferable Skills, Employable Skills, Cognitive Skills

		Documents, Web page. Creating Tables- Table settings, Borders, Alignments, Insertion, deletion, Merging, Splitting, Sorting, and Formula, Drawing - Inserting ClipArts, Tools – Word Completion, Spell Checks, Mail merge, Templates, Creating contents for books, Creating Letter/Faxes, Creating Web pages, Using Wizards, Tracking Changes, Security, Digital Signature. Printing Documents <u>Skill based exercises to be done:</u> 1. Creating the documents with Special effects like underline, bold, different size, different font and different color. 2. Creating Paragraphs Inserting Date & Time, Pictures, Bullets & Numbering, indentation etc. in MS-Word, librewriter 3. Formatting features of MS-Word: it includes paper-size, margins, header and footer, page no. and creation of table options. 4. Creation of mail merge for sending the new year wish to your class group.		
2	UNIT II SPREADSHEET	Spread Sheet & its Applications, Opening Spreadsheet, Menus - main menu, Formula Editing, Formatting, Toolbars, Using Icons, Using help, Shortcuts, Spreadsheet types. Working with Spreadsheets- opening, Saving files, setting Margins, Converting files to different formats (importing, exporting, sending files to others), Spread sheet addressing - Rows, Columns & Cells, Referring Cells & Selecting Cells – Shortcut Keys. Entering & Deleting Data- Entering data, Cut, Copy, Paste, Undo, Redo,	15 HRS	Transferable Skills, Employable Skills, Cognitive Skills, Analytical Skills

		Filling Continuous rows, columns, Highlighting values, Find, Search & replace, Inserting Data, Insert Cells, Column, rows & sheets, Symbols, Data from external files, Frames, Clipart, Pictures, Files etc, Inserting Functions, Manual breaks, Setting Formula - finding total in a column or row, Mathematical operations (Addition, Subtraction, Multiplication, Division, Exponentiation), Using other Formulae. Formatting Spreadsheets- Labelling columns & rows, Formatting- Cell, row, column & Sheet, Category - Alignment, Font, Border & Shading, Hiding/ Locking Cells, Anchoring objects, Formatting layout for Graphics, Clipart etc., Worksheet Row & Column Headers, Sheet Name, Row height & Column width, Visibility - Row, Column, Sheet, Security, Sheet Formatting & style, Sheet background, Colour etc, Borders & Shading – Shortcut keys. Working with sheets – Sorting, Filtering, Validation, Consolidation, and Subtotal. Creating Charts - Drawing. Printing. Using Tools – Error checking, Spell Checks, Formula Auditing, Creating & Using Templates, Pivot Tables, Tracking Changes, Security, Customization. <u>Skill based exercises to be done:</u> 1. Creating Worksheets in Excel-, Inserting, Deleting, Copying, Moving worksheets in Excel Usage of formulas, Built-in functions in Excel 2. Graph-Plotting facilities in MS Excel 3. Writing conditional expressions (using IF) and Using logical functions (AND, OR, NOT) Using lookup and reference functions (VLOOKUP, HLOOKUP, MATCH, INDEX)		

		4. Data Validations: Specifying a valid range of values for a cell, Specifying a list of valid values for a cell, Specifying custom validations based on formula for a cell, Sorting and Filtering Data, Macro facility in MS Excel.		
3	UNIT III PRESENTATION	Introduction to presentation – Opening new presentation, Different presentation templates, Setting backgrounds, Selecting presentation layouts. Creating a presentation - Setting Presentation style, Adding text to the Presentation. Formatting a Presentation - Adding style, Colour, gradient fills, Arranging objects, Adding Header & Footer, Slide Background, Slide layout. Adding Graphics to the Presentation- Inserting pictures, movies, tables etc into presentation, Drawing Pictures using Draw. Adding Effects to the Presentation- Setting Animation & transition effect. Printing Handouts, Generating Standalone Presentation viewer. <u>Skill based exercises to be done:</u> 1. Creating a presentation in PowerPoint-- Inserting/Deleting slides in PowerPoint. 2. Creation of Slide transition and Editing special effects in PowerPoint. 3. Creation of Inserting sound and picture in PowerPoint. 4. Creation of Inserting chart and organization chart in PowerPoint.	5 HRS	Transferable Skills, Employable Skills, Cognitive Skills

Reference Books:

1. Albert Chipman. (2021). *Microsoft Office 365 User Guide: A Complete User Manual for Beginners and Pro with Useful Tips & Tricks to Master the Microsoft Office 365 New Features for Easy Navigation.*

2. Matt Vic. (2021). *Microsoft Office 365: A Complete Guide to Master Word, Excel and PowerPoint 365 for Beginners and Pro.*
3. Steven Weikler. (2016). *Office 2017 For Beginners- The PERFECT Guide on Microsoft Office: Including Microsoft Excel Microsoft PowerPoint Microsoft Word Microsoft Access and more.*

Second Semester

BDC2.1: MATHEMATICAL FOUNDATION IN DATA SCIENCE-I

Total Teaching Hours: 45

No. of Hours per Week: 3

(3 credits)

CObj	Course Objectives

CObj_1	To introduce students to the fundamental Mathematical concepts required for Data Science
CObj_2	To understand the concept of sets, relations, functions, Mathematical logic and concept of matrices
CObj_3	A brief course in linear algebra familiarizes students with some basic techniques in matrix theory which are essential for analyzing linear system of equations.

CO	Course Outcomes
CO1	Gain ability to solve problems in sets and foundations in logic
CO2	Comprehend problems in relations and functions in sets
CO3	Apply the matrix concept to solve problems
CO4	To understand the determinant concept and solve the system of linear equations
CO5	Gain reasonable understanding of Linear Algebra

CO-PO MAPPING

	PO_1	PO_2	PO_3	PO_4	PO_5
CO_1	*	*			
CO_2	*	*			
CO_3	*	*	*	*	
CO_4	*	*	*	*	*
CO_5	*	*	*	*	*

Course Content

S. No	Unit title	Course Content	Number of Hours	Skills Developed
1	UNIT I	Sets, Relations, Functions: Introduction, Recapitulation of sets. Set operations,	8 hrs	Cognitive skills, Analytical

		properties of set theory, counting and Venn diagrams. Relations, types of relations, equivalence relation. Function, types of functions, one-one, onto, bijective function, inverse function, composition of function. Applications of sets, relations and functions in Data Science		skills, Synthesis skills
2	UNIT II	Mathematical logic: Open sentences, compound open sentences, quantifiers, truth sets, connectives involving quantifiers, methods of proofs, methods of disproof. Applications in Data Science.	7 hrs	Cognitive skills, Analytical skills, Synthesis skills
3	UNIT III	Matrices and Determinants: Introduction, Recapitulation of matrices and types of matrices, Algebra of matrices, determinants, expansion and evaluation of determinants, properties of determinants (only statement), solution of system of equation using Cramer's rule, minors and cofactors, inverse of the matrix, elementary row and column operations on matrices, row reduced echelon form, normal form of a matrix, rank of a matrix-problems. Cayley-Hamilton theorem (without proof), finding A^{-1}, A^{-2} using Cayley-Hamilton theorem. Eigen values and Eigen vectors of a square matrix. Applications in Data Science	15 hrs	Cognitive skills, Analytical skills, Synthesis skills
4	UNIT IV	Linear Algebra : Vector space, subspaces, criterion for a subset to be a	15 hrs	Cognitive skills, Analytical

		subspace(without proof), linear combination, linear independent and dependent subsets, basis(definitions only)-problems. Linear Transformation-Range and kernel of a linear transformation, rank and nullity of a linear transformation, rank-nullity theorem (without proof)-problems. Matrix factorization- LU decomposition, singular value decomposition. Applications in Data Science.		skills, Synthesis skills

Reference Books:

1. Dr. Devanjani Chakraborti, Dr. Nilangshu Acharya, Dr. Sameerkumar Bhandari. (2023). *Mathematical logic and set theory*. Santra Publication private Ltd.
2. Warner, S. (2019). *Set Theory for Pre-Beginners*.
3. Devlin, K. (1992). *Sets, Functions, and Logic A Foundation Course in Mathematics*. Chapman and Hall/CRC.
4. Lipschutz, S. (2005). *Set Theory And Related Topics (Schaum S Outline Series)*.
5. G. Strang (2016). *Introduction to Linear Algebra*, Wellesley-Cambridge Press, Fifth edition, USA.
6. Cathy O’Neil and Rachel Schutt. (2013). *Doing Data Science*. O’Reilly Media

BDC2.2: DATABASE MANAGEMENT SYSTEM

Total Teaching Hours: 45

No. of Hours per Week: 3

(3 credits)

CObj_ID	Course Objectives
CObj_1	To provide knowledge on how to organize and maintain data in a database

COBj_2	To instill an understanding of the underlying mathematical principles and concepts implemented in DBMS
COBj_3	To impart knowledge on storing, manipulating and retrieving efficiently and effectively the data using DBMS

CO_ID	Course Outcomes
CO_1	Gain good knowledge of the fundamental elements of relational database management systems
CO_2	Acquire knowledge of the concepts of relational data model, entity-relationship model, relational database design, relational algebra and SQL
CO_3	Capability to design ER-models to represent simple database application scenarios
CO_4	Ability to convert the ER-model to relational tables, populate relational database and formulate SQL queries on data
CO_5	Acquire skills to improve the database design by normalization and familiarize themselves with transaction processing

CO-PO Mapping

	PO_1	PO_2	PO_3	PO_4	PO_5
CO_1	*	*			
CO_2	*	*			
CO_3	*	*	*	*	*
CO_4	*	*	*	*	*
CO_5	*	*	*	*	*

Course Content

S. No	Module title	Module Content	Number of Hours	Skills Developed
		Databases and Database Users: Introduction, an example, Characteristics of the Database		

1	UNIT 1	Approach, Actors on the Scene, Workers behind the Scene, Advantages of Using DBMS Approach, A Brief History of Database Applications, When Not to Use a DBMS. Database System Concepts and Architecture: Data Models, Schemas, and Instances, Three-schema Architecture and Data Independence, Database Languages and Interfaces, The Database System Environment, Centralized and Client-Server Architectures, Classification of Database Management Systems.	10 hours	Cognitive skills
2	UNIT 2	Data Modeling Using Entity-Relationship Model: Using High-Level Conceptual Data Models for Database Design, An Example Database Application, Entity Types, Entity Sets, Attributes and Keys, Relationship Types, Relationship Sets, Roles and Structural Constraints, Weak Entity Types, Refining the ER Design Company Database Diagrams, Naming Conventions and Design. Issues, File organization and storage, secondary storage devices, type of single level ordered index, multi-level indexes, indexes on multiple keys, other types of indexes.	12 hours	Analytical skills, Cognitive skills, Employable Skills
3	UNIT 3	Relational Model and Relational Algebra: Relational Model Concepts, Relational Model Constraints and Relational Database Schemas, Update Operations, Transactions and Dealing with Constraint Violations, Unary Relational Operations: SELECT and PROJECT, Relational Algebra Operations from SET Theory, Binary Relational Operations: JOIN and DIVISION, Additional Relational Operations, Examples of Queries in Relational Algebra. Relational Database Design: Anomalies in a database, functional dependency, normal forms, lossless join and dependency, BCNF,	12 hours	Cognitive skills, synthesis skills, Employable Skills

		normalization through synthesis, higher order normal forms. SQL- SQL Data Definition and Data Types, Specifying Constraints in SQL, Schema Change Statements in SQL, Basic Queries in SQL, More Complex SQL Queries, Insert, Delete and Update Statements in SQL, Specifying Constraints as Assertion and Trigger, Views(Virtual Tables) in SQL, Embedded SQL, Dynamic SQL,		
4	UNIT 4	Introduction to transaction processing, transaction and system concepts, desirable properties of transactions, transaction support in SQL. Concurrency control techniques: two-phase locking techniques, concurrency control based on timestamp ordering. Recovery techniques: recovery concepts, recovery in multi-database systems, database backup and recovery from catastrophic failures.	11 hours	Cognitive skills, Analytical skills, Synthesis skills, Employable Skills

Reference Books:

1. Elmasri, R. and Navathe, S. (2014). *Fundamentals of database systems : models, languages, design, and application programming*. Boston: Addison Wesley.
2. Silberschatz, A., Korth, H.F. and S Sudarshan (2020). *Database system concepts*. New York, Ny: Mcgraw-Hill Education.
3. Date, C.J. (2000). *An Introduction to Database Systems*.
4. Ramakrishnan, R. and Gehrke, J. (2000). *Database Management Systems*. McGraw-Hill College.

BDC 2.3: DATA STRUCTURES

Total Teaching Hours: 45

No. of Hours per Week: 3

(3 credits)

CObj_ID	Course Objectives
CObj_1	To impart knowledge on storing and managing data in various structures

CObj_2	To emphasize the importance of data structures in developing and implementing efficient algorithms
CObj_3	To understand the operations on different data structures and their applications

CO_ID	Course Outcomes
CO_1	Gain good understanding of the concepts, types and operations of data structures
CO_2	Acquire skills to implement sorting, searching and implementation of higher order data structure using arrays
CO_3	Understand the concept of dynamic memory allocation, types of linked lists and gain the ability to use linked list in developing solutions to real world problems
CO_4	Apply the concept of Stacks and Queues in real world applications
CO_5	Analyze and apply graph and tree data structure in the problems where non-linear data structures are required

CO-PO Mapping

CO_1	*	*		*	
CO_2	*	*		*	
CO_3	*	*	*	*	*
CO_4	*	*	*	*	*
CO_5	*	*	*	*	*

Course Content

S. No	Module title	Module Content	No of Hours	Skills Developed
		Introduction and Overview: Definition, Elementary data organization, Data Structures, data Structures		Cognitive

1	UNIT 1	operations, Abstract data types, Complexity of algorithms, asymptotic notations for complexity of algorithms, time-space trade off. Arrays as data structure, arrays as ADT, Representation of 1-D, 2-D Arrays in Memory, operations on arrays.	8 hours	skills
2	UNIT 2	Searching: Sequential Search, Binary Search, Comparison of search Methods. Sorting: Bubble sort, Insertion Sort, Divide and Conquer Technique: Merge sort, Quick sort.	12 hours	Analytical skills, Cognitive skills
3	UNIT 3	Stacks: Definition, Array representation of stacks, Linked representation of stacks, Conversion of infix expression to postfix expression, Evaluation of Postfix expression, Application of Stacks: Recursion, Towers of Hanoi. Queues: Definition, Array representation of queue, Linked list representation of queues, Operations on Queues. Types of queues: Simple queue, Circular queue, Double-ended queue, Priority queue, Applications of queues. Linked list: Definition, Representation of Singly Linked List in memory, Traversing a Singly linked list, operations: adding, deleting, searching nodes, Doubly linked list, operations in doubly linked list: adding, deleting nodes.	15 hours	Cognitive skills, synthesis skills
4	UNIT 4	Trees: Definitions, Binary Tree, Traversals of Binary Tree, Building a Binary Search Tree, traversal of Binary search tree. AVL trees, B-tree, B+tree: definition, Applications of all these Trees. Graphs: Memory Representation, Types of graphs, Graph Traversal- BFS, DFS, Topological Sorting, application of graphs.	10 hours	Cognitive skills, Analytical skills, Synthesis skills

Reference Books:

1. Canning, J., Broder, A. and Lafore, R. (2022). *Data Structures & Algorithms in Python*. Addison-Wesley Professional.

2. Narasimha Karumanchi (2017). *Data structures and algorithmic thinking with Python*. Hyderabad, India: Careermonk Publications.
3. Dr. Basant Agarwal and Baka, B. (2018). *Hands-On Data Structures and Algorithms with Python*. Packt Publishing Ltd.
4. Goodrich, M.T., Tamassia, R. and Goldwasser, M.H. (2013). *Data Structures and Algorithms in Python*. Wiley Global Education.
5. Miller, B.N. and Ranum, D.L. (2011). *Problem solving with algorithms and data structures using Python*. Sherwood, Or.: Franklin, Beedle & Associates.
6. Lipschutz, S. (2014). *Data structures*. New Delhi: Mcgraw Hill Education (India) Private Limited.

BDC2.4: DATABASE MANAGEMENT SYSTEMS LAB

Total Teaching Hours: 60

No. of Hours per Week: 4

(2 credits)

CObj_ID	Course Objectives
CObj_1	To provide hands-on experience on how to organize and maintain data in a database
CObj_2	To instill the skills to implement relational algebra concepts while creating a database
CObj_3	To impart knowledge on how to store , manipulate and retrieve efficiently and effectively the data using DBMS

CO_ID	Course Outcomes
CO_1	Gain hands on experience of designing relational database management system applications
CO_2	Acquire practical knowledge of implementing the concepts of relational data model, entity-relationship model, relational database design, relational algebra and SQL
CO_3	Capability to implement relationships in simple database application scenarios
CO_4	Ability to convert the ER-model to relational tables, populate relational database and formulate SQL queries on data
CO_5	Acquire skills to improve the database design by normalization and familiarize themselves with transaction processing

CO-PO MAPPING

	PO_1	PO_2	PO_3	PO_4	PO_5
CO_1	*	*			
CO_2	*	*			
CO_3	*	*	*	*	*
CO_4	*	*	*	*	*
CO_5	*	*	*	*	*

Programs to be done using any DBMS software	Skills Developed
PART – A 1. Draw E-R diagram and convert entities and relationships to relation table for a given scenario. Two assignments shall be carried out i.e. consider two different scenarios (eg. bank, college) Consider the Company database with following Schema EMPLOYEE (FNAME, MINIT, LNAME, SSN, BDATE, ADDRESS, SEX, SALARY, SUPERSSN, DNO) DEPARTMENT (DNAME, DNUMBER, MGRSSN, MSRSTARTDATE) DEPT_LOCATIONS (DNUMBER, DLOCATION) PROJECT (PNAME, PNUMBER, PLOCATION, DNUM) WORKS_ON (ESSN, PNO, HOURS) DEPENDENT (ESSN, DEPENDENT_NAME, SEX, BDATE, RELATIONSHIP) 2. Perform the following: a. Viewing all databases, Creating a Database, Viewing all Tables in a Database, Creating Tables (With and Without Constraints), Inserting/Updating/Deleting Records in a Table, Saving (Commit) and Undoing (rollback) 3. Perform the following: a. Altering a Table, Dropping/Truncating/Renaming Tables, Backing up / Restoring a Database. 4. For a given set of relation schemes, create tables and perform the	Employable skills, Analytical Skills

following Simple Queries, Simple Queries with Aggregate functions, Queries with Aggregate functions (group by and having clause).

5. Execute the following queries

a. How the resulting salaries if every employee working on the 'Research' Departments is given a 10% raise.

b. Find the sum of the salaries of all employees of the 'Accounts' department, as well as the maximum salary, the minimum salary, and the average salary in this department

6. Execute the following queries

a. Retrieve the name of each employee Controlled by Department number 5 (use EXISTS operator).

b. Retrieve the name of each dept and number of employees working in each Department which has at least 2 employees

7. Execute the following queries

a. For each project, retrieve the project number, the project name, and the number of employee who work on that project.(use GROUP BY)

b. Retrieve the name of employees who born in the year 1990's

8. For each Department that has more than five employees, retrieve the department number and number of employees who are making salary more than 40000.

9. For each project on which more than two employees work, retrieve the project number, project name and the number of employees who work on that project.

10. For a given set of relation tables perform the following: Creating Views (with and without check option), Dropping views, Selecting from a view.

PART B

Create the following tables with properly specifying Primary keys, Foreign keys and solve the following queries.

BRANCH (Branchid, Branchname, HOD)

STUDENT (USN, Name, Address, Branchid, sem)

BOOK (Bookid, Bookname, Authorid, Publisher, Branchid)

AUTHOR (Authorid, Authurname, Country, age)

BORROW (USN, Bookid, Borrowed_Date)

1. Perform the following:

Viewing all databases, Creating a Database, Viewing all Tables in a Database, Creating Tables (With and Without Constraints), Inserting/Updating/Deleting Records in a Table, Saving (Commit) and

Undoing (rollback)

Execute the following Queries:

2.
 - a. List the details of Students who are all studying in 2nd sem BCA.
 - b. List the students who are not borrowed any books.
3.
 - a. Display the USN, Student name, Branch_name, Book_name, Author_name, Books_Borrowed_ Date of 2nd sem BCA Students who borrowed books.
 - b. Display the number of books written by each Author.
4.
 - a. Display the student details who borrowed more than two books.
 - b. Display the student details who borrowed books of more than one Author.
5.
 - a. Display the Book names in descending order of their names.
 - b. List the details of students who borrowed the books which are all published by the same publisher.

Consider the following schema:

STUDENT (USN, name, date_of_birth, branch, mark1, mark2, mark3, total, GPA)

6. Perform the following:
 - a. Creating Tables (With and Without constraints), Inserting/Updating/Deleting Records in a Table, Saving (Commit) and Undoing (rollback)
7. Execute the following queries:
 - a. Find the GPA score of all the students.
 - b. Find the students who born on a particular year of birth from the date_of_birth column.
8.
 - a. List the students who are studying in a particular branch of study.
 - b. Find the maximum GPA score of the student branch-wise.

BDC2.5: DATA STRUCTURES LAB**Total Teaching Hours: 60****No. of Hours per Week: 4****(2 credits)**

CObj_ID	Course Objectives
CObj_1	To provide practical knowledge of storing and managing data in various structures
CObj_2	To understand the importance of data structures and practically implementing efficient algorithms
CObj_3	To instill the ability to practically implement the operations on different data structures and their applications

CO_ID	Course Outcomes
CO_1	Gain good understanding of the concepts, types and operations of data structures by practically implementing them
CO_2	Acquire programming skills to implement sorting, searching and higher order data structure using arrays
CO_3	Gain ability to create programs using linked list to develop real world applications
CO_4	Capability to apply the concept of Stacks and Queues in real world applications
CO_5	Capability to analyze and apply graph and tree data structure in the problems where non-linear data structures are required

CO-PO MAPPING

CO_1	*	*		*	
CO_2	*	*		*	
CO_3	*	*	*	*	*
CO_4	*	*	*	*	*
CO_5	*	*	*	*	*

DS Programs to be done using Python	Skills Developed
1. Perform Linear Search on a list of elements 2. Perform Binary search on a list of elements. 3. Given a list of numbers order the numbers in ascending order using Bubble Sort Algorithm 4. Perform Insertion sort and display the output in descending order. 5. Perform Selection sort and display the output in descending order. 6. Perform Merge sort and display the output in descending order. 7. Write a program to insert the elements into singly linked list and delete an item from the list. Display your list after each insertion and deletion. 8. Write a program to insert into elements into linear queue and delete an elements from the queue. Display your queue after each insertion and deletion. 9. Write a program to push eleemnts into a stack and pop elements from the stack. Also display the popped numbers. 10. Write a recursive program to find GCD and LCM. 11. Write a program to convert an infix expression to its postfix expression. 12. Write a program to evaluate a postfix expression. 13. Write a program to create binary search tree.	Employable skills, Analytical Skills



Affiliated to Bangalore North University

REGULATIONS, SCHEME AND SYLLABUS

For the Programme

**MASTER OF SCIENCE IN DATA
SCIENCE (M.Sc. (DS))**

I to IV Semesters

(Choice Based Credit System)

w.e.f. Academic Year 2023-24 onwards

DEPARTMENT OF COMPUTER SCIENCE

Indian Academy Degree College Autonomous

Hennur Cross, Hennur Main Road, Bangalore

SCHEME OF STUDY AND SCHEDULE OF EXAMINATION

1. Title of the programme: M. Sc Data Science.
2. Duration of the programme: 2 years (4 semesters)
3. Eligibility:
 - A. A candidate who has passed Bachelor of Computer Applications (BCA) with 50% aggregate marks from any UGC recognized University in India or abroad.
 - B. A candidate who has passed an Under Graduate degree examination in Science with 50% aggregate from any UGC recognized University in India or abroad and has studied any two of the following subjects/courses as major or minor:
 - a. Computer Science
 - b. Mathematics
 - c. Statistics
4. Admission: A category wise merit list will be prepared with marks obtained in all optionals in all the three years of UG programme.
 - a) The minimum requirements for SC / ST candidates are relaxed in accordance with University regulations.
 - b) Intake: As per guidelines from Parent University.
5. Attendance: Minimum 75% attendance in each subject is required.
6. Medium of instruction: English.
7. Scheme of study:

Each semester is of 4 months duration.

I semester: Theory papers- 4, Practicals- 2

II semester: Theory papers- 4, Practicals- 2

III semester: Theory papers- 4, Practicals- 1, Internship- 1

IV semester: Theory paper- 1, Practicals- 1, Project Work- 1.
8. Scheme of examination:

There shall be a final examination at the end of each semester.

Appearance for the examination and provision for repeaters:
As per regulations of the Office of Controller of Examinations, Indian Academy Degree College Autonomous and guidelines from Parent University, for P.G. Courses.

Result declaration:
As per regulations of the Office of Controller of Examinations, Indian Academy Degree College Autonomous, for P.G. Courses.
9. Miscellaneous:
 - a) Continuous Internal Assessment:
 - Seminars -10
 - Assignments/ activity -10
 - Internal exam (Mid Semester, Pre final) -10
 - b) Lectures from experts in the field of Data Science are highly desirable.
 - c) 8 hours of experiential learning must be done in each course in the program.
10. Any other issue not envisaged above shall be resolved by the appropriate bodies of the Institution/University, which shall be final and binding.

**SCHEME OF STUDY AND EXAMINATION FOR
MASTER OF SCIENCE IN DATA SCIENCE (M.Sc. (DS))
(w.e.f 2023-24 onwards)**

Semester	Subject code	Subjects	Hrs / week	Marks			Credits
				I A	exam	Total	
I SEM	MDS101	Introduction to Data Science	4	30	70	100	4
	MDS102	Mathematical and Statistical foundation for Data Science	4	30	70	100	4
	MDS103	Python Programming	4	30	70	100	4
	MDS104	Big Data Analytics	4	30	70	100	4
	MDS105	Python Programming Lab	8	30	70	100	4
	MDS106	Big Data Analytics Lab	8	30	70	100	4
							Total:24
II SEM	MDS201	Advanced Algorithms	4	30	70	100	4
	MDS202	Machine Learning	4	30	70	100	4
	MDS203	Cloud computing	4	30	70	100	4
	MDS204	Advanced Algorithms Lab	8	30	70	100	4
	MDS205	Machine Learning Lab using Python	8	30	70	100	4
	MDS206	Non-Core: Professional Ethics and Corporate Governance	2	30	70	100	2
							Total:22
III SEM	MDS301	Deep Learning	4	30	70	100	4
	MDS302	Research Methodology	4	30	70	100	4
		Elective:	4	30	70	100	4

	MDSE31	Web scraping		0			
	MDSE32	Natural Language Processing					
	MDSE33	Forecasting and Optimization					
	MDSOPE	Open Elective	2	30	70	100	2
	MDS303	Deep Learning Lab	8	30	70	100	4
	MDS304	Internship	-	30	70	100	4
IV SEM	MDS401	Data Storytelling	4	30	70	100	4
	MDS402	Julia programming Lab	8	30	70	100	4
	MDS403	Main Project work	-	100	200	300	14
TOTAL CREDITS: 90							

M.Sc. DATA SCIENCE

PEO_ID	MSC-Programme Educational Objectives
PEO1	To develop in-depth understanding of the key technologies in Data Science

PEO2	To gain ability to design integrated solutions to problems by applying principles of Data Science
PEO3	To provide strong core training both theoretically and practically to create adept data scientists
PEO4	To gain exposure to real-world problems in order to adapt easily to the industry demands
PEO5	To inculcate values and make students realize the significance of ethics in a professional environment

PO_ID	MSC-Programme Outcomes
On completion of the MSc programme, the student will be able to:	
PO1	Apply Quantitative modeling and Data analysis techniques to solve real-world problems, communicate findings, and effectively present results
PO2	Apply Data-driven insights to enhance business and develop applications that would reduce human effort.
PO3	Employ cutting edge tools and technologies to analyze data particularly, large volume of data
PO4	Apply appropriate algorithms and build intelligent machines by following ethical practices and adapt to industry demands
PO5	Pursue quality research in Data Science by following ethical and moral values and develop solutions to societal needs

MDS101 – INTRODUCTION TO DATA SCIENCE

Total Teaching Hours: 52

No. of Hours / Week: 04

Course Objectives:

CObj_ID	Course Objectives
CObj_1	To understand the applications of Data Science
CObj_2	To provide in-depth knowledge of principles of Data Science, techniques and applications
CObj_3	To gain an insight into data driven programming

Course Outcomes:

CO_ID	Course Outcomes
CO_1	Explore data science and data engineering
CO_2	Apply Data-Driven Insights to Business and Industry
CO_3	Create and analyze Data through Visualizations
CO_4	Build Models that Operate Internet-of-Things Devices
CO_5	Apply Domain Expertise to Solve Real World Problems Using Data Science

	PO_1	PO_2	PO_3	PO_4	PO_5
CO_1	*	*		*	
CO_2	*	*	*	*	*
CO_3	*	*	*	*	*
CO_4	*	*	*	*	*
CO_5	*	*	*	*	*

Sl. No.	Unit/chapter title	Content	Number of hours	Skills developed
1	Unit- I	Getting Started with Data Science – Facets of Data- structured data, Unstructured data, Natural language, Machine-generated data, Graph based or network data, Audio, image, video streaming data. Data Science Process:	12 Hrs	Research/ Analytical/ Employable Skills

		setting research goal-retrieving data-Data Preparation, Data Exploration, Data modelling or model building-Presentation and Automation. Who Can Make Use of Data Science, Analyzing the pieces of the Data Science Puzzle, Exploring the Data Science Solution Alternatives, Letting Data Science Make You More Marketable.		
2	Unit- II	Exploring Data Engineering - Pipelines and Infrastructure -Grasping the Difference between Data Science and Data Engineering- Identifying Big Data Sources-Making Sense of Data in Hadoop-Identifying Alternative Big Data Solutions. Applying Data-Driven Insights to Business - Defining Business-Centric Data Science - Differentiating between Business and Data Driven Business- Benefiting from Business-Centric Data Science - Converting Raw Data into Actionable Insights with Data Analytics -Taking Action on Business Insights - Distinguishing between Business Intelligence and Data Science.	10 Hrs	Employable Skills
3	Unit- III	Using Data Science to Extract Meaning from Your Data: Machine Learning - Learning from Data with Your Machine, Defining Machine Learning and Its Processes Considering Learning Styles. Building Models That Operate Internet-of-Things Devices - Overviewing the Vocabulary and Technologies Digging into the Data Science Approaches, Advancing Artificial Intelligence Innovation	10 Hrs	Employable Skills
4	Unit- IV	Creating Data Visualizations: Following the Principles of Data Visualization Design, Data Visualizations - The Big Three Designing to Meet the Needs of Your Target Audience, Picking the Most Appropriate Design Style, Choosing How to Add Context, Selecting the	10 Hrs	Employable Skills

		Appropriate Data Graphic Type, Choosing a Data Graphic. Using D3.js for Data Visualization - Introducing the D3.js Library-Knowing When to Use D3.js-Getting Started in D3.js-Implementing More Advanced Concepts.		
5	Unit- V	Doing Data Science with Excel and Knime - Making Life Easier with Excel, Using KNIME for Advanced Data Analytics. Applying Domain Expertise to Solve RealWorld Problems Using Data Science - Data Science for driving growth in e-commerce.	10 Hrs	Employable Skills

Textbooks and References:

1. *Introducing Data Science* by Davy Cielen, Arno D.B.Meysman, Mohamed Ali, dream tech press.
2. *Data Science For Dummies (For Dummies (Computers)) 2nd Edition* by Lillian Pierson
3. *An Introduction to Data Science* by Jeffrey S. Saltz and Jeffrey M. Stanton
4. *A Hands-On Introduction to Data Science* by Chirag Shah

MDS102 – MATHEMATICAL AND STATISTICAL FOUNDATION FOR DATA SCIENCE

Total Teaching Hours: 52

No. of Hours / Week: 04

Course Objectives:

CObj_ID	Course Objectives
CObj_1	To introduce students to the fundamental mathematical concepts required for Data Science
CObj_2	To enable students in applying the fundamentals of statistics to assess descriptive measures and probability for data analysis
CObj_3	Able to apply mathematics and statistics in Data Science applications

Course Outcomes:

Upon completion of the course, students will be able to:

CO1	Apply Linear algebra and graph theory to develop applications in Data Science
CO2	Demonstrate the use of Eigenvalues, Eigenvectors and Inner Product Space in data processing
CO3	Apply the concept of correlation, linear and non-linear regressions to analyze data science problems
CO4	Become competent to analyze data using descriptive statistics
CO5	Apply the knowledge of probability distribution for various events

CO-PO Mapping

	PO_1	PO_2	PO_3	PO_4	PO_5
CO_1	*			*	*
CO_2	*			*	*
CO_3	*	*	*	*	*
CO_4	*	*	*	*	*
CO_5	*	*	*	*	*

	Unit/chapter title	Content	Number of hours	Skills developed
1	Unit- I	Introduction: Typology of problems; Importance of linear algebra, statistics and optimization from a data science perspective; Structured thinking for solving data science problems. Linear Algebra : Matrices and their properties (determinants, traces, rank, nullity, etc.); Eigenvalues and eigenvectors; Matrix factorizations; Inner products; Distance measures; Projections; Notion of hyperplanes; half-planes.	14 Hrs	Research/ Analytical/ Employable Skills
2	Unit- II	Graph Theory : Graphs - subgraphs - factors - Paths - cycles - connectedness - trees - Euler tours - Hamiltonian cycles - Planar Graphs - Digraphs.	6 Hrs	Research/ Analytical/ Employable Skills

3	Unit- III	Organization and Presentation of Data : Descriptive Statistics Sampling Techniques – Data Classification – Tabulation – Frequency and graphic Representation – Measures of Central Tendency – Measures of Variation – Quartiles and Percentiles – Moments -Skewness and Kurtosis.	10 Hrs	Research/ Analytical/ Employable Skills
4	Unit- IV	Correlation and Regression : Correlation and Regression Scatter Diagram – Karl Pearson’s Correlation Coefficient – Rank Correlation - Correlation Coefficient for Bivariate Frequency Distribution – Regression Coefficients – Fitting of Regression Lines.	10 Hrs	Research/ Analytical/ Employable Skills
5	Unit- V	Basics of Probability : Probability Theory Random Experiment – Sample Space – Events – Axiomatic Definition of Probability – Addition Theorem – Multiplication Theorem – Baye’s Theorem - Applications. Distribution functions : Continuous and Discrete Random Variables – Distribution Function of a Random Variable – Probability Mass Functions and Probability Density Functions – Characteristic Functions – Central Limit Theorems.	12 Hrs	Research/ Analytical/ Employable Skills

Text books & References:

1. Gupta, S.C. and Kapoor, V.K.: “Fundamentals of Mathematical Statistics”, Sultan & Chand & Sons, New Delhi, 11th Ed, 2002.
2. Hastie, Trevor, et al. “The elements of Statistical Learning”, Springer, 2009.
3. Ross, S.M., “Introduction to Probability and Statistics”, Academic Foundation, 2011.
4. Papoulis, A. and Pillai, S.U. , “Probability, Random Variables and Stochastic

Processes”, TMH, 2010.

5. G. Strang (2016). Introduction to Linear Algebra, Wellesley-Cambridge Press, Fifth edition, USA.
6. Bendat, J. S. and A. G. Piersol (2010). Random Data: Analysis and Measurement Procedures. 4th Edition. John Wiley & Sons, Inc., NY, USA:
7. Montgomery, D. C. and G. C. Runger (2011). Applied Statistics and Probability for Engineers. 5th Edition. John Wiley & Sons, Inc., NY, USA:
8. David G. Luenberger (1969). Optimization by Vector Space Methods, John Wiley & Sons (NY)
9. Cathy O’Neil and Rachel Schutt (2013). Doing Data Science, O’Reilly Media

MDS103 - PYTHON PROGRAMMING

Total Teaching Hours: 52

No. of Hours / Week: 04

Course Objectives:

CObj_ID	Course Objectives
CObj_1	Understand the concept of functions, list, dictionaries
CObj_2	Acquire skills to create object oriented programs in Python
CObj_3	Gain ability to access database and handle files from python programs

Course Outcomes:

CO_ID	Course Outcomes
CO_1	Gain knowledge of the concepts of list, dictionaries, tuples and sets
CO_2	Create and use functions, user defined modules functions and apply regular expressions in appropriate situations.

CO_3	Gain ability to perform file handling and database operations using Python.
CO_4	Become competent in using numpy and pandas and apply in project development
CO_5	Become proficient in object oriented programming using python

CO-PO Mapping

	PO_1	PO_2	PO_3	PO_4	PO_5
CO_1	*	*	*	*	*
CO_2	*	*	*	*	*
CO_3	*	*	*	*	*
CO_4	*	*	*	*	*
CO_5	*	*	*	*	*

Sl. No.	Unit/chapter title	Content	Number of hours	Skills developed
1	Unit- I	Introduction To Python Installation and Working with Python- Understanding Python variables- Python basic Operators- Understanding python blocks- Declaring and using Numeric data types: int, float, complex. Using string data type and string operations- Defining list and list slicing -Use of Tuple data type. Conditional blocks using if, else and elif -Simple for loops in python-For loop using ranges, string, list and dictionaries-Use of while loops in python-Loop manipulation using pass, continue, break.	[10 hours]	Research/ Analytical/ Employable Skills

2	Unit- II	Functions, Modules, list, dictionary, regular expressions Organizing python codes using functions-Organizing python projects into modules-Importing own module as well as external modules. Understanding string in built methods-List manipulation using in built methods-Dictionary manipulation -Programming using string, list and dictionary in built functions Regular expression: Powerful pattern matching and searching-Power of pattern searching using regex in python, Pattern finding programs using regular expression,	10 Hrs	Research/ Analytical/ Employable Skills
3	Unit- III	Object Oriented Programming Concept of class, object and instances-Constructor, class attributes and destructors-Inheritance, overlapping and overloading operators -Adding and retrieving dynamic attributes of classes Programming using OOps - exception handling -Safe guarding file operation using exception handling - Programming using Exception handling. Understanding threads- Forking threads -Synchronizing the threads-Programming using multithreading	10 Hrs	Research/ Analytical/ Employable Skills
4	Unit- IV	NumPy: Narray, numpy.matlib, numpy.linalg: Dot product of the two arrays, Dot product of the two vectors, Inner product of the two arrays, Matrix product of the two arrays, Computes the determinant of the array, Solves the linear matrix equation, Finds the multiplicative inverse of the matrix. Pandas: pandas series, dataframes, read csv, read JSON, clean data, explore data,	12 Hrs	Research/ Analytical/ Employable Skills

		correlation, plotting.		
5	Unit- V	Using files and Database Files: Types of Files, Creating and Reading Text Data, File Methods to Read and Write Data, Reading and Writing Binary Files, The Pickle Module, Reading and Writing CSV Files, Python os and os.path Modules. Using Databases in Python: Python MySQL Database Access -Install the MySQLdb and other Packages -Create Database Connection - CREATE, INSERT, READ, UPDATE and DELETE Operation- DML and DDL operation with Databases -Performing Transactions- Handling Database Errors.	10 Hrs	Research/ Analytical/ Employable Skills

References :

1. Ashok Namdev Kamthane, Amit Ashok Kamthane, “Programming And Problem Solving With Python”, 2nd Edition, Mc Graw Hill, 2020.
2. Gowrishankar S, Veena A, “Introduction to Python Programming”, 1st Edition, CRC Press/Taylor & Francis, 2018.
3. Charles R. Severance, “Python for Everybody: Exploring Data Using Python 3”, 1st Edition, CreateSpace Independent Publishing Platform, 2016. (http://do1.drchuck.com/pythonlearn/EN_us/pythonlearn.pdf)
4. Jake VanderPlas, “Python Data Science Handbook: Essential Tools for Working with Data”, 1st Edition, O'Reilly Media, 2016.

Web References:

1. <https://www.w3resource.com/python-exercises/>
2. <https://docs.python.org/3/tutorial/index.html>

MDS104 – BIG DATA ANALYTICS

Total Teaching Hours: 52

No. of Hours / Week: 04

Course Objectives

CObj_ID	Course Objectives
CObj_1	To provide an overview of fundamental concepts of big data and analytics
CObj_2	To gain knowledge of the tools required for working with big data like Hadoop, NoSql MongoDB
CObj_3	To gain ability to integrate large amounts of data

Course Outcomes

CO_ID	Course Outcomes
CO_1	Understand the fundamentals of various big data analytics techniques
CO_2	Work with big data analysis techniques and develop Big Data Solutions using Hadoop Eco System
CO_3	Acquire fundamental enabling techniques and scalable algorithms like Hadoop, Map Reduce and NO SQL in big data analytics
CO_4	Become competent to create databases using mongodb and apply appropriate operations in real world applications
CO_5	Become proficient to create projects using spark

CO-PO Mapping

	PO_1	PO_2	PO_3	PO_4	PO_5
CO_1	*		*	*	*
CO_2	*		*	*	*
CO_3	*	*	*	*	*
CO_4	*	*	*	*	*

CO_5	*	*	*	*	*

Sl. No.	Unit/chapter title	Content	Number of hours	Skills developed
1	Unit- I	Introduction to Big Data Introduction to Big Data, Evolution of Big data, Best Practices for Big data Analytics, Big data characteristics, Scalability and Parallel Processing, Designing Data Architecture, Data Sources, Quality, Pre-Processing and Storing, Data Storage and Analysis	10 Hrs	Cognitive/ Research/ Analytical Skills
2	Unit- II	Hadoop: Introduction, HDFS Concepts, Hadoop Distributed File System, MapReduce Framework and Programming Model, Composing MapReduce for Calculations and Algorithms Hadoop I/O: Compression, Serialization, Avro and File-Based Data structures	10 Hrs	Research/ Analytical/ Employable Skills
3	Unit- III	NoSQL Big Data Management Introduction, NoSQL Datastore, NoSQL Data Architecture Patterns, NoSQL to Manage Big Data, Shared Nothing Architecture for Big data Tasks,.	5 Hrs	Research/ Analytical/ Employable Skills
4	Unit- IV	MongoDB Database :MongoDB CRUD operation – Collections, MongoDB CRUD operations. Bulk write operations. MongoDB import and export. Embedded documents, Working with arrays, Array of embedded documents, Projection, Dealing with null and missing values, Working with limit() and skip(), Working with Node.js and MongoDB. Data modelling and aggregation : Data models, Data model relationship	15 Hrs	Research/ Analytical/ Employable Skills

		between documents, Modeling tree structures, Aggregation operations, SQL aggregation terms and corresponding MongoDB aggregation operations. Indexes : Indexes, Types of indexes, Index properties, The various indexing strategies to be considered. Replication and sharding, Multidocument translations, MongoDB security.		
5	Unit- V	Spark : Overview- Linking with Spark, Initializing Spark - Using the Shell. Resilient Distributed Datasets (RDDs) - Parallelized Collections, External Datasets, RDD Operations - Basics, Passing Functions to Spark, Understanding closures, Example, Local vs. cluster modes, Printing elements of an RDD, Working with Key-Value Pairs, Transformations, Actions, Shuffle operations - Background, Performance Impact. RDD Persistence - Which Storage Level to Choose?, Removing Data. Shared Variables- Broadcast Variables, Accumulators, Deploying to a Cluster.	12 Hrs	Research/ Analytical/ Employable Skills

References:

1. Raj Kamal and Preeti Saxena, Big Data Analytics Introduction to Hadoop, Spark, and Machine-Learning, McGraw Hill Education, 2018 ISBN: 9789353164966, 9353164966
2. Anand Rajaraman and Jeffrey David Ullman, "Mining of Massive Datasets", Cambridge University Press, 2012.
3. EMC Education Services, "Data Science and Big Data Analytics: Discovering, Analyzing, Visualizing and Presenting Data", Wiley publishers, 2015.
4. Bart Baesens, "Analytics in a Big Data World: The Essential Guide to Data Science and its Applications", Wiley Publishers, 2015.
5. David Loshin, "Big Data Analytics: From Strategic Planning to Enterprise Integration with Tools, Techniques, NoSQL, and Graph", Morgan Kaufmann/El sevier Publishers, 2013.
6. Dietmar Jannach and Markus Zanker, "Recommender Systems: An Introduction", Cambridge University Press, 2010.

7. Kim H. Pries and Robert Dunnigan, "Big Data Analytics: A Practical Guide for Managers " CRC Press, 2015.
8. Jimmy Lin and Chris Dyer, "Data-Intensive Text Processing with MapReduce", Synthesis Lectures on Human Language Technologies, Vol. 3, No. 1, Pages 1-177, Morgan Claypool publishers, 2010.
9. Matei Zaharia, Mosharaf Chowdhury, Tathagata Das, Ankur Dave, Justin Ma, MurphyMcCauley, Michael J. Franklin, Scott Shenker, Ion Stoica, Resilient Distributed Datasets: A Fault-Tolerant Abstraction for In-Memory Cluster Computing, NSDI 2012, April 2012.

MDS105: PYTHON PROGRAMMING LAB PRACTICALS

Total Teaching Hours: 60

No. of Hours per Week: 8

CObj	Course Objectives
CObj_1	To provide practical knowledge of the concept of functions, list, dictionaries
CObj_2	To instill skills to create object oriented programs in Python
CObj_3	To enable easy understanding of accessing database and handling files from python programs

CO	Course Outcomes
	After completion of this module, students should be able to:
CO1	Gain practical knowledge of the concepts of functions, list, dictionaries

CO2	Analyze the usage of Python libraries and apply them appropriately
CO3	Become competent in file handling using Python
CO4	Create Python programs to access databases
CO5	Create object oriented programs in Python

CO-PO Mapping

	PO_1	PO_2	PO_3	PO_4	PO_5
CO_1	*	*	*	*	*
CO_2	*	*	*	*	*
CO_3	*	*	*	*	*
CO_4	*	*	*	*	*
CO_5	*	*	*	*	*

List of Programs	Skills Developed
1. a) Write a program to demonstrate list and tuple in python. b) Write a program to demonstrate set and dictionary in python. 2. a) Write a Python function $\sin(x, n)$ to calculate the value of $\sin(x)$ using its Taylor series expansion up to n terms. Compare the values of $\sin(x)$ for different values of n with the correct value. b) Write a Python program to implement a stack and queue using a list data-structure.	Employable / Analytical/ Synthesis Skills

3. a) Write a Python function `cos(x, n)` to calculate the value of `cos(x)` using its Taylor series expansion up to `n` terms. Compare the values of `sin(x)` for different values of `n` with the correct value.
b) Write a program to count the numbers of characters in the string and store them in a dictionary data structure.
4. Write a Python program to:
 - a) sort a list of dictionaries using Lambda
 - b) filter even numbers from a list of integers using Lambda
 - c) sort a list of tuples using Lambda
 - d) to square every number in a given list of integers using Lambda
 - e) to cube every number in a given list of integers using Lambda
5. Write a Python program to:
 - a) remove everything except alphanumeric characters from a string
 - b) to find URLs in a string
 - c) to concatenate the consecutive numbers in a given string
 - d) to search for numbers (0-9) of length between 1 and 3 in a given string
 - e) to remove leading zeros from an IP address
6. Write a Python program to:
 - a) extract year, month and date from an URL
 - b) to replace all occurrences of a space, comma, or dot with a colon
 - c) to abbreviate 'Road' as 'Rd.' in a given string
 - d) find all three, four, and five character words in a string
 - e) extract values between quotation marks of a string
7. Write a Python program to download multiple files concurrently using threads.
8. Write a Python program to create a class representing a bank. Include methods for managing customer accounts and transactions.
9. Write a Python program to create a class representing a shopping cart. Include methods for adding and removing items, and calculating the total price.
10. Write a Python program to find the majority element from a given array of size `n` using the Collections module.

11. Write a Python program to merge more than one dictionary into a single dict using collections module. 12. Write a Python program to find the second lowest total marks of any student(s) from the given names and marks of each student using lists and lambda. Input number of students, names and grades of each student. 13. a) Write a Python program to copy odd lines of one file to another file in Python b) Write a program to remove all the lines that contain the character 'a' in a file and write it to another file. c) Write a Python program to generate QR code. 14. Write a Python program to create an Employee table, insert 5 tuples and delete a particular employee from the table. 15. Write a Python program to create a student table and find the min, max, sum, and average of the marks in a student marks table. 16. Write a Python program to create a customer table and find the total number of customers from each country in the table (customer ID, customer name, country) using group by. 17. a) Write a python program to plot the function $y = x^2$. b) Write a Python program to create Histogram in Python. 18. Demonstrate private, protected, public access specifiers for both data members and functions in a class.	

Scheme of evaluation:

CIA	30 Marks
Writing two programs	20 Marks
Execution	40 Marks
Viva-Voce	10 Marks
Total	100 Marks

MDS106 – BIG DATA ANALYTICS LAB

Total Teaching Hours: 60

No. of Hours per Week: 8

Course Objectives

CObj_ID	Course Objectives
CObj_1	To provide an overview of fundamental concepts of big data and analytics
CObj_2	To gain knowledge of the tools required for working with big data like Hadoop, NoSql MongoDB
CObj_3	To gain ability to integrate large amounts of data

Course Outcomes

CO_ID	Course Outcomes
CO_1	Solve Big Data problems using HADOOP
CO_2	Gain ability to use Spark
CO_3	Ability to Comprehend query processing using map-reduce
CO_4	Become competent in CRUD operations on MongoDB
CO_5	Acquire skills to handle big data projects

CO-PO Mapping

	PO_1	PO_2	PO_3	PO_4	PO_5
CO_1	*		*	*	*
CO_2	*		*	*	*

CO_3	*	*	*	*	*
CO_4	*	*	*	*	*
CO_5	*		*	*	*

List of Experiments

Part-A

1. Perform various HDFS commands
2. File Management commands in Hadoop
 - i. Create a directory in HDFS at given path(s).
 - ii. List the contents of a directory.
 - iii. Upload and download a file in HDFS.
 - iv. See contents of a file
 - v. Copy a file from source to destination
 - vi. Copy a file from/To Local file system to HDFS
 - vii. Move file from source to destination.
 - viii. Remove a file or directory in HDFS.
 - ix. Display last few lines of a file.
 - x. Display the aggregate length of a file.
3. Word Count Map Reduce program to understand Map Reduce Paradigm
4. Implementing Matrix Multiplication with Hadoop Map Reduce
5. Implement Map reduce in spark
6. Implement Page ranking using Spark
7. Implement CRUD operations in mongo db

Part-B

The students are supposed to develop a mini industry level application for the lab. The students can do the activity in a group (team) consisting of not more than 2 students.

Scheme of evaluation:

CIA	30 Marks
Writing one program	10 Marks
Execution	20 Marks
Mini project Demonstration	30 Marks
Viva-Voce	10 Marks
Total	100 Marks

MDS201 – ADVANCED ALGORITHMS

Total Teaching Hours: 52

No. of Hours / Week: 04

Course Objectives:

CObj_ID	Course Objectives
CObj_1	Analyze variety of algorithms with practical applications emphasizing optimal Solution of each algorithm
CObj_2	Identify most suitable algorithm for a given task in order to save time and cost Resources
CObj_3	To be aware of complex problems such as NP Hard and NP-complete problems

Course Outcome:

CO_ID	Course Outcomes
CO_1	Gain knowledge of various designing paradigms in formulating algorithm
CO_2	Understand approximation algorithms and implement in solving the problems
CO_3	Explore various string matching/pattern matching algorithm widely used in machine learning automation
CO_4	Gain exposure to parallel algorithms, parallel time and processors time complexity
CO_5	Acquire knowledge and implement probabilistic and randomized algorithms

CO-PO Mapping

	PO_1	PO_2	PO_3	PO_4	PO_5
CO_1	*		*	*	*
CO_2	*		*	*	*
CO_3	*	*	*	*	*
CO_4	*		*	*	*
CO_5	*		*	*	*

Sl. No.	Unit/chapter title	Content	Number of hours	Skills developed
1	Unit- I	Introduction: Algorithm Specification – Analysis of Insertion sort – Performance Analysis - Space complexity – Time Complexity – Asymptotic notations. Divide and Conquer – Binary search – Quick sort – Maxmin algorithm.	12 Hrs	Research/ Analytical/ Employable Skills

2	Unit- II	Greedy Approach - Knapsack problem – Minimum cost spanning tree – PRIM's and Kruskal's Algorithm – single source shortest path problem (Dijkstra's Algorithm). String Matching - Introduction to string-matching problem, Naïve algorithm, Rabin Karp, Knuth Morris Pratt, Boyer- Moore algorithms	10 Hrs	Research/ Analytical/ Employable Skills
3	Unit- III	Dynamic Programming – 0/1 Knapsack problem - All pairs shortest path – Travelling Salesperson problem – Multistage graph. Backtracking - The general method – 8 Queens problem Branch and Bound - Sum of subsets, Graph colouring.	10 Hrs	Research/ Analytical/ Employable Skills
4	Unit- IV	Approximation Algorithms Approximation algorithms for vertex cover, set cover, TSP, knapsack. Parallel Algorithms: Introduction, Models, speedup and efficiency, Some basic techniques, PRAM Algorithms – Computational model.	10 Hrs	Research/ Analytical/ Employable Skills
5	Unit- V	Theory of NP- Hard and NP-Complete Problems: P, NP and NP-Complete complexity classes; A few NP-Completeness proofs. Probabilistic Algorithms & Randomized Algorithms: Las Vegas and Monte Carlo algorithms, Game-theoretic techniques.	10 Hrs	Research/ Analytical/ Employable Skills

References:

1. T. H Cormen, C E Leiserson, R L Rivest and C Stein: "Introduction to Algorithms", 3rd Edition, Prentice-Hall of India, 2011.
2. Mark Allen Weiss, Data Structures and Algorithm analysis in C++, 3rd edition, PEA, 2011.
3. Ellis Horowitz, Sartaj Sahni, S.Rajasekharan: "Fundamentals of Computer Algorithms", 1st edition, University Press, 2012.

Total Teaching Hours: 52

No. of Hours / Week: 04

Course objectives:

CObj_ID	Course Objectives
CObj_1	To understand the concepts and techniques of Machine Learning
CObj_2	To gain knowledge of classification and regression models
CObj_3	To apply the various dimensionality reduction techniques

Course outcomes: Upon completion of the course, the students will be able to:

CO_ID	Course Outcomes
CO_1	Gain ability to comprehend supervised, unsupervised and reinforcement learning
CO_2	Acquire skills to apply the appropriate machine learning strategy for any given problem
CO_3	Modify existing machine learning algorithms to improve classification efficiency
CO_4	Create Ensemble models to improve performance of the classifier
CO_5	Competency to apply dimensionality reduction on high dimensional datasets

	PO_1	PO_2	PO_3	PO_4	PO_5
CO_1	*	*	*	*	*
CO_2	*	*	*	*	*
CO_3	*	*	*	*	*
CO_4	*	*	*	*	*
CO_5	*	*	*	*	*

Sl. No.	Unit/chapter title	Content	Number of hours	Skills developed
1	Unit- I	Foundations for ML Learning – Machine Learning-Types of Machine Learning – Supervised Learning –unsupervised learning-reinforcement learning-ML Technique overview: build model, Train, validate, Test,evaluate. - Cross-Validations -confusion matrix, Evaluation metrics: precision, recall, f1 score, accuracy, ROC, AUC, sensitivity, specificity, MSE, MAE.	10 Hrs	Research/ Analytical/ Employable Skills
2	Unit- II	Clustering Distance measures - Different clustering methods (Distance, Density, Hierarchical) - Iterative distance-based clustering; - Dealing with continuous, categorical values in K-Means - Constructing a hierarchical cluster - K-Medoids, k-Mode-density-based clustering - Measures of quality of clustering.	10 Hrs	Research/ Analytical/ Employable Skills
3	Unit- III	Classification and Regression Linear Regression, Logistic Regression, Classifiers: K-Nearest Neighbors - Naïve Bayes Classifier - Support Vector Machines - SVM for classification and regression problems, Decision Tree.	10 Hrs	Research/ Analytical/ Employable Skills
4	Unit- IV	Dimensionality Reduction Curse of dimensionality – Dimensionality Reduction- Techniques for Dimensionality Reduction: Feature Selection Methods: filter methods- chi square, correlation, wrapper method- RFE, Matrix Factorization- PCA, Manifold	12 Hrs	Research/ Analytical/ Employable Skills

		Learning- SOM, t-Distributed Stochastic Neighbor Embedding (t-SNE)- Genetic algorithm used in feature selection.		
5	Unit- V	Ensemble Learning and Reinforcement Learning Ensemble methods - Bagging - boosting -stacking- impact on bias and variance - Random forest - Gradient Boosting Machines - XGBoost. Reinforcement Learning – Analogy- process– Markov Decision Process- Q learning.	10 Hrs	Research/ Analytical/ Employable Skills

References:

1. Tom M. Mitchell, Machine Learning, India Edition 2013, McGraw Hill Education.
2. Trevor Hastie, Robert Tibshirani, Jerome Friedman, h The Elements of Statistical Learning, 2nd edition, springer series in statistics.
3. Ethem Alpaydin, “Introduction to Machine Learning 3e (Adaptive Computation and Machine Learning Series)”, Third Edition, MIT Press, 2014
4. Christopher M. Bishop Pattern Recognition and Machine Learning, Springer 2006.
5. Peter Flach, “Machine Learning: The Art and Science of Algorithms that Make Sense of Data”, First Edition, Cambridge University Press, 2012.
6. Stephen Marsland, “Machine Learning – An Algorithmic Perspective”, Second Edition, Chapman and Hall/CRC Machine Learning and Pattern Recognition Series, 2014.

MDS203 – CLOUD COMPUTING

Total Teaching Hours: 52

No. of Hours / Week: 04

Course Objectives:

CObj_ID	Course Objectives
CObj_1	To make students to be aware of various cloud computing models, strength and weakness of cloud
CObj_2	Enabling students to understand security, privacy and interoperability
CObj_3	To help and motivate students to undertake projects in cloud environment

Course Outcome:

CO_ID	Course Outcomes
CO_1	Analyze various cloud programming models and apply them to solve problems on the cloud
CO_2	Articulate the main concepts, key technologies, strengths, and limitations of cloud computing and the possible applications for state-of-the-art cloud computing
CO_3	Explain the core issues of cloud computing such as security, privacy, and interoperability
CO_4	Acquire knowledge of system, network and storage virtualization and outline their role in enabling the cloud computing system model
CO_5	Ability to comprehend Service Oriented Architecture[SOA] and its services in Business and IT in cloud environment

CO-PO Mapping

	PO_1	PO_2	PO_3	PO_4	PO_5
CO_1	*		*	*	*
CO_2	*		*	*	*
CO_3	*		*	*	*
CO_4	*		*	*	*
CO_5	*		*	*	*

Sl. No.	Unit/chapter title	Content	Number of hours	Skills developed
1	Unit- I	Introduction: Essentials, Benefits and need for Cloud Computing -Business and IT Perspective-Cloud and Virtualization -Cloud Services Requirements -Cloud and Dynamic Infrastructure - Cloud Computing Characteristics Cloud Adoption. Cloud Models: Cloud Characteristics - Measured Service -Cloud Models - Security in a Public Cloud Public versus Private Clouds.	10 Hrs	Research/ Analytical/ Employable Skills
2	Unit- II	Cloud Infrastructure Self Service - Cloud as a Service: Gamut of Cloud Solutions -Principal Technologies - Cloud Strategy Cloud Design and Implementation using SOA - Conceptual Cloud Model -Cloud Service Defined.	6 Hrs	Research/ Analytical/ Employable Skills
3	Unit- III	Cloud Solutions: Cloud Ecosystem - Cloud Business Process Management -Cloud Service Management -Cloud Stack -Computing on Demand (CoD) -Cloud sourcing. Cloud Offerings: Information Storage, Retrieval, Archive and Protection -Cloud Analytics Testing under Cloud - Information Security -Virtual Desktop Infrastructure -Storage Cloud. Cloud Management: Resiliency - Provisioning -Asset Management - Cloud Governance -High Availability and Disaster Recovery -Charging Models, Usage Reporting, Billing and Metering.	14 Hrs	Research/ Analytical/ Employable Skills

4	Unit- IV	Cloud Virtualization Technology: Virtualization Defined -Virtualization Benefits - ServerVirtualization - Virtualization for x86 Architecture - Hypervisor Management Software - Logical Partitioning (LPAR) -VIO Server -Virtual Infrastructure Requirements. Cloud Virtualization: Storage virtualization -Storage Area Networks -Network-Attachedstorage -Cloud Server Virtualization - Virtualized Data Center.	10 Hrs	Research/ Analytical/ Employable Skills
5	Unit- V	Cloud and SOA: SOA Journey to Infrastructure -SOA and Cloud -SOA Defined -SOA and IaaS - SOA-based Cloud Infrastructure Steps -SOA Business and IT Services. Cloud Infrastructure Benchmarking: OLTP Benchmark -Business Intelligence Benchmark -e-Business Benchmark - ISV Benchmarks -Cloud Performance Data Collection and Performance Monitoring Commands-Benchmark Tools.	12 Hrs	Research/ Analytical/ Employable Skills

References

1. Cloud Computing –Insight into New Era Infrastructure, Dr. Kumar Saurabh, Wiley India, 2011.
2. Cloud Computing, Roger Jennings, Wiley India, 2009.
3. Cloud Computing Explained, John Rhoton, Recursive Press,2009. 4.Cloud Computing Bible, Barry Sosinsky, Wiley, 2011.
4. Cloud Computing: Principles and Paradigms, Rajkumar Buyya, James Broberg, Wiley, 2011.
5. Cloud Computing for Dummies, Judith Hurwiz, Wiley Publishing, 2009.
6. The Cloud at yourservice, Rosenberg and Matheos, Manning Publications, 2010.

MDS204 - ADVANCED ALGORITHMS LAB

Total Teaching Hours: 60

No. of Hours per Week: 8

Course Objectives:

CObj _1	To research a specific algorithm with different set of values and to plot graph to understand its behavioral patterns with respect to input size n
CObj _2	To handle string matching problems using naïve Bayes classification and KMP problems in order to compare performance
CObj _3	To make the students to find out optimized solution in algorithms using research statistics

Course Outcome:

CO _1	Gain knowledge of different design techniques and their implementation.
CO _2	Understand algorithm efficiency computation and write effective algorithms
CO _3	Implement pattern matching algorithm
CO _4	Apply sorting algorithms to improve program performance
CO _5	Implement Parallel algorithm to improve efficiency

CO-PO Mapping

	PO_1	PO_2	PO_3	PO_4	PO_5
CO_1	*		*	*	*
CO_2	*		*	*	*
CO_3	*	*	*	*	*
CO_4	*		*	*	*
CO_5	*		*	*	*

List of Experiments

1. Write a Program to Implement recursive binary search and linear search and determine the time required to search an element. Repeat the experiment for different values of n, the number of elements in the list to be searched and plot a graph of the time taken versus n.
2. Write a Program to Sort a given set of elements using the Quicksort method and determine the time required to sort the elements. Repeat the experiment for different values of n, the number of elements in the list to be sorted and plot a graph of the time taken versus n. The elements can be read from a file or can be generated using the random number generator.
3. Write a Program to Sort a given set of elements using heap sort method and determine the time required to sort the elements. Repeat the experiment for different values of n, the number of elements in the list to be sorted and plot a graph of the time taken versus n.
4. Write a Program to Implement 0/1 Knapsack problem using Dynamic Programming.
5. Write a Program to find shortest paths from a given vertex in a weighted connected graph to other vertices using Dijkstra's algorithm.
6. Write a Program to solve the string pattern matching problem using Rabin Karp approach.

7. Write a Program to Find a subset of a given set $S = \{s_1, s_2, \dots, s_n\}$ of n positive integers whose sum is equal to a given positive integer d . For example, if $S = \{1, 2, 5, 6, 8\}$ and $d = 9$ there are two solutions $\{1, 2, 6\}$ and $\{1, 8\}$. A suitable message is to be displayed if the given problem instance doesn't have a solution.
8. Write a Program to solve the string matching problem using Boyer-Moore approach.
9. Write a Program to solve the string matching problem using naïve approach and the KMP algorithm.
10. Write a Program to Implement a parallelized Merge Sort algorithm to sort a given set of elements and determine the time required to sort the elements. Repeat the experiment for different values of n , the number of elements in the list to be sorted and plot a graph of the time taken versus n . The elements can be read from a file or can be generated using the random number generator.
11. Write a Program to Implement All-Pairs Shortest Paths Problem using Floyd's algorithm.
12. Write a program to implement a Monte Carlo algorithm.

Scheme of evaluation:

CIA	30 Marks
Writing two programs	20 Marks
Execution	40 Marks
Viva-Voce	10 Marks
Total	100 Marks

Course objectives:

CObj_ID	Course Objectives
CObj_1	To understand practically the concepts and techniques of Machine Learning
CObj_2	To gain practical knowledge of classification and regression models
CObj_3	To apply the various dimensionality reduction techniques and ensemble models in ML Projects

Course outcomes:

CO_ID	Course Outcomes
CO_1	Gain practical knowledge of fundamental concepts and methods of machine learning, statistical pattern recognition and its applications.
CO_2	Gain ability to analyze and evaluate algorithms for pattern classification
CO_3	Gain ability to comprehend simple models and Ensemble models
CO_4	Acquire skills to design ML algorithms for classification in Python and test them with benchmark data sets
CO_5	Become competent to develop ML projects

	PO_1	PO_2	PO_3	PO_4	PO_5
CO_1	*	*	*	*	*
CO_2	*	*	*	*	*
CO_3	*	*	*	*	*
CO_4	*	*	*	*	*
CO_5	*	*	*	*	*

List of Experiments

Part-A

1. Data Preprocessing Techniques
2. Feature Selection using GA
3. Dimensionality reduction using PCA
4. Regression Analysis using Linear regression
5. Regression Analysis using Logistic Regression
6. Classification using Decision tree
7. Classification using SVM
8. Classification Techniques- Naïve Bayes, KNN
9. Clustering using K- Means clustering
10. Ensemble method- Bagging
11. Ensemble method- Boosting
12. Ensemble method- Stacking

Part-B

Mini Project

The students are supposed to develop a mini application for the lab. The students can do the activity in a group (team) consisting of not more than 2 students

Scheme of evaluation:

CIA	30 Marks
Writing one program	10 Marks
Execution	20 Marks
Mini project Demonstration	30 Marks
Viva-Voce	10 Marks

Total	100 Marks

MDS206 – Non Core: PROFESSIONAL ETHICS AND CORPORATE GOVERNANCE

Total Teaching Hours: 30

No. of Hours per Week: 2

CObj	Course Objectives
CObj_1	To instill Moral, Social Values and Loyalty in a professional environment
CObj_2	To create an awareness on Professional Ethics, Human Values and the impact of unethical practices
CObj_3	To understand organizational culture and to adapt to changing cultures without compromising ethical values

CO	Course Outcomes After completion of this module, students should be able to:
CO1	Recognize the significance of human values and practice the same
CO2	Understand and control the excessive desires of the mind
CO3	Interpret and apply professional code of ethics in real world
CO4	Assess the benefits of restraining from unethical practices while designing software solutions to problems
CO5	Critically examine ethical dilemmas and to understand the importance of governance mechanisms in a globalized economy

CO-PO Mapping

	PO_1	PO_2	PO_3	PO_4	PO_5
CO_1	*	*	*	*	*
CO_2			*		*
CO_3	*	*	*	*	*
CO_4	*	*	*	*	*
CO_5					*

Course Content

Sl. No.	Unit/chapter title	Content	Number of hours	Skills Developed
1	Unit- I	Introduction To Terminology In Ethics : Ethics: Integrity, Honesty, Courage, Empathy, Personality, Character, Self-Confidence, Respect for Others – Work culture, Social responsibility, Responsibilities as a citizen, Cooperation and commitment Religion vs. Spirituality, Philosophy, Customs and practices– Self-interest, Fear, Deception, Ignorance, Ego, Uncritical acceptance of authority. Mind And Its Mysteries Control of Senses and Mind – Concentration, Meditation and Enlightenment	6 Hrs	Ethical Skills

2	Unit- II	Ethics for IT Professionals and IT Users Professional Codes Of Ethics for IT Professionals, IT Professional Malpractice, IT Users-Common Ethical Issues for IT Users, Supporting the Ethical Practices of IT Users.IT Professional Malpractice-Common Ethical Issues for IT Users, Supporting the Ethical Practice of IT Users. Global Issues: Globalization, Multinational Corporations, Environmental Ethics, Computer Ethics.	6 Hrs	Professionalism
3	Unit- III	Non-Ethical Practices In Vogue Conflict of Interest, Occupational crime – How multinational corporations influence government decisions, public policy – Data Scientists as advisors and experts, Data Scientists as moral leaders – Problem of bribery, extortion, grease payments, nepotism – Nexus between politicians and industrialists.	6 Hrs	Ethical Skills, Professionalism
4	Unit- IV	Ethics in Data Science Data Collection, Representation and Privacy: Data Sampling and Collection, Managing Datasets Responsibility and Data Cannibalism – Flaws in the premise of data science –Machine Bias: How can a machine be biased? - Bias vs Correlation vs Causation - What is fair? - What is discrimination? - Fairness in Deep Learning – Accountability - Who is responsible when a machine takes a decision? - Doing ethical data analysis	6 Hrs	Ethical Skills, Professionalism
4	Unit- V	Corporate Governance Corporate formation-Steps in formation. Corporate management-Types of corporate management models. Basic Corporate Governance-Definition-How it works, Benefits of corporate governance. Board of Directors, Principles, Models.	6 Hrs	Cognitive Skills

Reference Books:

1. Subramanian, R. (2013). Professional ethics. OUP India.
2. Sivananda, S. (1986). Mind: Its mysteries and control. Divine Life Society.
3. Loukides, M., Mason, H., & Patil, D. (2018). Ethics and data science. O'Reilly Media.
4. Gaur, R., Sangal, R., & Bagaria, G. (2010). A foundation course in human values and professional ethics: Presenting a universal approach to value education - Through self-exploration.
5. Reynolds, G. W. (2007). Ethics in information technology. Course Technology.
6. Naagarazan, R. (2007). A textbook on professional ethics and human values. New Age International.

MDS301 – DEEP LEARNING

Total Teaching Hours: 52

No. of Hours / Week: 04

Course Objectives:

CObj_ID	Course Objectives
CObj_1	To understand and gain knowledge of Deep learning techniques.
CObj_2	To create Deep Learning Applications.
CObj_3	To learn and design RNN applications.

Course Outcomes:

CO_ID	Course Outcomes
CO_1	Gain knowledge of Deep learning techniques.
CO_2	Familiarize with TensorFlow/Keras in Deep Learning Applications.
CO_3	Design and implement RNN applications.
CO_4	Gain knowledge of optimization in Deep Learning.
CO_5	Design and implement Convolutional Neural Networks.

	PO_1	PO_2	PO_3	PO_4	PO_5
CO_1	*	*	*	*	*

CO_2	*	*	*	*	*
CO_3	*	*	*	*	*
CO_4	*	*	*	*	*
CO_5	*	*	*	*	*

Sl. No.	Unit/chapter title	Content	Number of hours	Skills developed
1	Unit- I	Basics Of Neural Networks And Deep Learning Basic concept of ANN – Perceptron and activation function – Feed Forward Neural Networks – Gradient Descent – Back Propagation Algorithm – Vanishing and exploding Gradient problem. What is Deep learning- – ReLU Heuristics for Avoiding Bad Local Minima – Heuristics for Faster Training – Nestors Accelerated Gradient Descent – Regularization – Dropout.	10 Hrs	Research/ Analytical/ Employable Skills
2	Unit- II	Convolutional Neural Networks CNN Architectures – Convolution – Pooling Layers – Transfer Learning – Image Classification using Transfer Learning	10 Hrs	Research/ Analytical/ Employable Skills

3	Unit- III	Optimization And Generalization Optimization in deep learning– Non-convex optimization for deep networks- Stochastic Optimization -Generalization in neural networks- Spatial Transformer Networks- Recurrent networks, LSTM - Recurrent Neural Network Language Models- Word-Level RNNs , F-RNN, Deep Reinforcement Learning - Computational & Artificial Neuroscience	10 Hrs	Research/ Analytical/ Employable Skills
4	Unit- IV	Other Deep Learning Architectures Encoder/Decoder Architectures – Autoencoders – Standard- Sparse – Denoising – Contractive- Variational Autoencoders – Adversarial Generative Networks – Autoencoder, Deep Belief Networks.	12 Hrs	Research/ Analytical/ Employable Skills
5	Unit- V	Applications Of Deep Learning Imagenet- Detection-Audio WaveNet- Natural Language Processing Word2Vec - Joint Detection - Face Recognition- Scene Understanding- Gathering Image Captions	10 Hrs	Cognitive/ Research/ Analytical / Employable Skills

References:

1. Ian Good Fellow, Yoshua Bengio, Aaron Courville, “Deep Learning”, MIT Press, 2017.
2. Francois Chollet, “Deep Learning with Python”, Manning Publications, 2018.
3. Phil Kim, “Matlab Deep Learning: With Machine Learning, Neural Networks and Artificial Intelligence”, Apress , 2017.
4. Ragav Venkatesan, Baoxin Li, “Convolutional Neural Networks in Visual Computing”, CRC Press, 2018.
5. Navin Kumar Manaswi, “Deep Learning with Applications Using Python”, Apress, 2018.
6. Joshua F. Wiley, “R Deep Learning Essentials”, Packt Publications, 2016.

MDS302 – RESEARCH METHODOLOGY

Total Teaching Hours: 52

No. of Hours / Week: 04

Course Objectives:

CObj_ID	Course Objectives
CObj_1	To motivate students to do research in computer science by understanding research process and methodologies
CObj_2	To prepare students to writing articles with originality in content
CObj_3	To provide an awareness on IPR and copyrights

Course Outcomes:

CO_ID	Course Outcomes
CO_1	Explore research types, objectives and techniques of defining research problem
CO_2	Gain Good knowledge of types of reasoning, hypothesis and research designs
CO_3	Gain awareness of IPR and ethics to be practiced in research
CO_4	Implement report writing in order to publish a research/review paper
CO_5	Become competent in scientific writing

CO-PO Mapping

	PO_1	PO_2	PO_3	PO_4	PO_5
CO_1	*			*	*
CO_2	*			*	*
CO_3	*			*	*
CO_4	*				*
CO_5				*	*

Sl. No.	Unit/chapter title	Content	Number of hours	Skills developed
1	Unit- I	Science and Research Definition – History – Evolution of Scientific Inquiry, Scientific Research: Definition, Characteristics, types of research, need of research. Identification of the problem, assessing the status of the problem, formulating the objectives, preparing design (experimental or otherwise), Actual investigation.	10 Hrs	Cognitive/ Research/
2	Unit- II	Introduction to Research Methodology Meaning and importance of Research – Types of Research – Selection and techniques in formulation of Research Problem. Research Design – Need – Features. Developing a Research Plan – Exploration, Descriptive, Diagnostic, Experimental, Determining Experimental and Sample Designs. Analysis of Literature Review – Primary and Secondary Sources, Web sources – critical Literature Review. Hypothesis – Different Types – Significance – Development of Working Hypothesis, Null hypothesis. Research Methods: Scientific method vs Arbitrary Method, Logical Scientific Methods: Deductive, Inductive, Deductive-Inductive, pattern of Deductive –	10 Hrs	Cognitive/ Research/Analytical skill

		Inductive logical process – Different types of inductive logical methods.		
3	Unit- III	Data Collection and Analysis Sources of Data – Primary, Secondary and Tertiary – Types of Data – Categorical, nominal & Ordinal. Methods of Collecting Data: Observation, field investigations, Direct studies Reports, Records or Experimental observations. Sampling methods – Data Processing and Analysis strategies- Graphical representation – Descriptive Analysis – Inferential Analysis- Correlation analysis. Least square method - Data Analysis using statistical package – Hypothesis testing – Generalization and Interpretation – Modeling.	10 Hrs	Cognitive/ Research/Analytical skill
4	Unit- IV	Scientific Writing Structure and components of Scientific Reports – types of Report – Technical Reports and Thesis – Significance – Different steps in the preparation – Layout, structure and Language of typical reports - Illustrations and tables – Bibliography, Referencing and foot notes –Importance of Effective Communication. Preparing Research papers for journals, Seminars and Conferences – Design of paper using TEMPLATE, Calculations of Impact factor of a journal, citation Index, ISBN & ISSN. Preparation of Project	12 Hrs	Cognitive/ Research/Analytical skill

		Proposal - Title, Abstract, Introduction – Rationale, Objectives, Methodology – Time frame and work plan – Budget and Justification – References. Documentation and scientific writing Results and Conclusions, Preparation of manuscript for Publication of Research paper, Presenting a paper in scientific seminar, Thesis writing, Structure and Components of Research Report, Types of Report: research papers, thesis, Research Project Reports, Pictures and Graphs, citation styles, writing a review of paper, Bibliography.		
5	Unit- V	Ethics Ethical Issues – APA ethics code- Ethical Committees – Commercialization – copy right – royalty – Intellectual Property rights and patent law – Track Related aspects of intellectual property Rights – Reproduction of published material – Plagiarism – Citation and Acknowledgement – Reproducibility and accountability	10 Hrs	Cognitive/ Research/Analytical skill

References:

1. Kothari, C.R. (2008). Research Methodology: Methods and Techniques. Second Edition. New Age International Publishers, New Delhi.
2. Sinha, S.C. and Dhiman, A.K. (2002). Research Methodology, Ess Publications.
3. Gupta S.P. (2008). Statistical Methods. 37th ed. (Rev) Sultan Chand and Sons. New Delhi. 1470 p.
4. Garg.B.L., Karadia, R., Agarwal,F. and Agarwal, U.K., (2002). An introduction to research Methodology, RBSA Publishers.
5. Wadehra, B.L. (2000). Law relating to patents, trademarks, copyright designs and geographical indications. Universal Law Publishing.
6. Research Methodology Dr P M Bulakh, Dr P. S. Patki and Dr A S Chodhary. (2010).

MDSE31 - WEB SCRAPING

Total Teaching Hours: 52

No. of Hours / Week: 04

Course Objectives:

CObj_ID	Course Objectives
CObj_1	To understand the concept of web scraping using Python
CObj_2	Gain knowledge on data extraction and processing
CObj_3	Gain ability to handle data with NLTK

Course Outcomes:

Upon completion of this course, students will be able to :

CO_ID	Course Outcomes
CO_1	To comprehend the concept of web scraping using Python
CO_2	Gain Knowledge of the legalities of Web scraping
CO_3	Acquire skills on data extraction from web pages and processing the data
CO_4	Acquire skills to process CAPTCHA using python
CO_5	Gain ability to scrape dynamic websites

	PO_1	PO_2	PO_3	PO_4	PO_5
CO_1	*	*	*		*

CO_2	*	*	*	*	*
CO_3	*	*	*	*	*
CO_4	*	*	*	*	*
CO_5	*	*	*	*	*

Sl. No.	Unit/chapter title	Content	Number of hours	Skills developed
1	Unit- I	Introduction – What is web scraping, origin of web scraping, web crawling vs web scraping, uses of web scraping, components of a web scraper. Python Modules for Web Scraping - Python Development Environments using virtualenv, requests, Urllib3, Selenium, Scrapy.	10 Hrs	Cognitive/ Research/ Analytical Skills
2	Unit- II	Legality of Web Scraping – Introduction, research required prior to scraping. Data Extraction – web page analysis, viewing page source, Inspecting Page Source by Clicking Inspect Element Option. Different Ways to Extract Data from Web Page, Regular Expression. Beautiful soup,	10 Hrs	Research/ Analytical/ Employable Skills

		Lxml		
3	Unit- III	Data Processing – introduction, CSV and JSON data processing, Data processing using AWS S3, Data processing using MySQL, Data processing using PostgreSQL. Processing Images and Videos – Introduction, getting media content from web page, extracting file name from URL, information about type of content from URL, generating thumbnail for images, screenshot from website, thumbnail generation for video, ripping an MP4 video to MP3	10 Hrs	Research/ Analytical/ Employable Skills
4	Unit- IV	Dealing with Text – Introduction, getting started with NLTK, stemming, Lemmatization, Chunking, Bag of Word (BoW) Model Extracting and converting the Text into Numeric Form, Building a Bag of Words Model in NLTK, Topic Modeling: Identifying Patterns in Text Data, Topic Modeling Algorithms. Scraping Dynamic Websites – Introduction, dynamic website example, approaches for Scraping data from Dynamic Websites, Rendering JavaScript	10 Hrs	Research/ Analytical/ Employable Skills
5	Unit- V	Scraping Form based Websites - Introduction, Interacting with Login forms, Loading Cookies from the Web Server, Automating forms with Python. Processing CAPTCHA - What is CAPTCHA? Loading CAPTCHA with Python, Pillow Python Package, OCR: Extracting Text from Image using Python. Testing with Scrapers - Introduction, Testing using Python, Unit test – Python Module, Testing with Selenium, Comparison: unittest or	12 Hrs	Research/ Analytical/ Employable Skills

		Selenium.		

References:

1. Web Scraping with Python: Successfully scrape data from any website with the power of Python (Community Experience Distilled) Paperback – October 28, 2015 by Richard Lawson.
2. Web Scraping with Python: Collecting More Data from the Modern Web Paperback – April 24, 2018 by Ryan Mitchell.
3. Python Web Scraping Cookbook: Over 90 proven recipes to get you scraping with Python, micro services, Docker and AWS Paperback – February 9, 2018 by Michael Heydt
1. <https://www.datacamp.com/community/tutorials/web-scraping-using-python>

MDSE32 - NATURAL LANGUAGE PROCESSING

Total Teaching Hours: 52

No. of Hours / Week: 04

Course objectives:

CObj_ID	Course Objectives
CObj_1	To learn about NLP techniques and key issues
CObj_2	To gain knowledge about the data structures and algorithms used in NLP
CObj_3	To understand how key concepts from NLP and linguistics are used to describe and analyze language

Course Outcomes:

Upon completion of the course, students will be able to

CO_ID	Course Outcomes
CO_1	Gain good understanding of the NLP techniques and NL interfaces
CO_2	Gain ability to analyze data stored in standard formats.
CO_3	Acquire skills to understand the methods and algorithms used to process different types of textual data
CO_4	Gain ability to understand semantics and pragmatics of English language for processing
CO_5	Demonstrate the Extraction of information from text and classification of text

CO-PO Mapping

	PO_1	PO_2	PO_3	PO_4	PO_5
CO_1	*	*		*	*
CO_2	*	*	*	*	*
CO_3	*	*		*	*
CO_4	*	*			*
CO_5	*	*	*	*	*

Sl. No.	Unit/chapter title	Content	Number of hours	Skills developed
1	Unit- I	Introduction Application of NLP techniques and key issues- MT grammar checkers- dictation–document generation- NL interfaces- Natural language processing key issues- the different analysis level used for NLP: morpho-lexical-syntactic-semantic-pragmatic-markup(TEI, UNICODE)-finite state automata- Recursive and augmented transition networks- open problems.	10 Hrs	Cognitive/ Research/ Analytical Skills
2	Unit- II	Processing Raw Text Accessing Text from the Web and from Disk – Strings - Text Processing with Unicode - Regular Expressions for Detecting Word Patterns - Useful Applications of Regular Expressions - Normalizing Text - Regular Expressions for Tokenizing Text – Segmentation – Formatting. Writing Structured Programs – Sequences - Questions	12 Hrs	Research/ Analytical/ Employable Skills

		of Style – Functions - Doing More with Functions - Program Development - Algorithm Design - A Sample of Python Libraries.		
3	Unit- III	Categorizing and Tagging Words Using a Tagger - Tagged Corpora - Mapping Words to Properties Using Python Dictionaries - Automatic Tagging - N-Gram Tagging - Transformation-Based Tagging - How to Determine the Category of a Word. Learning to Classify Text: Supervised Classification – Evaluation - Decision Trees - Naive Bayes Classifiers - Maximum Entropy Classifiers - Modeling Linguistic Patterns	10 Hrs	Research/ Analytical/ Employable Skills
4	Unit- IV	Extracting Information from Text Information Extraction – Chunking - Developing and Evaluating Chunkers - Recursion in Linguistic Structure - Named Entity Recognition - Relation Extraction. Analyzing Sentence Structure: Some Grammatical Dilemmas - Context-Free Grammar - Parsing with Context- Free Grammar - Dependencies and Dependency Grammar - Grammar Development.	10 Hrs	Research/ Analytical/ Employable Skills
5	Unit- V	Building Feature-Based Grammars: Grammatical Features - Processing Feature Structures - Extending a Feature-Based Grammar. Analyzing the Meaning of Sentences: Natural Language Understanding - Propositional Logic - First-Order Logic - The Semantics of English Sentences - Discourse Semantics.	10 Hrs	Research/ Analytical/ Employable Skills

References:

1. Daniel J and James H. Martin, speech and language processing , an introduction to natural language processing, computational linguistics & speech recognition, prentice hall,2009.
2. Steven Bird, Ewan Klein, and Edward Loper, “Natural Language Processing with Python”, O’Reilly,2009.
3. Nitin Indurkha, Fred J. Damerau, “Handbook of Natural Language Processing”, CRC Press, 2010.
4. Dwight Gunning, Sohom Ghosh, Natural Language Processing Fundamentals, Packt Publishers, 2019.
5. Brian McMahan and Delip Rao, “Natural Language Processing with PyTorch: Build Intelligent
6. Language Applications Using Deep Learning”, O’Reilly, First edition, 2019.
7. Hobson Lane, Hannes Hapke, and Cole Howard, “Natural Language Processing in Action:
8. Understanding, analyzing, and generating text with Python”, Manning Publications, First edition, 2019.
9. Adarsha Shivananda and Akshay Kulkarni, “Natural Language Processing Recipes: Unlocking Text
10. Data with Machine Learning and Deep Learning Using Python”, APress, 2019.

MDSE33 – FORECASTING AND OPTIMIZATION

Total Teaching Hours: 52

No. of Hours / Week: 04

Course Objectives:

CObj_ID	Course Objectives
CObj_1	To provide a comprehensive introduction of the forecasting methods
CObj_2	To study the various regression models and perform forecasting
CObj_3	To understand the autoregressive models and its variants for forecasting
CObj_4	To get an overview of various numerical methods of optimization
CObj_5	To get an insight into advanced optimization techniques.

Course Outcomes:

Upon completion of this course, the student will be able to:

CO_ID	Course Outcomes
CO_1	Identify and understand the types of forecasting techniques
CO_2	Implement time series modeling and forecasting
CO_3	Measure and evaluate the performance of forecasting models
CO_4	Implement regression analysis using different regression models
CO_5	Deliberate the concept of advanced optimization techniques using soft computing techniques and apply them to various problems.

CO-PO Mapping

	PO_1	PO_2	PO_3	PO_4	PO_5
CO_1	*	*		*	*
CO_2	*	*	*	*	*
CO_3	*	*	*	*	*
CO_4	*	*		*	*
CO_5	*	*	*	*	*

Sl. No.	Unit/chapter title	Content	Number of hours	Skills developed
1	Unit- I	Introduction To Forecasting: The Nature and Uses of Forecasts- The Forecasting Process- Resources for Forecasting- Types of Forecasting Techniques - Graphical Displays-Time Series Plots- Plotting Smoothed Data- Numerical Description of Time Series Data- Stationary Time Series- Auto covariance and Autocorrelation Functions- Use of Data Transformations and Adjustments- Transformations- Trend and Seasonal Adjustments- General Approach to Time Series Modeling and Forecasting- Evaluating and Monitoring Forecasting Model Performance- Forecasting Model Evaluation- Choosing Between	10 Hrs	Cognitive/ Research/ Analytical Skills

		Competing Models- Monitoring a Forecasting Model		
2	Unit- II	Autoregressive Integrated Moving Average (Arima) And Other Models First Order Exponential Smoothing- Second Order Exponential Smoothing- Higher Order Exponential Smoothing- Exponential Smoothing for Seasonal Data- Linear Models for Stationary Time Series Finite Order Moving Average (MA) Processes- Finite Order Autoregressive Processes- Mixed Autoregressive-Moving Average Processes- Nonstationary Processes- Time Series Model Building Forecasting ARIMA Processes- Seasonal Processes- Exponential Smoothers and ARIMA Models Multivariate Stationary Process- Vector ARIMA Models- Vector AR (VAR) Models- Direct Forecasting of Percentiles-Neural Networks and Forecasting	12 Hrs	Research/ Analytical/ Employable Skills
3	Unit- III	Linear Programming Introduction and formulation of Linear Programming problems, Graphical solution method, Simplex Algorithm, Duality in linear programming. Nonlinear Programming - Sample Applications, Graphical Illustration of Nonlinear Programming Problems	10 Hrs	Research/ Analytical/ Employable Skills
4	Unit- IV	Sequencing Introduction, processing N jobs through two/three/M machines; Game Theory: Two person zero-sum game, Game with mixed strategies, Graphical method and solution by	10 Hrs	Research/ Analytical/ Employable Skills

		linear programming.		
5	Unit- V	Modern Methods Of Optimization – Metaheuristic Techniques Genetic Algorithms, Simulated Annealing, Particle Swarm Optimization, Ant Colony Optimization. Simulation - Introduction & steps of simulation method, distribution functions and random number generation.	10 Hrs	Research/ Analytical/ Employable Skills

References:

1. Spyros Makridakis and Steven C. Wheelwright, "Forecasting: Methods and Applications". Wiley 1997.
1. A. Hamdy Taha "Operations research: An introduction". Pearson Education India, 2017.
2. Hillier and Lieberman "Introduction to Operations Research", TMH
3. S. S. Rao. Engineering optimization: theory and practice. John Wiley & Sons, 2009.
4. J K Sharma, Operations Research Theory and Applications, MacMillan India Ltd.
5. An introduction to Optimization by Edwin P K Chong, Stainslaw Zak
6. C. B. Gupta, "Optimization Techniques in Operation Research".I.K. International Publishing House, Pvt Ltd., 2nd Edition, 2012.
7. George Athanasopoulos and Rob J. Hyndman, "Forecasting: Principles and Practice".O texts, WWW. otexts.org
8. L. R. Foulds, "Optimization Techniques: An Introduction". Springer-Verlag New York, 1981
5. Ronald L. Rardin, "Optimization in operations research". Prentice Hall, 1998
- 6.

MDSOPE- OPEN ELECTIVE

Total Teaching Hours: 30

No. of Hours / Week: 02

Open elective course is chosen from the list of courses offered by the Institution for all PG courses.

MDS303 – DEEP LEARNING LAB

Course Objectives:

CObj_ID	Course Objectives
CObj_1	To understand and gain practical knowledge of Deep learning techniques
CObj_2	To create Deep Learning Applications
CObj_3	To design RNN applications

Course Outcomes:

CO_ID	Course Outcomes
CO_1	On completion of the course, the students will be able to:
CO_2	Gain practical knowledge of Deep learning techniques.
CO_3	Familiarize with TensorFlow/Keras in Deep Learning Applications
CO_4	Design and implement RNN applications
CO_5	Gain knowledge of optimization in Deep Learning.
CO_6	Design and implement Convolutional Neural Networks

	PO_1	PO_2	PO_3	PO_4	PO_5
CO_1	*	*	*	*	*
CO_2	*	*	*	*	*

CO_3	*	*	*	*	*
CO_4	*	*	*	*	*
CO_5	*	*	*	*	*

Part-A

1. Implement vector addition in TensorFlow.
2. Implement regression model in Keras.
3. Implement a perceptron in TensorFlow/Keras Environment.
4. Implement a Feed-Forward Network in TensorFlow/Keras.
5. Implement an Image Classifier using CNN in TensorFlow/Keras.
6. Implement a Transfer Learning concept in Image Classification.
7. Implement an Autoencoder in TensorFlow/Keras.
8. Implement a Simple LSTM using TensorFlow/Keras.
9. Implement an Opinion Mining in Recurrent Neural network.
10. Implement an Object Detection using CNN.

Part-B

Mini Project

The students are supposed to develop a mini industry level application for the lab. The students can do the activity in a group (team) consisting of not more than 2 students.

Scheme of evaluation:

CIA	30 Marks

Writing one program	10 Marks
Execution	20 Marks
Mini project Demonstration	30 Marks
Viva-Voce	10 Marks
Total	100 Marks

MDS304 – INTERNSHIP

Students will have to take up summer internship at the end of Second semester. The report of the same is to be submitted in the third semester. The Internship will be evaluated through a practical examination at the end of the third semester.

Scheme of evaluation:

CIA	30 Marks
Demonstration and presentation	40 Marks
Validation	10 Marks
Viva-Voce	10 Marks
Report	10 Marks
Total	100 Marks

MDS401 - DATA STORYTELLING

Total Teaching Hours: 52

No. of Hours / Week: 04

Course Objectives

CObj_ID	Course Objectives
CObj_1	To focus on how to tell stories with data to create social change with tools and technologies
CObj_2	To introduce basic methods for research, cleaning and analyzing datasets, but the focus is on creative methods and media for data presentation and storytelling
CObj_3	To consider the emotional, aesthetic and practical effects of different presentation methods as well as how to develop metrics for assessing impact

Course Outcomes:

CO_ID	Course Outcomes
CO_1	CO1: Learn techniques for finding a story in data, building a basic set of tool-assisted data analysis skills.

CO_2	CO2: Think like a designer
CO_3	CO3: Build things that tell data-driven stories with a rich set of digital and non-digital tools, online and offline.
CO_4	CO4: Learn to connect data stories to meaningful, situated social action.
CO_5	CO5: Understand basic techniques for measuring the impact of data-driven storytelling.

	PO_1	PO_2	PO_3	PO_4	PO_5
CO_1	*	*	*	*	*
CO_2	*	*	*	*	*
CO_3	*	*	*	*	*
CO_4	*	*	*	*	*
CO_5	*	*	*	*	*

Sl. No.	Unit/chapter title	Content	Number of hours	Skills developed
1	Unit- I	Understand the context : Get to know your audience, Narrow your audience, Complete big idea worksheet, Refine and reframe, Critique the big idea. Choose an effective visual : Improve the table, Lets draw, Practice your tool, How should you show this data, Visualize the weather	12 Hrs	Cognitive/ Research/ Analytical Skills

2	Unit- II	Identify and eliminate cluster : Gestalt principles in play, Tying words to graph, Harness alignment and whitespace, De-clutter. Focus Attention: Where are your eyes drawn, Direct attention, Visualize all data, Direct attention many ways, Practice differentiating in your tool.	12 Hrs	Research/ Analytical/ Employable Skills
3	Unit- III	Think like a designer: Use words wisely, Do better, Pay attention to detail, Examine and emulate, Make minor changes for major impact.	8 Hrs	Analytical/ Employable Skills
4	Unit- IV	Tell a story: Use takeaway titles, Put it into words, Identify tension, Utilize components of story. Practice more with cole: New advertiser revenue, Sales channel update, Back to school shopping, Diabetes rates.	12 Hrs	Analytical/ Employable Skills
5	Unit- V	Practice more at work : Create your plan of attack, Set good goals, Cultivate a feedback culture, Refer to SWD process, Make use of assessment rubrics, set yourself for successful data story.	8Hrs	Analytical/ Employable Skills

References:

1. Effective Data Storytelling: How to Drive Change with Data, Narrative and Visuals Hardcover – 23 January 2020 by Brent Dykes.
2. Wickham, H. "Tidy Data." (PDF) Journal of Statistical Software 59 no. 10 (August 2014).

3. Leskovec, J., A. Rajaraman and J. D. Ullman. "Data Mining." (PDF) Chapter 1 (author's manuscript version) in Mining of Massive Datasets. Cambridge University Press, 2011.
4. Zer-Aviv, M. "Disinformation Visualization: How to lie with datavis." Visualizing Information for Advocacy (blog), January 31, 2014.
5. Edward R. Tufte. "Graphical Excellence." Chapter 1 in The Visual Display of Quantitative Information. 2nd edition. Graphics Press, 2001. ISBN: 9781930824133. pp 13-52
6. Ware, C. "Visual and Verbal Narrative." Chapter 7 in Visual Thinking for Design. Morgan Kaufmann, 2008. ISBN: 9780123708960. [Preview with Google Books]
7. Blair, J. A. "The Rhetoric of Visual Arguments." Chapter 2 in Defining Visual Rhetorics. Lawrence Erlbaum, 2014. ISBN: 9780805844023. pp. 41-61.

MDS402 - JULIA PROGRAMMING LAB

No. of Hours / Week: 08

Course Objectives:

CObj_ID	Course Objectives
CObj_1	○ To understand and gain practical knowledge of Julia Programming
CObj_2	○ To solve math problems using Julia Programming
CObj_3	○ To understand recipes and implement them

Course Outcomes:

CO_ID	Course Outcomes
CO_1	Gain practical knowledge of Julia Programming
CO_2	Familiarize with Clustering.jl
CO_3	Implement dimensionality reduction in Julia

CO_4	Gain knowledge of animation of plots.
CO_5	Familiarize with recipes

	PO_1	PO_2	PO_3	PO_4	PO_5
CO_1	*	*	*	*	*
CO_2	*	*	*	*	*
CO_3	*	*	*	*	*
CO_4	*	*	*	*	*
CO_5	*	*	*	*	*

1. Write a Julia program to solve the ForwardDiff Problems using linear algebra
2. Write a Julia program to solve the Lorenz Problem
3. Write a Julia program to solve the Ball Bounce Problem
4. Write a Julia program to solve the Optimization Problems
5. Write a Julia program to solve the Nonlinear Solver Problems
6. Use Clustering.jl to cluster the SepalLength, PetalLength, and PetalWidth features via K-means clustering in Iris database. Make a scatter plot of the resulting clusters.
7. Perform advanced clustering task by using a subset of Word Embedding, trained using Word2Vec.jl. Use Affinity Propagation from Clustering.jl, to cluster word2vec word embeddings, according to meaning.
8. Make binomial stock price trees. Use them to model future stock prices.
9. Use PCA from MultivariateStats.jl, to reduce 100 dimensional word embedding down to 3,2 and 1 dimensions. Plot these using Plots.jl, coloring according to class
10. Perform an Animation of Any plot
11. Interpret the data of an abstract type using Type Recipes.
12. Build a set of series plots and defaults using Plot Recipes.
13. Demonstrate series recipe in Julia programming.

MDS402 – MAIN PROJECT WORK

It is an individual project. Students should implement their project in the Institution/Industry. Internal marks can be awarded by the guide by evaluating the performance of the students during the course of project work. In viva-voce the questions must be directed only on the project work to assess the involvement and understanding of the problem by the students.

The **project carries 300 marks** is distributed as follows:

Internal Assessment: 100 marks

External Assessment is as follows:

Demonstration and presentation	100 Marks
Validation	30 Marks
Viva-Voce	40 Marks
Report	30 Marks
Total	200 Marks



SCHEME AND SYLLABUS

For the Programme

B.Sc. (Hons.) Degree in Biochemistry

B.Sc. (Basic and Honours Degree)

(Choice Based Credit System – 2021 scheme)

B.Sc. (Hons.) Biochemistry Program

PEO_ID	Programme Educational Objectives
PEO1	To provide students a comprehensive knowledge base in biochemistry that help instill deep interest in learning biochemistry, through analytical and application based courses.
PEO2	To equip students with appropriate theoretical and practical skill sets to tackle issues and problems in the field of biochemistry.
PEO3	To inculcate in students the critical analysis, questioning and reasoning skills and train them for a future career in higher studies and research.
PEO4	To encourage students build their potential for inter-disciplinary research, so that they can serve the society better.
PEO5	To produce students with leadership and professional integrity skills, thus enabling them to work in multidisciplinary and diverse professional platforms.

PO_ID	Programme Outcomes <i>After completion of B.Sc (Hons.) in Biochemistry, students will be able to</i>
PO1	Get exposed to advanced theoretical and practical concepts of Biochemistry
PO2	Develop insight on the modern tools of biochemical research for real life problem solving
PO3	Get familiarized with the advanced multidisciplinary allied areas of development in Biochemistry
PO4	Develop the requisite skills for enabling them to express and present their persuasive scientific ideas in bigger scientific platforms
PO5	Demonstrate professional attitude and ethical responsibility to serve the society.

PO_ID	Programme Specific Outcomes
PSO1	To create interest and appreciation for the chemical basis of Biological processes, inculcate spirit of inquiry and provide holistic knowledge of related disciplines
PSO2	To provide knowledge of biochemical basis of life processes by gaining indepth understanding on biomolecules, enzymes and metabolism under normal and pathological conditions.
PSO3	To develop the requisite laboratory skills in order to apply for scientific experimentation, hypothesis testing, data interpretation and logical conclusions.
PSO4	To instil in students the essential skills and experience in conducting biological research, project management, scientific publications, ethics and IP rights.
PSO5	To prepare competent human resource with better knowledge, hands-on-experience and scientific attitude for national and global level careers in research

	and development, academia, Pharma-, biotech- , agro-, and food processing industries

NEP-2020

B.Sc (Hons.) in Biochemistry Course Matrix (w.e.f. 2021-22 Onwards)

I Semester							
Code	Course Code	Course	Teaching Hours	Course Components			Credits
				L	T	P	
AECC	LAN 1.1	Language-1	3	2	1	-	3
AECC	LAN 1.2	English / Hindi	3	2	1	-	3
DSC-1	BC 1.1	Chemical Foundation of Biochemistry – 1	4	3	1	-	4
DSC-1	BC 1.2	Volumetric Analysis – Practical’s - 1	4	-	-	2	2
DSC-2		Other Discipline - Theory	4	3	1	-	4
DSC-2		Other Discipline – Lab	4	-	-	2	2
OE-1	OPE 1.1	Open Elective 1 – Biochemistry in Health and Disease	3	2	1	-	3
SEC-1	SBC 1.1	Digital Fluency	2	1	-	2	2
SEC-2	VBC 1.1	Health and Well-being	2	-	-	2	1
SEC-3	VBC 1.2	Yoga	2	-	-	2	1
Total							25
II Semester							
AECC	LAN 2.1	Language-2	3	2	1	-	3
AECC	LAN 2.2	English / Hindi	3	2	1	-	3
AECC	EVS 2.1	Environmental Studies	2	2	-	-	2
DSC-1	BC 2.1	Chemical Foundation of Biochemistry – 2	4	3	1	-	4
DSC-1	BC 2.2	Qualitative and Quantitative analysis - Practical’s – 2	4	-	-	2	2
DSC-2		Other Discipline - Theory	4	3	1	-	4
DSC-2		Other Discipline – Lab	4	-	-	2	2
OE-2	OPE 2.1	Open Elective 2 – Nutrition and Dietetics	3	2	1	-	3
SEC-4	VBC 2.1	NCC/NSS/Cultural	2	-	-	2	1
SEC-5	VBC 2.2	Sports	2	-	-	2	1
Total							25

**Continuous Internal Assessment – Scheme of Evaluation
For Theory Courses**

End Semester Examination: 60%

Continuous Internal Assessment: 40%

Activities (CIA: 40 Marks)	Proposed and Approved Scheme		Total Marks (40)
	IA-1	IA-2	
Session Test Maximum Marks	30	30	
1. Weightage (Marks)	10	10	20
2. Assignment (Marks)	20		20
i. Writing	10		
ii. Quiz / Presentation / Creating diagrams / charts / Viva	05		
iii. Classroom participation	05		
Total			40

**Continuous Internal Assessment – Scheme of Evaluation
For Practical Courses**

End-Semester Examination: 50%

Continuous Internal Assessment: 50%

CIA (25 marks) + End Semester Exam (25 marks)	
Maximum Marks (Internal Assessment)	25
1. Continuous evaluation and Class tests	15
2. Record work (Marks)	05
3. Viva Voce	05
Total (Marks)	25

SEMESTER – I

S21 BC 1.1: Chemical Foundation of Biochemistry – 1

Total Teaching Hours: 60

No. of Hours / Week: 4

CObj_ID	Course Objectives
CObj_1	To understand chemical basis of bioprocesses, organization of organisms, fundamental properties of elements and units of measurements.
CObj_2	To revisit the fundamentals concepts of chemical bonds, electronic configuration, concepts of acids/ bases/ buffers and their importance in biological systems.
CObj_3	To familiarize with thermodynamic concepts as applicable to biological processes.

CO_ID	Course Outcomes
CO_1	To appreciate Biochemistry as a discipline by understanding the chemical basis of biological systems.
CO_2	To understand the concepts of mole, mole fraction, molarity and to apply them in biochemical research.
CO_3	To know the significance of chemical bonding, electronic configuration and theories of bond formation
CO_4	To understand the concepts of acids, bases, indicators, buffers and realize the importance of water as a universal solvent.
CO_5	To recognize the fundamentals of electrochemistry and the thermodynamic basis of biochemical reactions.

CO-PO Mapping

	PO_1	PO_2	PO_3	PO_4	PO_5	PSO_1	PSO_2	PSO_3	PSO_4	PSO_5
CO_1	X	X	X	-	-	X	X	-	-	-
CO_2	X	-	-	-	-	X	-	-	X	-
CO_3	X	-	-	-	-	X	-	-		-
CO_4	X	-	-	-	-	X	-	-	X	-
CO_5	X	-	-	-	-	X	-	-		-

Course Content

Sl.No	Module title	Module Content	Number	Skills

			of Hours	Developed
1	Scope of Biochemistry and units of measurement	Origin of life, Miller's experiment, types of organisms, prokaryotes, eukaryotes, unicellular multicellular, compartmentalization of functions in lower and higher organisms, and common physiological events of organisms (RQ), chemical composition of living organisms, subcellular organelles: Structure, function and interrelationship. SI units, Mass, volume, temperature, amount, length and time An overview on the metric system, atomic weight, molecular weight, equivalent weight, basicity of acids, acidity of bases, Avogadro's number, molarity, normality, molality, Dalton concept, mole concept, concentration, mole to molar conversion, oxidation number and its significance, density and specific gravity, their significances.	15	Cognitive Skills & Research Skills
2	Atomic structure and chemical bonds	Structure of an atom, electrons and Quantum numbers, orbitals, shapes of orbitals, s, p, d, and f sub shells, K, L, M, N, O, P, and Q shells. Illustration of Pauli's exclusion principle, Aufbau principle, and Hund's rule, electron configuration: up to atomic number 20, octet rule. Formation and properties of non-covalent and covalent bonds, hydrogen bonds, ionic bonds, van der Waals interactions, London forces, dipole-dipole interactions, electrostatic interactions, and hydrophobic interactions. Sigma, pi and co-ordinate bonds, back bonding. Corresponding energy associated, outline of theories of bonding: Valence bond theory, Molecular orbital theory and crystal field theory.	15	Cognitive Skills
3	Buffers and Colligative properties	Acids, bases, Arrhenius concept, Lowry and Bronsted concepts, Lewis concept. Buffers, composition, pH, pH scale, Henderson-Hasselbalch equation, titration curve of H ₃ PO ₄ , pK value, isoelectric pH, ionization of HCl, CH ₃ COOH, NH ₄ OH, H ₂ SO ₄ . Colligative properties and anomalous colligative properties of solutions, structure of water based on VS and PR theory, ionic product of water, special properties of water, buffers in animal system. Solutions and types, ionizable solutes, non-ionizable solutes, vapor pressure and its application in distillation, Vant Hoff law – Boyle's and Charles' law, Rault's law of RLVP, boiling point, freezing point, de-icing, osmosis and osmotic pressure determination by Berkeley and Hardley's method, reverse osmosis.	15	Cognitive Skills & Research Skills
4	Electrochemistry and redox reactions	Scope of electrochemistry, electrochemical cells, Daniel cell, galvanic cell, electrode potential and its measurement, electrolysis, types of electrolytes, primary and secondary batteries, electrodes, half-cell reaction, standard electrodes. Laws of thermodynamics, entropy and enthalpy, their relation, Gibb's energy, free energy change, ions, Redox reactions, types, stock notations, change in oxidation number and combination. Endergonic and exergonic reactions with examples. The Importance	15	Cognitive Skills

		in biological systems, redox potential, application of redox potential, energy linked to redox reactions, reduction of oxygen, oxidation and reduction of iron in hemoglobin, biological active forms of zinc, calcium, nickel, molybdenum, selenium, and cobalt, NAD ⁺ /NADH, NADP ⁺ /NADPH, FAD/FADH ₂ , FMN/FMNH ₂ .		

Books for Reference:

1. Advanced Inorganic Chemistry: A comprehensive Text, 1999, Cotton and Geoffrey Wilkinson, 6th edition, Wiley publication
2. Inorganic Chemistry, 2014, Miessler GL, Paul Fischer PJ, and Tarr DA, 5th edition, Pearson Publication.
3. Inorganic Chemistry, 2004, Catherine E and Sharpe AG, ACS publication
4. Inorganic Chemistry, 2015, Overton, Rourke, Weller, Armstrong and Hagerman, Oxford Press.
5. Physical Chemistry: A molecular approach, 2019, Donald A, McQuarrie and Simon JD, Viva Books Publication.
6. Physical chemistry 2019, Atkins P, Paula JD, Keeler J, 11th edition, Oxford press .
7. Biochemical Calculations, 1976, Irwin H. Siegel 2nd Ed. John Wiley and Sons.
8. A biologist's Physical Chemistry, 1976, 2nd Edition, J Gareth Morris, Edward Arnold Ltd.

S21 BC 1.2: Volumetric Analysis – Practical 1

Total Teaching Hours: 60

No. of Hours / Week: 4

CObj_ID	Course Objectives
	<i>This course aims to</i>
CObj_1	Familiarize students with the principles of analytical chemistry and basic analytical techniques such as volumetric analysis.
CObj_2	Provide experimental practice of quantitative volumetric analysis.
CObj_3	Enable students to prepare standard solutions and perform chemical analysis.

CO_ID	Course Outcomes
CO_1	Understanding Good laboratory practices in a chemistry/biochemistry laboratory
CO_2	Learn safety and precautionary measures for working in a laboratory.
CO_3	Develop skill and proficiency in preparation of laboratory reagents
CO_4	Use of handling of glass wares, minor equipment for conducting experiments
CO_5	Develop skills to prepare standard chemical solutions and secondary standards

CO-PO Mapping

	PO_1	PO_2	PO_3	PO_4	PO_5	PSO_1	PSO_2	PSO_3	PSO_4	PSO_5
CO_1	X	-	-	X	-	-	-	X	X	X
CO_2	X	X	X	-	-	-	-	X	X	X
CO_3	X	X	X	X	-	-	-	X	X	X
CO_4	X	X	X	-	-	-	-	X	X	X
CO_5	X	X	X	X	-	-	-	X	X	X

Course Content

Sl.No	Module title	Module Content	Number of Hours	Skills Developed
1	Practical 1	Concept of molarity, molality and normality. Calculation and preparation of molar solutions. (Problems to be given in exams). Calculation and preparation of normal solutions and percent solutions and dilute solutions.	4 Hrs/week	Employable & Analytical Skills
2		Calibration of volumetric glassware's (Burette, pipette).		
3		Preparation of standard Sodium carbonate solution, standardization of HCl (Methyl orange) and estimation of NaOH in the given solution. (methyl orange or phenolphthalein).		
4		Preparation of standard Oxalic acid. Standardization of NaOH and estimation of H ₂ SO ₄ in the given solution (phenolphthalein).		
5		Preparation of standard Oxalic acid. Standardization of KMnO ₄ and estimation of H ₂ O ₂ in the given solution.		
6		Preparation of standard K ₂ Cr ₂ O ₇ . Standardization of Na ₂ S ₂ O ₃ and estimation of CuSO ₄ in the given solution.		
7		Preparation of ZnSO ₄ . Standardization of EDTA and estimation of total hardness of water using Eriochrome black-T indicator.		
8		Preparation of standard potassium biphthalate.		

		Standardization of NaOH and estimation of HCl in the given solution. (Phenolphthalein).		
9		Estimation of sulphuric acid and oxalic acid in a mixture using standard sodium hydroxide solution and standard potassium permanganate solution.		
10		Preparation of standard Potassium dichromate and estimation of ferrous/ferric mixture using diphenylamine indicator (Demonstration).		
11		Preparation of standard oxalic acid solution. Standardization of NaOH solution and estimation of acidity in vinegar.		
12		Preparation of standard potassium biphthalate solution, standardization of sodium hydroxide solution and estimation of alkalinity of antacids.		
13		Preparation of standard Oxalic acid solution. Standardization of KMnO_4 solution and estimation of calcium in milk.		

REFERENCES:

1. Svehla, G. Vogel's Qualitative Inorganic Analysis, Pearson Education, 2012.
2. Mendham, J. Vogel's Quantitative Chemical Analysis, Pearson, 2009.
3. Dr. O. P. Pandey, D. N. Bajpai, dr. S. Giri, Practical Chemistry S. Chand and Co. Ltd.,
4. Principles of Practical Chemistry- M. Viswanathan
5. Instrumental Methods of chemical Analysis B.K Sharma.
6. Experiments in Physical Chemistry R.C. Das and B. Behra, Tata Mc Graw Hill
7. Advanced Practical Physical Chemistry J.B.Yadav, Goel Publishing House
8. Advanced Experimental Chemistry. Vol-I J.N.Gurtu and R Kapoor, S.Chand and Co.
9. Practical Chemistry K.K. Sharma, D. S. Sharma (Vikas Publication).
10. General Chemistry experiment – Anil J Elias (University press).
11. Vogel textbook of quantitative chemical analysis G.H. Jeffery, J. Basset.
12. Quantitative chemical analysis S. Sahay (S. Chand & Co.).
13. Practical Chemistry Dr O P Pandey, D N Bajpai, Dr S Giri. S. Chand Publication
14. College Practical Chemistry. V K Ahluwalia, Sunitha Dingra, Adarsh Gulati
15. Practical Physical Chemistry- B. Viswanathan, P S Raghavan. MV Learning Publication

SEMESTER I – Open Elective OPE 1.1: Biochemistry in Health and Disease

Total Teaching Hours: 45

No. of Hours / Week: 3

CObj_ID	Course Objectives
CObj_1	To provide knowledge about health and various terminologies used in health and disease conditions
CObj_2	To promote information about communicable & non-communicable diseases and their diagnosis, treatments and prevention
CObj_3	To analyze concepts of mental health and hygiene and requisite guidance and counseling

CO_ID	Course Outcomes <i>After studying this course, student will be able</i>
CO_1	To categorize terminologies related to health and world patterns of disease
CO_2	To outline the indications and diagnostic used in the identification and management of disease.
CO_3	To relate health and disease conditions with their treatment as well as prevention methods
CO_4	To appreciate the concepts of mental health and hygiene, their basis and possible remedies
CO_5	To appraise health promotion in infections and available defences against them

CO-PO Mapping

	PO_1	PO_2	PO_3	PO_4	PO_5	PSO_1	PSO_2	PSO_3	PSO_4	PSO_5
CO_1	X	-	-	-	-	X	X	-	-	X
CO_2	-	X	X	X	X	X	X	X	-	X
CO_3	X	X	X	X	X	X	X	X	-	X
CO_4	X	X	X	X	X	X	X	X	-	X
CO_5	X	X	X	-	X	X	X	X	-	X

Course Content

Sl.No	Module title	Module Content	Number of Hours	Skills Developed

1	Introduction	WHO definition of health, Health and hygiene, General health care, Factors affecting health, Indices and evaluation of health, Disease patterns in developed and developing world; Classification of diseases - Endemic, Epidemic, Pandemic; Professional health hazards. Disease conditions: Acute disease, Chronic disease, Incurable disease, Terminal disease, Illness, disorders, Syndrome, Pre-disease. Treatment: Psychotherapy, Medications, Surgery, Medical devices, and Self-care. Dimensions of Health: Physical, Mental, Spiritual, Emotional, Environmental, and Philosophical.	15	Cognitive Skills & Life Skills
2	Communicable diseases	Tuberculosis, Cholera, Typhoid, Conjunctivitis. Sexually transmitted diseases (STD): Information, statistics, and treatment guidelines for STD, Prevention: Syphilis, Gonorrhea, AIDS, etc. Non-communicable diseases: Malnutrition- Under nutrition, Over nutrition, Nutritional deficiencies; Anemia, Stroke, Rheumatic heart disease, Coronary heart disease, Cancer, blindness, accidents, mental illness, Iodine deficiency, Fluorosis, Epilepsy, Asthma. Genetic disorders: Down's syndrome, Klinefelter's syndrome, Turner's syndrome, Thalassemia, Sickle cell anemia. Lifestyle disorders: Obesity, Liver cirrhosis, Diabetes mellitus, Hypertension (Causative agents, symptoms, diagnosis, treatment, prognosis, prevention)	15	Cognitive Skills & Life Skills
3	Health promotion	Preventing drug abuse, Oral health promotion by tobacco control. Mental hygiene and mental health: Concepts of mental hygiene and mental health, Characteristics of mentally healthy person, Warning signs of poor mental health, Promotive mental health, strategies and services, Ego defense mechanisms and implications, Personal and social adjustments, Guidance and Counseling. Infection control: Nature of infection, Chain of infection transmission, Defenses against infection transmission	15	Cognitive Skills & Life Skills

Books for Reference:

1. Modern Nutrition in Health and Disease 2006 10th Edition by Maurice E. Shils, Moshe Shike, A Catharine Ross.
2. Clinical Biochemistry and Metabolic Medicine , 2012 Eighth Edition by Martin Andrew Crook, CRC Press,
3. Nutrition & Health in Developing Countries, 2000, Editors: R. Semba and M.W. Bloem, Humana Press

SEMESTER – II
S21 BC 2.1: Chemical Foundation of Biochemistry – 2

Total Teaching Hours: 60

No. of Hours / Week: 4

CObj_ID	Course Objectives
CObj_1	To understand reaction kinetics, concepts of colloids and their biological applications.
CObj_2	To revisit concepts of organic chemistry and learn the role of stereochemistry in biological systems.
CObj_3	To familiarize with types of organometallic compounds and their biological effects.

CO_ID	Course Outcomes
CO_1	To understand the principles of chemical kinetics and their interpretation for biological systems
CO_2	To comprehend about types of colloids, their properties, examples and biological applications
CO_3	To analyze the concepts of stereochemistry of organic compounds and their importance in biomolecules
CO_4	To appreciate the roles of metals, non-metals, transition metals and organometallic compounds in biological systems.
CO_5	To study the properties of inorganic molecules and coordination compounds and understand the toxic effects of heavy metals.

CO-PO Mapping

	PO_1	PO_2	PO_3	PO_4	PO_5	PSO_1	PSO_2	PSO_3	PSO_4	PSO_5
CO_1	X	-	X	-	-	X	X	-	-	-
CO_2	X	-	X	-	-	X	-	-	-	-
CO_3	X	X	X	X	-	X	X	-	-	X
CO_4	X	-	X	-	-	X	X	-	-	X
CO_5	X	-	X	-	-	X	X	-	-	X

Course Content

Sl.No	Module title	Module Content	Number of Hours	Skills Developed
1	Chemical Kinetics and Colloids	Introduction, Rate of reactions, rate law or Rate equation, Molecularity and order of a reaction with examples, velocity constant or rate constant and half-life period expressions for zero, first and second order reactions with derivations ($a=b$ and $a \neq b$), Numerical problems. Effect of temperature, Pressure and catalyst on rate of reaction, Arrhenius equation and Arrhenius interpretation of energy of activation, Transition state theory with brief explanation. Colloids: True solutions, classification, Brownian movements, electric properties, coagulation, mutual lyophilic sols, peptisation, purification, ultrafiltration, dialysis, electro and persistent dialysis, addition of electrolytes, colloids in daily life and applications. Emulsion, types, micelles with biomolecules and its Biological applications	15	Cognitive Skills
2	Nomenclature of Organic Compounds	Classification, naming, IUPAC nomenclature, compounds containing one, two functional groups with chains, homologous series. Stereochemistry, geometrical and structural Isomerism, conformation and free rotation. Optical isomerism, symmetry of elements, plane polarized light and optical purity. Nomenclature of enantiomers, epimers, racemic mixture, resolution. Fischer and Newmann projection formulae, molecule with one and two chiral and achiral centers. Priority rules; E and Z (CIP rules), R and S, D and L notations, absolute (R and S) and relative (d and l) configuration. Role of stereochemistry in biological systems	15	Cognitive Skills
3	Organometallic Compounds	Metal atom linked organic compounds. Preparation of Grignard reagents and structure, limitations, protonolysis and reactions. Organolithium compounds, preparation and reactions. Organozinc compounds. Organoboranes its mechanisms. Ferrocenes. Introduction to mineral and ores, classification, concentration, extraction, refining, uses of minerals and metals and its importance. Porphyrins and Metal ions: Role of metal ions in biological systems, Fe, Cu, Zn, structure and functions of porphyrins, metalloporphyrins and iron-sulphur clusters with suitable examples and their role in biological systems.	15	Cognitive Skills
4	Inorganic Chemistry	Nomenclature of inorganic molecules and coordination compounds, formula. IUPAC nomenclature. Central metal ion, ligand, coordination number, sphere, complex ion, oxidation number of central atom, homoleptic and heteroleptic complexes. Isomerism in complexes, structural, ionisation, solvate, linkage and coordination Stereoisomerism, geometrical, optical isomerism with simple inorganic complexes. Applications of qualitative, quantitative analysis, photographic, metallurgy, medicine, catalysis and	15	Cognitive Skills

		biosystems. Heavy Metal Poisons: Introduction, poisons, lead, mercury, aluminium, arsenic, corrosives, cyanide, irritants, phosphorus, CO ₂ , SO ₂ , SO ₃ , NO ₂ , halides and acid fumes, poisoning, sources, signs and symptoms. Free radicals: introduction, definition, generation and scavenger systems.		

Books for Reference:

1. Physical Chemistry, 2006, Peter Atkins. 8th edition, W.H. Freeman and Company
2. Inorganic Chemistry: 2006, Principles of structure and Reactivity, Huheey JE, Keiter EA, Keiter RL, Pearson Education India
3. Stereochemistry: Conformation and Mechanism, 2009, Kalsi PS, New Age International Publications
4. Introduction to Stereochemistry, 2012, Kurt Mislow, Dover Publications
5. A text book of Organic Chemistry, 2016, Raj K Bansal, 6th edition, New Age International Publications
6. Advanced Inorganic Chemistry, 1999, Cotton et.al, 6th edition, A Wiley-International
7. Principles of physical Chemistry, Puri, Sharma and Pathania.
8. Physical Chemistry, R.L. Madan, G.D. Tuli. S. Chand and Co.
9. A Text Book of Physical Chemistry, K.L. Kapoor, Vol.2. McMillan Publisher, India Ltd.
10. Advanced Organic Chemistry, Bahl and Bahl.
11. Principles of organometallic Chemistry, 1991, P. Powell, 2nd Edition, ELBS.
12. Inorganic Chemistry, 1983, 3rd Edition, J.E. Huheey, Harper International.
13. Organic Chemistry, Claden J., Greeves, N., Warren, S. 2012, Oxford University Press.
14. Inorganic Chemistry, 1987, R.W. Hay, Ellis Harwood.
15. Bioinorganic Chemistry, 2002, R.M. Roat-Malone, John-Wiley.
16. Basic Organometallic chemistry, 2nd Edition, B.D. Gupta and A.J Elias.

S21 BC 2.2: Qualitative and Quantitative Analysis – Practical 2

Total Teaching Hours: 60

No. of Hours / Week: 4

CObj_ID	Course Objectives
	<i>This course aims to</i>
CObj_1	Provide experimental practice of quantitative and qualitative inorganic analysis
CObj_2	Train students in basic physical chemistry laboratory techniques
CObj_3	Develop skills in handling instruments and understand its application in research work.

CO_ID	Course Outcomes
	<i>After the course, students will be able to</i>
CO_1	Perform competently qualitative analysis of inorganic salt mixtures

CO_2	Determine physical properties of liquids such as density, viscosity and surface tension
CO_3	Separate components from mixtures of organic compounds and determine distribution coefficients.
CO_4	Estimate concentration of a biomolecule by using colorimeter and then principles of Beer's Law
CO_5	Calibrate pH meter and determine pH of common daily life substances.

CO-PO Mapping

	PO_1	PO_2	PO_3	PO_4	PO_5	PSO_1	PSO_2	PSO_3	PSO_4	PSO_5
CO_1	X	X	-	X	-	-	-	X	X	X
CO_2	X	X	-	X	-	-	-	X	X	X
CO_3	X	X	-	X	-	-	-	X	X	X
CO_4	X	X	X	X	-	-	-	X	X	X
CO_5	X	X	-	X	-	-	-	X	X	X

Course Content

Sl.No	Module title	Module Content	Number of Hours	Skills Developed
1	Practical 2	Semi micro–Qualitative Analysis of Inorganic salt Mixtures. Systematic semi micro qualitative analysis of two acid and two basic radicals in the given inorganic salt mixture. The constituent ions in the mixture to be restricted to the following. (Any four binary mixtures shall be given) Anions: HCO_3^- , CO_3^{2-} , Cl^- , Br^- , NO_3^- , BO_3^{3-} , SO_4^{2-} and PO_4^{3-} . Cations: Pb^{2+} , Al^{3+} , Fe^{2+} , Fe^{3+} , Mn^{2+} , Zn^{2+} , Ca^{2+} , Sr^{2+} , Ba^{2+} , Mg^{2+} , K^+ , Na^+ and NH_4^+ .	4 Hrs/week	Employable & Analytical Skills
2		Determination of density and viscosity of the given liquid using specific gravity bottle and Ostwald's viscometer.		

3	Determination of density and surface tension of the given liquid using specific gravity bottle and stalagmometer.		
4	Determination of molecular weight of non-volatile solute by Walker-Lumsden method.		
5	Determination of rate constant of decomposition of H_2O_2 using $KMnO_4$ by volumetric analysis method using ferric chloride as catalyst		
6	Determination of distribution coefficient of benzoic acid between water and benzene or iodine between water and carbon tetrachloride.		
7	Separation of Two Components from given Binary Mixture of Organic Compounds Qualitatively. (Types of binary mixtures- Solid – Solid, Solid – Liquid, Liquid – Liquid)		
8	Verification of Beer's Law. Estimation of unknown concentration of a biomolecule by using colorimeter		
9	Calibration of pH meter and determination of pH of aerated soft drinks.		

REFERENCES:

1. Svehla, G. Vogel's Qualitative Inorganic Analysis, Pearson Education, 2012.
2. Mendham, J. Vogel's Quantitative Chemical Analysis, Pearson, 2009.
3. Dr. O. P. Pandey, D. N. Bajpai, Dr. S. Giri, Practical Chemistry S. Chand and Co. Ltd.,
4. Principles of Practical Chemistry- M. Viswanathan
5. Instrumental Methods of chemical Analysis B.K Sharma.
6. Experiments in Physical Chemistry R.C. Das and B. Behra, Tata Mc Graw Hill
7. Advanced Practical Physical Chemistry J.B. Yadav, Goel Publishing House
8. Advanced Experimental Chemistry. Vol-I J.N. Gurtu and R Kapoor, S.Chand and Co.
9. Practical Chemistry K.K. Sharma, D. S. Sharma (Vikas Publication).
10. General Chemistry experiment – Anil J Elias (University press)
11. Vogel textbook of quantitative chemical analysis G.H. Jeffery, J. Basset.
12. Quantitative chemical analysis S. Sahay (S. Chand & Co.)
13. Practical Chemistry Dr O P Pandey, D N Bajpai, Dr S Giri. S. Chand Publication
14. College Practical Chemistry. V K Ahluwalia, Sunitha Dingra, Adarsh Gulati
15. Practical Physical Chemistry- B. Viswanathan, P S Raghavan. MV Learning Publication

SEMESTER II – Open Elective

OPE 2.1: Nutrition and Dietetics

Total Teaching Hours: 45

No. of Hours / Week: 3

CObj_ID	Course Objectives
CObj_1	To introduce the students to the fundamentals of Nutrition, food and health and to familiarize them with importance of nutrition during various stages of life
CObj_2	To understand the functions and role of macronutrients, their requirements and the effect of deficiency and excess.
CObj_3	To impart knowledge regarding nutritional disorders ranging from nutritional deficiencies to life style disorders and the importance of functional foods

CO_I D	Course Outcomes <i>After studying this course, student will be able</i>
CO_1	The gain knowledge about energy requirements, energy content of foods and Recommended Dietary Allowances.
CO_2	To understand the functions and role of micro and macronutrients, their requirements and the effect of deficiency and excess.
CO_3	To analyze the impact of various functional foods on our health.
CO_4	To apply basic nutrition knowledge in making food choices and obtaining an adequate diet.
CO_5	To gain competence in connecting the role of various nutrients in maintaining health and learn to enhance traditional recipes.

CO-PO Mapping

	PO_1	PO_2	PO_3	PO_4	PO_5	PSO_1	PSO_2	PSO_3	PSO_4	PSO_5
CO_1	X	-	X	X	X	X	X	-	-	X
CO_2	X	X	X	-	X	X	X	-	-	X
CO_3	X	X	X	-	X	X	X	-	-	X
CO_4	X	X	X	X	X	X	X	-	-	X
CO_5	X	X	X	X	X	X	X	-	-	X

Course Content

Sl.No	Module title	Module Content	Number	Skills

			of Hours	Developed
1	Basic concepts of Nutrition	Introduction, Basic principles of a balanced diet to provide energy and nutrients. Composition of foods and proximate analysis of foods. Calorific value of foods, and Basal metabolism. Basal Metabolic Rate (BMR), Factors affecting BMR, Energy requirements for different physical activities, Specific dynamic action of food, Nutritive value of proteins. Energy requirements and recommended dietary allowance (RDA) for infants, children and pregnant women. Protein calorie malnutrition.	15	Cognitive Skills & Life Skills
2	Macronutrients and Micronutrients	Carbohydrates- Digestible and non-digestible, Dietary fibres, Essential fatty acids, lipoproteins and Cholesterol. Essential amino acids, Fortification of foods, Protein requirement for different categories. Vitamins -Sources, requirements, functions and deficiency symptoms of Vitamin-C, Thiamine, Riboflavin, Pyridoxine, Folic acid, Vitamin B12. Absorption of fatsoluble vitamins- A, D, E and K. Micronutrients : Source, Daily requirement, functions and deficiencydisease symptoms of Macro minerals (Ca, P, and Cl) and micro minerals/trace elements (I, Fe, Zn and Se).	15	Cognitive Skills & Life Skills
3	Dietetics and Diet Therapy	Introduction to nutrition. Food pyramid. Diet planning and introduction to diet therapy. Nutritional requirements for different age groups, anemic child, expectant women, and lactating women. Diet planning for prevention and cure of nutritional deficiency disorders. Diet therapy : Functional foods, Anthropometric measurements, dietary considerations during fever, malaria, and tuberculosis. Prevention and correction of obesity, underweight, and metabolic diseases by diet therapy. Dietary interventions to correct and or manage the gastrointestinal diseases (indigestion, peptic ulcer, constipation, diarrhoea, steatorrhoea, irritable bowel syndrome. Functional foods based diet therapy for diabetes, cardiovascular disease and cancer.	15	Cognitive Skills & Life Skills

Books for Reference:

1. Clinical Dietetics and Nutrition, 2002, Antia FP and Abraham P. Oxford University Press; 4th Edition. ISBN-10: 9780195664157.
2. Oxford Handbook of Nutrition and Dietetics, 2011, Webster-Gandy J, Madden A and Holds worth M. Oxford University Press, Print ISBN-13: 9780199585823.
3. Krause's Food, Nutrition and Diet therapy, 2003, Mahan KL and Escott-Stump S. Elsevier, ISBN:9780721697840.
4. Human Nutrition and Dietetics. 1986, Passmore R. and Davidson S. Churchill Livingstone Publications, ISBN-10: 0443024863.
5. Rosemary Stanton's Complete Book of Food & Nutrition, 2007, Simon & Schuster

Publishers,Australia, ISBN 10: 0731812999.

6. Food Science and Nutrition, 2018, Roday S. Oxford University Press Publishers, ISBN:9780199489084/0199489084.
7. Food Science, 2007, Srilakshmi S. New Age International (P) Limited Publishers, ISBN: 9788122420227/ 8122420222.

NEP-2020

B.Sc (Hons.) in Biochemistry - Programme Matrix (w.e.f. 2021-22 Onwards)

III Semester							
Code	Course Code	Course	Teaching Hours	Course Components			Credits
				L	T	P	
AECC	LAN 3.1	Kannada / other languages	3	2	1	-	3
AECC	LAN 3.2	English / Hindi	3	2	1	-	3
DSC7	S21 BC 3.1	Bioorganic Chemistry	4	3	1	-	4
DSC8	S21 BC 3.2	Bioorganic Chemistry – Practical's - 3	4	-	-	2	2
DSC9		Other Discipline - Theory	4	3	1	-	4
DSC10		Other Discipline - Lab	4	-	-	2	2
OE	OE 3.1	Open Elective – Health and Hygeine	3	2	1	-	3
SEC-3	SBC 3 .1	Digital Fluency					2
SEC-4	VBC 3.1	Sports					1
SEC-5	VBC 3.2	NCC/NSS/R&R/Cultural					1
Total							25
IV Semester							
AECC	LAN 4.1	Kannada / Functional Kannada	3	2	1	-	3
AECC	LAN 4.2	English / Hindi	3	2	1	-	3
AECC	EVS 4.3	Constitution of India					2
DSC11	S21 BC 4.1	Analytical Biochemistry	4	3	1	-	4
DSC12	S21 BC 4.2	Analytical Biochemistry – Practical's - 4	4	-	-	2	4
DSC13		Other Discipline - Theory	4	3	1	-	4
DSC13		Other Discipline - Lab	4	-	-	2	2
OE	OE 4.1	Open Elective – Nutraceuticals and Functional Foods	3	2	1	-	3
SEC-4	VBC 4.1	Sports					1
SEC-5	VBC 4.2	NCC/NSS/Cultural					1
Total							25

AECC- Ability Enhancement Compulsory Courses

DSC- Discipline Specific Course

VBC- Value-based Course

SEC- Skill Enhancement Course

DSE- Discipline Specific Elective

OE- Open Elective

Continuous Internal Assessment – Scheme of Evaluation For Theory Courses

End Semester Examination: 60%
Continuous Internal Assessment: 40%

Activities (CIA: 40 Marks)	Proposed and Approved Scheme		Total Marks (40)
	IA-1	IA-2	
Session Test Maximum Marks	30	30	
1. Weightage (Marks)	10	10	20
2. Assignment (Marks)	20		20
i. Writing	10		
ii. Quiz / Presentation / Creating diagrams /charts / Classwork / Case study / Viva /Field work etc.,	05		
iii. Classroom participation	05		
Total			40

Continuous Internal Assessment – Scheme of Evaluation For Practical Courses

End-Semester Examination: 50%
Continuous Internal Assessment: 50%

CIA (25 marks) + End Semester Exam (25 marks)	
Maximum Marks (Internal Assessment)	25
1. Weightage (Marks)	15
2. Record work (Marks)	05
3. Quiz/Presentation/creating diagrams/charts/Lab work/	05
Total (Marks)	25

SEMESTER – III

S21 BC 3.1: Bioorganic chemistry

Total Teaching Hours: 60

No. of Hours / Week: 4

CObj	Course Objectives
CObj_1	To understand general reaction mechanisms of organic compounds and the concepts of allides, alcohols and carbonyl compounds.
CObj_2	To revisit the fundamentals concepts of primary and secondary metabolites of cells.
CObj_3	To familiarize with bioorganic compounds like nutrients, proteins, vitamins and drugs.

CO	Course Outcomes
CO1	To appreciate the concepts of reaction mechanisms of hydrocarbons.
CO2	To understand the properties and importance of allides, alcohols and carbonyl compounds.
CO3	To know the significance of primary metabolites in living organisms such as carboxylic acids, amines and heterocyclic compounds.
CO4	To understand the significance of secondary metabolites in living organisms, such as terpenes and alkaloids.
CO5	To recognize the fundamentals of nutrition, nutrients and understand about drugs and antibiotics.

CO-PO Mapping

	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	X	-	-	-	-	X	X	-	-	-
CO2	X	-	-	-	-	X	X	-	-	-
CO3	X	-	-	-	-	X	X	-	-	-
CO4	X	-	-	-	-	X	X	-	-	X
CO5	X	X	X	-	-	X	X	-	-	X

Course Content

Sl.No	Module title	Module Content	Number of Hours	Skills De-veloped
1	Reaction mechanisms	Reaction mechanisms: Concept of inductive effect, resonance and hyperconjugation. Classification of organic reactions (substitution, addition, elimination and rearrangement), with two examples for each. Concepts of the following – carbanions, carbocations, carbenes, nucleophiles and electrophiles (Formation and Stability). Hydrocarbons - Mechanism of addition of HCl to propene, Markovnikov's rule. Peroxide effect, Alkenes – ozonolysis, oxidation. Alkynes – formation of acetylides and their importance. Dienes– types with examples. Conjugate dienes, 1,3-butadiene – stability, mechanism of addition of HBr. Arenes - Modern concept of structure of benzene by Resonance and molecular orbital theories, mechanism of electrophilic substitution in benzene (nitration, Friedel– Craft's alkylation and acylation). Electronic interpretation of the orienting influence of substituents in the electrophilic substitution of toluene, chlorobenzene and nitrobenzene. Aromaticity– Huckel rule ($4n+2$ rule), structure of naphthalene, anthracene.	15	Cognitive Skills & Research Skills
2	Organic compounds	Cycloalkanes - Reactivity and relative stabilities. Baeyer strain theory, Sachse – Mohr theory, boat and chair forms of cyclohexane, axial and equatorial bonds. Alkylhalides - SN^1 and SN^2 reaction mechanisms taking 1°, 2° & 3° alkylhalides as examples. Mechanistic concepts of elimination reactions involving tertiary butylchloride and <i>n</i>-butylchloride. Alcohols and phenols - Classification, monohydric alcohols: examples, general and distinguishing reactions. Dihydric alcohols: glycols, Trihydric alcohols: glycerol – synthesis from propene, properties and uses. Classification of phenols, electronic interpretation of acidity of phenols, mechanism of Kolbe, Reimer– Tiemann and bromination reactions. Carbonyl compounds - General properties, addition of alcohols to aldehydes and ketones. Keto-enol tautomerism. Mechanisms: addition of	15	Cognitive Skills

		HCN to acetaldehyde, Claisen and aldol condensations. Quinones: <i>o</i> - and <i>p</i> -benzoquinones- structure and properties.		

3	Primary and secondary metabolites	Introduction, types. Carboxylic Acids : Classification; hydroxy acids: preparation and properties of lactic acid; structures of tartaric, malic, citric and iso citric acids; dicarboxylic acids: saturated dicarboxylic acids- effect of heat on the first five members; ketoacids: structures , properties and reactions of pyruvic acid, α- ketoglutaric acid and oxaloacetic acid. Amines: Classification; properties, Basicity of amines acylation isomerism; React with HNO₂ & Schiff's base formation distinguishing reactions of 1°, 2° and 3° amines; some biologically important amines (DOPA, Histamine. Heterocyclic Compounds: Structural and nomenclature of furan, pyran, thiophene, thiazole, pyrrole, imidazole, pyridine, pyrimidine, purine, isoalloxazine and indole; biological compounds containing the above skeletons. reactions of imidazole and pyridine; Aromaticity of furan, thiophene, pyrrole and pyridine. Steroids: Basic ring structure in steroids. Structure and biological importance of cholesterol, steroid hormones (testosterone and oestrogen), phytosterols and ergosterol. Bile acids [Mono, Di & Tri cholic acids]. Alkaloids: Introduction and general characteristics; classification based on their structure and biological functions, general method of extraction; structure and medicinal uses of nicotine, atropine, morphine and LSD. Terpenes: Definition, isoprene rule, classification, Structure and Biological roles of menthol, camphor, farnesol, phytol, lycopene and dolichols, santonin, juvenile hormone I, abscisic acid II, gibberilic acid and lanosterol.	15	Cognitive Skills & Research Skills
4	Bioorganic chemistry	Nutrients – Introduction: Concept of nutrition, calorific value of foods, different components of energy expenditure, respiratory quotient, basal metabolic rate (BMR), determination of BMR, factors affecting BMR. Carbohydrates: Dietary Sources, dietary fibers, its importance. Proteins: Dietary sources, nutritional classification, nutritional value of proteins – PER, NPU and biological value of proteins (BV). Essential amino acids, nitrogen balance, Malnutrition-Kwashiorkar and Marasmus. Fats: Dietary sources of fats, invisible fat, essential fatty acids and their biological importance. Minerals: Ca, P, Fe, Zn, Cu, Iodine, Fluoride, Mg, Se, Manganese, Molybdenum.	15	Cognitive Skills

		Vitamins: Classification- Water soluble & fat soluble. Structural formulae and co-enzyme forms of B1, B2, B6 and niacin. Vitamin C as red-ox reagent, Chemical synthesis of vitamin C. Structural formula of vitamin A, D, E and K. Drugs: Classification of drugs; synthesis and uses of sulphanilamide and pentothal. Antibiotics: Definition; types; sources; structures and antimicrobial spectrum of action of penicillin, chloroamphenicol, streptomycin and tetracyclines.		

Books for Reference:

1. Carey, Francis A. Organic Chemistry. VIIth Edition, Tata McGraw Hill, 2009.
2. Page, M.I. and Andrew Williams Organic and Bio-organic Mechanisms. Pearson, 2010.
3. Dugas, Hermann Bioorganic Chemistry: A Chemical Approach to Enzyme Action 3rd Edition, Springer, 2003.
4. Organic Chemistry. Vol.I. Fundamental principles. I. L .Finar. 6th Edn. ELBS
5. Organic Mechanisms, Peter Sykes, Longman, (1977).
6. Biochemical Calculations, Irwin H. Segel (1976) 2nd Ed. John Wiley and Sons.
7. Organic Chemistry. R.T. Morrison and R.N.Boyd. 6th Edn. Prentice Hall, India.
8. Lehninger- Principles of Biochemistry; DL Nelson and MM Cox [Eds), 6th Edn. Macmillan Publications (2012).
9. Chemistry- An Introduction to General, Organic and Biological Chemistry, 7th Edn. Karen C. Timberlake, Benjamin Cummings, (1999).
10. Reaction Mechanisms at a glance, ed. M. Moloney, Blackwell Science (2000).

S21 BC 3.2: Bioorganic Chemistry – Practical 3

Total Teaching Hours: 60

No. of Hours / Week: 4

CObj_ID	Course Objectives
	<i>This course aims to</i>
CObj_1	Familiarize students with the principles of qualitative analysis of organic compounds.
CObj_2	Provide experimental practice of preparations of important organic compounds.
CObj_3	Enable students to isolate and analyze biological macromolecules.

CO_ID	Course Outcomes
CO_1	Understanding good laboratory practices in a chemistry/biochemistry laboratory.
CO_2	Develop skill and proficiency in preparation of laboratory reagents.

CO_3	Perform systematic qualitative analysis of organic compounds.
CO_4	Synthesize and evaluate biologically useful organic compounds like aspirin.
CO_5	Develop skills to isolate, characterize and analyze biomolecules like cholesterol, starch and nucleic acids.

CO-PO Mapping

	PO_1	PO_2	PO_3	PO_4	PO_5	PSO_1	PSO_2	PSO_3	PSO_4	PSO_5
CO_1	X	-	-	X	-	-	-	X	X	X
CO_2	X	X	X	-	-	-	-	X	X	X
CO_3	X	X	-	-	-	X	X	X	X	X
CO_4	X	X	-	-	-	X	X	X	X	X
CO_5	X	X	-	X	-	X	X	X	X	X

Course Content

Sl.No	Module title	Module Content	Number of hours	Skills developed
1	Practical 1	Systematic qualitative analysis of the organic compounds: glucose, Urea, aniline, phenol, nitrobenzene, naphthalene, p-toluidine, benzoic acid, salicylic acid, resorcinol and p-dichoro benzene	4 Hrs/week	Employable & Analytical Skills
2		Organic preparations: Aspirin from salicylic acid, benzoic acid from benzaldehyde, p- bromoacetanilide from acetanilide and metadinitrobenzene from nitrobenzene		
3		Isolation of cholesterol from egg yolk		
4		Isolation of starch from potatoes.		
5		Qualitative Identification of DNA, RNA and Nitrogen Bases		

REFERENCES:

1. Analytical techniques in Biochemistry and Molecular Biology; Katoch, Rajan. Springer (2011)
2. Basic Methods for the Biochemical Lab; Martin Holtzhauer, Springer, (2007).
3. Principles and Techniques of Biochemistry and Molecular Biology
4. 7th Edn. Keith Wilson and John Walker, Cambridge University Press, (2010).
5. Principles of Gene Manipulations; 6th Edn. S.B. Primrose, R.M. Twyman, and R.W. Old, Blackwell Science (2012).
6. Techniques in Molecular Biology, Walker and Gastra, Croom Helm, (1983)
7. Biochemistry LabFax, Ed. J.A.A. Chambers and D. Rickwood,, Blackwell Science, (1993),
8. Advanced Practical Organic Chemistry, John Leonard, 2017, CRC press
9. Biochemistry: An Organic Chemistry Approach 1st Edition, by Michael B. Smith, CRC Press, 2020.

SEMESTER III – Open Elective

S21 OE 3.1: Health and Hygiene

Total Teaching Hours: 45

No. of Hours / Week: 3

CObj_ID	Course Objectives
CObj_1	To impart knowledge on the importance of nutrition, health and hygiene in life
CObj_2	To provide awareness to student about community and personal health and different health care programmes available
CObj_3	To enrich knowledge on personal and community hygiene, and awareness about health and hygiene policies and apps

CO_ID	Course Outcomes <i>After studying this course, student will be able</i>
CO_1	Understand the importance of nutrition in healthy life and use available information to optimize daily nutrition
CO_2	Comprehend the significance of healthful living for promotion and maintenance of personal and public health
CO_3	Assess personal, community and government roles in disease management
CO_4	Develop the ability to utilize knowledge of public health and health policies for promoting positive health practices
CO_5	Create awareness in public about government measures and digital media

CO-PO Mapping

	PO_1	PO_2	PO_3	PO_4	PO_5	PSO_1	PSO_2	PSO_3	PSO_4	PSO_5
CO_1	X	X	-	-	X	X	X	-	-	X
CO_2	X	X	-	-	X	X	X	-	X	X
CO_3	X	X	-	-	X	X	X	-	-	X

CO_4	X	X	-	-	X	X	X	-	X	X
CO_5	X	X	-	X	X	X	X	-	X	X

Course Content

Sl.No	Module title	Module Content	Number of Hours	Skills De-veloped
1	Nutrition for health	Nutrition – definition, importance, Good nutrition and mal nutrition; Balanced Diet: Basics of Meal Planning. Carbohydrates –functions, dietary sources, effects of deficiency. Lipids –functions, dietary sources, effects of deficiency. Proteins –functions, dietary sources, effects of deficiency. Brief account of Vitamins- functions, food sources, effects of deficiency. Macro and micro minerals –functions, effects of deficiency; food sources of Calcium, Potassium and Sodium; food sources of Iron, Iodine and Zinc. Importance of water– functions, sources, requirement and effects of deficiency.	15	Cognitive Skills & Life Skills
2	Health	Health - Determinants of health, Key Health Indicators, Environment health & Public health; Health-Education: Principles and Strategies. Health Policy & Health Organizations: Health Indicators and National Health Policy of Govt. of India-2017; Functioning of various nutrition and health organizations in India viz., NIN (National Institution of Nutrition), FNB (Food and Nutrition Board), ICMR (Indian Council of Medical Research), IDA (Indian Dietetics Association),WHO-India, UNICEF-India. National Health Mission: National Rural Health Mission (NRHM) Framework, National Urban Health Mission (NUHM) Framework. Women & Child Health Care Schemes: Reproductive, Maternal, Newborn, Child and Adolescent Health (RMNCH+); Janani Shishu Suraksha Karyakaram (JSSK); Rashtriya Bal Swasthya Karyakaram(RBSK); India Newborn Action Plan (INAP); Adolescent Health- Rashtriya Kishor Swasthya Karyakram (RKSK). Disaster Management – Containment, Control and Prevention of Epidemics and Pandemics – Acts,	15	Cognitive Skills & Life Skills

		Guidelines and Role of Government and Public.		
3	Hygiene	Hygiene – Definition; Personal, Community, Medical and Culinary hygiene; WASH (Water, Sanitation and Hygiene) programme. Rural Community Health: Village health sanitation & Nutritional committee (Roles & Responsibilities); About Accredited Social Health Activist (ASHA); Village Health Nutrition Day, Rogi Kalyan Samitis. Community & Personal Hygiene: Environmental Sanitation and Sanitation in Public places. Public Awareness through Digital Media - An Introduction to Mobile Apps of Government of India: NHP, Swasth Bharat, No More Tension, Pradhan Mantri Surakshit Mantritva Abhiyan (PM Suman Yojana), My Hospital (Mera aspataal), India fights Dengue, JSK Helpline, Ayushman Bhava, Arogya Setu, Covid 19app.	15	Cognitive Skills & Life Skills

Books for Reference:

1. Bamji, M.S., K. Krishnaswamy & G.N.V. Brahmam (2009) Textbook of Human Nutrition(3rd edition) Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi
2. Swaminathan (1995)Food & Nutrition(Vol I, Second Edition) The Bangalore Printing &Publishing Co Ltd., , Bangalore
3. Vijaya Khader (2000)Food, nutrition & health, Kalyan Publishers, New Delhi
4. Srilakshmi, B., (2010)Food Science, (5th Edition) New Age International Ltd., New Delhi

SEMESTER – IV
S21 BC 4.1: Analytical Biochemistry

Total Teaching Hours: 60

No. of Hours / Week: 4

CObj_ID	Course Objectives
CObj_1	To understand the strategies in biochemical investigations employing various basic biochemical techniques.
CObj_2	To understand the principles and applications of various techniques employed for separation and analysis of biomolecules.

CObj_3	To familiarize with basic culture techniques in microbiology.

CO_ID	Course Outcomes
CO_1	To understand the principles of biochemical analysis employing various bioanalytical techniques.
CO_2	To comprehend about general principles of various chromatographic techniques useful for bioanalysis.
CO_3	To analyze biomolecules using electrophoretic methods.
CO_4	To appreciate the importance of spectroscopic techniques in molecular analysis.
CO_5	To study the properties of microorganisms and their handling techniques.

CO-PO Mapping

	PO_1	PO_2	PO_3	PO_4	PO_5	PSO_1	PSO_2	PSO_3	PSO_4	PSO_5

CO_1	X	X	-	X	-	X	X	X	X	X
CO_2	X	X	X	X	-	X	X	X	X	X
CO_3	X	X	X	X	-	X	X	X	X	X
CO_4	X	X	X	X	-	X	X	X	X	X
CO_5	X	X	X	X	X	X	X	X	X	X

Course Content

Sl.No	Module title	Module Content	Number of Hours	Skills Developed

1	Biochemical investigations	Outline of strategies in biochemical investigations, models for biochemical investigations, introduction to animal cell culture and plant tissue culture, applications. Preparation of extracts for biochemical investigations. Methods of tissue homogenization: (Potter-Elvehjem, mechanical blender, sonicator and enzymatic). Centrifugation techniques, principles and applications- differential, density gradient. Ultracentrifugation- preparative and analytical. Solvent extraction, solid phase extraction, Soxhlet extraction. Physicochemical properties of metabolites and drugs from plant materials.	15	Cognitive Skills
2	Chromatography	General Principles of chromatography – adsorption and partition, partition coefficient, Rf values Types of chromatographic techniques, Principle and applications – Paper chromatography- solvents, Rf value, applications; Thin layer chromatography- principle, choice of adsorbent and solvent, Rf value, applications; Gel filtration, Ion- exchange- principle, resins, action of resins, experimental techniques, applications, Affinity chromatography. HPLC: Instrumentation, mobile phases in HPLC, factors affecting resolution in HPLC chromatography. Normal and reverse, Fast protein liquid chromatography (FPLC). Gas chromatography: Principle and design of instrument. Factors affecting GC, stationary phase, mobile phase.	15	Cognitive Skills
3	Electrophoresis and spectroscopy	Electrophoresis: principle, non-denaturing PAGE, denaturing electrophoresis (PAGE), SDS-PAGE, SDS-PAGE in reducing conditions, isoelectrofocusing. 2D electrophoresis, Immuno-electrophoresis: Dot blotting and immune-diffusion tests with antibodies, zone electrophoresis/immune- electrophoresis. Rocket electrophoresis, counter immune-electrophoresis, Agarose gel electrophoresis of nucleic acids. Spectroscopic techniques: Beer and Lambert's law, Principles of colorimeter, spectrophotometer, circular dichroism (CD), CD of biomolecules (proteins) and LD (linear dichroism) of biomolecules. IR spectroscopy, NMR: Principle, biochemical application of NMR. Mass spectroscopy: Principle, experiment, ionization modes, equipments in MS analysis Uses of MS in Biochemistry	15	Cognitive Skills

4	Isotopic and immunological techniques	Radioisotopic methods of analysis - Radio isotopes, units of radio activity, half life, β and γ- emitters, detection and measurement of radioactivity – GM counter, scintillation counter. Autoradiography. Applications of radioisotopes – ^3H, ^{14}C, ^{131}I, ^{60}Co and ^{32}P. Biological effects of radiations. Important biological discoveries using radioisotopes. Immunological techniques – antigen-antibody interaction, immune-diffusion tests with antibodies, Immuno-electrophoresis: zone electrophoresis, Rocket electrophoresis, counter immune-electrophoresis. Immunoblotting. Radioimmunoassays (RIA). ELISA – principle, types and applications. Immunofluorescence. Introduction to immunofluorescent staining and flow cytometry. Introduction to biosensors.	15	Cognitive Skills

Books for Reference:

1. Analytical techniques in Biochemistry and Molecular Biology; Katoch, Rajan. Springer (2011)
2. Basic Methods for the Biochemical Lab; Martin Holtzhauer, Springer, (2007).
3. Principles and Techniques of Biochemistry and Molecular Biology
4. 7th Edn. Keith Wilson and John Walker, Cambridge University Press, (2010).
5. Principles of Gene Manipulations; 6th Edn. S.B. Primrose, R.M. Twyman, and R.W. Old, Blackwell Science (2012).
6. Techniques in Molecular Biology, Walker and Gastra, Croom Helm, (1983)
7. Biochemistry LabFax, Ed. J.A.A. Chambers and D. Rickwood,, Blackwell Science, (1993),
8. Protein Purification Applications, S.L.V. Harris and Angal IRL Press, (1990)
9. Laboratory Techniques in Biochemistry and Molecular Biology, Work and Work Vol. I & II, North Holland, (1969).
10. Biochemistry LabFax, Ed. J.A.A. Chambers and D. Rickwood,, Blackwell Science, (1993),
11. Protein Purification Applications, S.L.V. Harris and Angal IRL Press, (1990)
12. Laboratory Techniques in Biochemistry and Molecular Biology, Work and Work Vol. I & II, North Holland, (1969).

S21 BC 4.2: BIOCHEMICAL TECHNIQUES – Practical 4

Total Teaching Hours: 60

No. of Hours / Week: 4

CObj_ID	Course Objectives
	<i>This course aims to</i>
CObj_1	Enable students to develop familiarity with advanced laboratory biochemical techniques.
CObj_2	Enable students to investigate the biomolecules using their physico chemical properties.
CObj_3	Develop <i>hands-on</i> experience of handling analytical instruments.

CO_ID	Course Outcomes
	<i>After the course, students will be able to</i>
CO_1	Learn various techniques useful for separation of biomolecules
CO_2	Perform chromatography methods for separation of amino acids and carbohydrates
CO_3	Separate and purify proteins by various chromatographic methods
CO_4	Analyze proteins and nucleic acids by electrophoresis and spectrophotometry.
CO_5	Isolate, culture and study microorganisms in laboratory.

CO-PO Mapping

	PO_1	PO_2	PO_3	PO_4	PO_5	PSO_1	PSO_2	PSO_3	PSO_4	PSO_5
CO_1	X	X	X	X	-	X	X	X	X	X
CO_2	X	X	X	X	-	X	X	X	X	X
CO_3	X	X	X	X	-	X	X	X	X	X
CO_4	X	X	X	X	-	X	X	X	X	X
CO_5	X	X	X	X	X	X	X	X	X	X

Course Content

Sl.No	Module title	Module Content	Number of Hours	Skills Developed
1	Practical 1	Separation of amino acids by paper chromatography	4 Hrs/week	Employable & Analytical Skills
2	Practical 2	Separation of serum proteins by paper electrophoresis		
3	Practical 3	Absorption maxima of coloured substances (p-Nitrophenol and Methyl Orange)		
4	Practical 4	Absorption maxima of proteins (BSA) and nucleic acids		
5	Practical 5	Separation of plant pigments using paper chromatography		
6	Practical 6	Separation of plant pigments by column chromatography using silica gel-G		
7	Practical 7	Demonstration of separation of lipids by TLC		
8	Practical 8	Extraction and estimation of lycopene from tomato fruit		
9	Practical 9	Extraction and estimation of anthocyanin from flowers		
10	Practical 10	Study of antigen and antibody interaction by immunodiffusion		
11	Practical 11	Agarose gel electrophoresis of DNA		

REFERENCES:

1. Basic Methods for the Biochemical Lab; Martin Holtz hauer, Springer, (2007).
2. Principles and Techniques of Biochemistry and Molecular Biology 7th Edn.Keith Wilson and John Walker, Cambridge University Press, (2010).
3. Laboratory Techniques in Biochemistry and Molecular Biology, Work and WorkVol. I & II, North Holland, (1969).
4. Principle and Techniques of Practical Biochemistry; Keith Wilson and John M.Walker, Cambridge University Press (2000).
5. Biochemistry LabFax, Ed. J.A.A. Chambers and D. Rickwood,, BlackwellScience, (1993).
6. Protein Purification Applications, S.L.V. Harris and Angal IRL Press, (1990) .
7. Laboratory Techniques in Biochemistry and Molecular Biology, Work and WorkVol. I & II, North Holland, (1969).

SEMESTER IV – Open Elective

OPE 4.1: Nutraceuticals and functional foods

Total Teaching Hours: 45

No. of Hours / Week: 3

CObj_ID	Course Objectives
CObj_1	To provide students with an overview of the field of functional foods, nutraceuticals and natural health products
CObj_2	To enable students to understand the functional food concept as related to ingredient efficacy and safety and bioactive ingredient-disease relationships
CObj_3	To impart knowledge about regulatory aspects of functional foods; and requirements for standards for health claims

CO_ID	Course Outcomes <i>After studying this course, student will be able</i>
CO_1	Understand the basic concepts of Nutraceuticals and functional foods, their chemical nature and importance
CO_2	Understand the role of Nutraceuticals and functional foods in health and disease
CO_3	Identify the role of Nutraceuticals in health and disease and apply it to real time scenarios
CO_4	Understand the safety issues, health claims and the safety issues about Nutraceuticals
CO_5	Comprehend the associated regulations for Nutraceuticals and functional foods

CO-PO Mapping

	PO_1	PO_2	PO_3	PO_4	PO_5	PSO_1	PSO_2	PSO_3	PSO_4	PSO_5
CO_1	X	X	-	-	-	X	X	-	-	X
CO_2	X	-	X	X	-	X	X	-	-	X
CO_3	X	X	-	X	X	X	X	X	X	X
CO_4	X	X	-	-	X	X	X	X	X	X

CO_5	X	-	X	X	X	X	-	X	X	X

Course Content

Sl.No	Module title	Module Content	Number of Hours	Skills Developed
1	Introduction And Significance	Introduction to Nutraceuticals and functional foods; importance, history, definition, classification, understanding benefits of functional foods and nutraceuticals, list of functional foods and their benefits, Phytochemicals, zoo chemicals and microbes in food, plants, animals and microbes. Properties and functions of various nutraceuticals such as lycopene, isoflavonoids, glucosamine, phytosterols, free radicals, mushroom extracts, concept of antioxidants, phytoestrogens in plants; isoflavones; flavonols, polyphenols, tannins, saponins, lignans, Chitin; Carotenoids.	15	Cognitive Skills & Life Skills
2	Role In Health And Disease	Role of nutraceuticals/functional foods in management of health and disease, nutraceuticals for gastrointestinal disorders, cardiovascular diseases, hypertension, cancer, diabetes, cholesterol management, obesity, joint pain, immune enhancement, age-related macular degeneration, mood disorders. Importance and functions of probiotic, prebiotic and symbiotic and their applications, Functional foods and immune competence; role and use in obesity and nervous system disorders.	15	Cognitive Skills & Life Skills
3	Safety Issues	Important definitions associated with the nutraceutical and functional food industry. Health Claims, regulations and safety issues- International and national scenarios. Basis of claims for a compound as a nutraceuticals, regulatory aspects for nutraceuticals / functional foods including CODEX, nutraceuticals bridging gap between food and drug. Adverse effects and toxicity of nutraceuticals, nutrigenomics, recent advancements and techniques in the formulation and processing of functional foods	15	Cognitive Skills & Life Skills

Books for Reference:

1. Cupp J & Tracy TS. 2003. Dietary Supplements: Toxicology and Clinical Pharmacology. Humana Press.
2. Gibson GR & William CM. 2000. Functional Foods - Concept to Product.
3. Goldberg I. 1994. Functional Foods: Designer Foods, Pharma Foods.
4. Losso JN. 2007. Anti-angiogenic Functional and Medicinal Foods. CRC Press.
5. Manson P. 2001. Dietary Supplements. 2nd Ed. Pharmaceutical Press.
6. Campbell JE & Summers JL. 2004. Dietary Supplement Labeling Compliance.
7. Robert EC. 2006. Handbook of Nutraceuticals and Functional Foods. 2nd Ed.
8. Shi J. (Ed.). 2006. Functional Food Ingredients and Nutraceuticals: Processing Technologies. CRC Press.
9. Wildman, Robert "Handbook of Nutraceuticals and Functional Foods". CRC Press, 2016.
10. Geoffrey Webb. "Dietary Supplements and Functional Foods". John Wiley & Sons, 2011.
11. Shi, John, Fereidoon Shahidi and Chi-Tang Ho "Asian Functional Foods". CRC/Taylor & Francis, 2005
12. Bagchi, D., Preuss, H.G. and Swaroop, A. eds., 2015. Nutraceuticals and functional foods in human health and disease prevention. CRC Press.

NEP-Curriculum Framework for Approval
B.Sc.– Matrix for V Semester (w.e.f. 2021-22 Onwards)

V Semester							
Category	Course Code	Course	Teaching Hours	Course Components			Credits
				L	T	P	
DSC5	BC 5.1	Biochemistry of macromolecules	60	4	-	-	4
DSC5	BC 5.2	Biochemistry Practical VI – Macromolecules Lab	60	-	-	4	2
DSC6	BC 6.1	Human Physiology & Cell Biology	60	4	-	-	4
DSC6	BC 6.2	Biochemistry Practical V - Physiology & Cell Biology Lab	60	-	-	4	2
DSC5	S21 GN5.1/ S21 BT5.1/ S21 ZO5.1	Genetics/ Biotechnology/ Zoology (T)	60	4	-	-	4
DSC5	S21 GN5.2/ S21 BT5.2/ S21 ZO5.2	Genetics/ Biotechnology/ Zoology (P)	60	-	-	4	2
DSC6	S21 GN6.1/ S21 BT6.1/ S21 ZO6.1	Genetics/ Biotechnology/ Zoology (T)	60	4	-	-	4
DSC6	S21 GN6.2/ S21 BT6.2/ S21 ZO6.2	Genetics/ Biotechnology/ Zoology (P)	60	-	-	4	2
SEC-3		R-Programming – A practical approach	30	1	-	2	2
Total							26

DSC- Discipline-Specific Course
DSE- Discipline-Specific Elective
SEC- Skill Enhancement Course

Continuous Internal Assessment – Scheme of Evaluation
For Theory Courses

End Semester Examination: 60%
Continuous Internal Assessment: 40%

Activities (CIA: 40 Marks)	Proposed and Approved Scheme		Total Marks (40)
	IA-1	IA-2	

Session Test Maximum Marks	30	30	
1. Weightage (Marks)	10	10	20
2. Assignment (Marks)	20		20
i. Writing	10		
ii. Quiz / Presentation / Creating diagrams /charts / Classwork / Case study / Viva / Field work etc.	05		
iii. Classroom participation	05		
Total			40

**Continuous Internal Assessment – Scheme of Evaluation
For Practical Courses**

End-Semester Examination: 50%

Continuous Internal Assessment: 50%

CIA (25 marks) + End Semester Exam (25 marks)	
Maximum Marks (Internal Assessment)	25
1. Weightage (Marks)	15
2. Record work (Marks)	05
3. Quiz/ Presentation/ creating diagrams/ charts/ Lab work/	05
Total (Marks)	25

SEMESTER – V

S21 BC 5.1: Biochemistry of Macromolecules

Total Teaching Hours: 60

No. of Hours per Week: 4

(4 credits)

CObj	Course Objectives

COBj_1	To understand chemical basis of biological process.
COBj_2	To revisit the fundamental concepts of correlation of macromolecules and its chemical reactions.
COBj_3	To familiarize with understanding of significance of macromolecular structures in understanding the life process.

CO	Course Outcomes
CO_1	To appreciate Biochemistry as a discipline by understanding the chemical basis of biological systems.
CO_2	To understand the basic concepts of carbohydrate structures and biological roles relevant to living cell growth and division.
CO_3	To know the significance of coordination of lipid molecules and their properties in a living cell structure.
CO_4	To understand the structural and chemical properties of amino acids and proteins in living systems.
CO_5	To understand the composition and structure of RNA and DNA those regulate the biological process.

CO-PO Mapping

	PO_1	PO_2	PO_3	PO_4	PO_5
CO_1	X	X	X	-	-
CO_2	X	-	X	-	-
CO_3	X	-	X	-	-
CO_4	X	X	X	-	-
CO_5	X	X	X	-	-

Course Content

Sl. No.	Unit/Chapter title	Content	Number of Hours	Skills Developed
1	Carbohydrates	Biological importance ; Monosaccharides : Elucidation of structure of glucose (open chain and ring structure); Epimers and Anomers-definition and example ; Brief review on configurational and conformational aspects of carbohydrates; Derived monosaccharides: structures and biological importance of : Amino sugars: glucose amine and galactosamine and their N-acetylated forms, Sugar phosphates:	15	Cognitive Skills & Research Skills

		Dribose-5-P, β-D-ribose-5-P, glucose-6-P and fructose -6-diphosphate, Sugar acids: types with examples; Disaccharides: Structure of isomaltose, cellobiose and trehalose; brief discussion on reducing property; Polysaccharides: classification with examples ; structure, properties and importance of homo and hetero polysaccharides, Structure, properties and importance of structural (cellulose and chitin) and storage polysaccharides (starch and glycogen), Blood group and bacterial polysaccharides; glycosaminoglycans, cardioglycosides, Glycoproteins-structure and functions.		
2	Lipids	Biological importance; Classification. Fatty acids: definition, classification, examples and structures, properties of fatty acids: melting point, solubility, cis-trans isomerism, reaction with NaOH, alcohol, catalytic hydrogenation, Acylglycerols: mono, di, triacylglycerols (general, structure). Hydrolysis of acylglycerols: Saponification, saponification number; Acid hydrolysis of triglycerides, unsaturation in acyl glycerols and iodine number; Rancidity: definition, oxidative and hydrolytic rancidity; Phosphoglycerides: structure and biological roles of phosphatidylcholine, phosphatidyl ethanolamine, phosphatidyl serine, phosphatidyl inositol. Sphingolipids: structure of 4-sphingenine, ceramides and sphingomyelin, biological importance. Glycosphingolipids: Biological importance and general structure of cerebrosides and gangliosides; Prostaglandins: definition and example, structure of PGE₂ and PGF₂ and biological role of prostaglandins in general; Thromboxanes and leukotrienes; Waxes: definition, types, biological importance; Lipoproteins: Types and functions, clinical significance; behaviour of amphipathic lipids in water; formation of micelles, bilayers and vesicles; Membrane: common features of membranes. Steroids: definition, functions of cholic acid.	15	Cognitive Skills & Research skills
3	Amino acids and Proteins	Structure and classification of α-amino acids based on the polarity of R group; acid – base properties of amino acids. Non – standard, non-protein and biologically active amino acids. UV-light absorption property of amino acids, amino acids as ampholytes – zwitterion structure of amino acids, Isoelectric pH, titration curve of alanine; reactions of amino acids with ninhydrin, FDNB, Edman's reagent and decarboxylation of amino acids; peptides: structure and conformation, biological importance of peptides.	15	Analytical skills, Cognitive Skills & Research Skills

		Proteins: classification based on composition shape and function with examples; color reactions: ninhydrin, xanthoproteic, Lowry, Sakaguchi's and Biuret reaction; Overview of structural organization of proteins: Primary structure- importance of restoration of primary structure by taking sickle cell anemia as example, Secondary structure-Types –α-helix, β-pleated structure, triple helix – example and characteristic features of each type; Structure of fibrous proteins: α-keratin, silk fibroin and collagen. Tertiary structure and Quaternary structure-factors stabilizing both; Structure and function of myoglobin and hemoglobin. Denaturation-Denaturing agents and mechanism of operation, renaturation of ribonuclease-Anfinsen's experiment.		
4	Nucleic acids	Structure and properties of Nucleosides and Nucleotides, configuration and conformation. Composition of RNA and DNA, Physico-chemical properties of nucleic acids - effect of alkali, acid and heat (denaturation and renaturation), features of phosphodiester bond, endonucleases. Properties of nucleic acids in solution. Structure of nucleic acids– primary, secondary and tertiary structure of DNA, Complementary base pairing, features of DNA double helix (Watson-Crick model), Secondary structure of RNA, Secondary structure of tRNA and role of secondary structure in mRNA stability. Nucleoproteins – histone and nonhistone. Isolation of nucleic acids and sequencing.	15	Cognitive Skills, Analytical & Research Skills

Books for Reference:

1. Biochemistry; Voet , D. and Voet, J.G. [Eds.] (1999) 3 Ed. Jhon Wiley and sons.
2. Principles of Biochemistry; Lehninger et al., [Eds.] (1997) 2nd Edn. Worth Publishers.
3. Text Book of Biochemistry with Clinical correlations; Thomas Devlin [Ed.] (2010), Wiley and sons.
4. Biochemistry VI Edition; Jeremy M Berg, John L Toymoczko and Lubert Stryer, W H Freeman and Co. (2006).
5. Biochemistry; David Rawn, J, Neil Patterson Publishers (1989).
6. Complex Carbohydrates, Sharon, N. Addison Wisely, (1975).
7. Nucleic acid Biochemistry and Molecular Biology, Mainwaring et al., Blackwell Scientific (1982).
8. Principles of Biochemistry; Smith et al., McGraw Hill (1986).

S21 BC 5.2: Macromolecules Lab – Practical 5
Total Teaching Hours: 60
No. of Hours per Week: 4
(2 credits)

CObj	Course Objectives
CObj_1	Familiarize students with the principles of basic macromolecular analysis.
CObj_2	Provide experimental practice of quantitative identification of various biomolecules.
CObj_3	Enable students to prepare biological samples for analysis.

CO	Course Outcomes
CO_1	Perform systematic analysis of biomolecules like carbohydrates, amino acids, lipids, vitamins and proteins
CO_2	Perform qualitative analysis of carbohydrates, amino acids and lipids
CO_3	Perform quantitative analysis of carbohydrates, amino acids and lipids
CO_4	To analyze the content of biomolecules like vitamins.
CO_5	To prepare biological samples for analysis and perform qualitative and quantitative analyses

CO-PO Mapping

	PO_1	PO_2	PO_3	PO_4	PO_5
CO_1	X	X	-	X	-
CO_2	X	X	-	X	-
CO_3	X	X	-	X	-
CO_4	X	X	-	X	-
CO_5	X	X	-	X	-

Course Content

Sl.No	Module title	Module Content	Number of Hours	Skills Developed

1	PRACTICAL V Macromolecules Lab	Qualitative analysis of carbohydrates.	4 Hrs/week	Employable, Research & Analytical Skills
2		Qualitative analysis of amino acids and proteins.		
3		Qualitative analysis of lipids.		
4		Extraction and determination of reducing carbohydrate content in fruit samples by DNS method.		
5		Estimation of amino acids by formal titration.		
6		Extraction and estimation of ascorbic acid from biological samples (chilli/citrus fruits) by titrimetric method.		
7		Determination of iodine value of oils/ fats samples.		
8		Demonstration: Determination of pI value of amino acids (glycine/alanine).		

Books for Reference:

1. Practical Biochemistry; Principles and Techniques; K. Wilson and J. Walker (1995), Cambridge University.
2. Practical Clinical Biochemistry- Harold Varley CBS, New Delhi
3. An Introduction to practical Biochemistry—Plummer D. T, Tata Mc Graw Hill

S21 BC 6.1 Human Physiology and Cell Biology

Total Teaching Hours: 60

No. of Hours per Week: 4

(4 credits)

CObj	Course Objectives
CObj_1	To understand the structures and purposes of basic components of cells, especially membranes and organelles
CObj_2	To revisit the fundamentals concepts of cells and tissues, organ systems and their working

CObj_3	To familiarize with physiology and biochemistry of processes and organization of various organ systems

CO	Course Outcomes
CO1	To appreciate the concepts of cell biology, tissue organization, organ systems and physiological processes
CO2	To comprehend the structural organization, functioning and important cellular events of cells and cell organelles
CO3	To understand importance of tissues, and organization, dynamics and role of organs in circulatory and skeletal systems
CO4	To understand the biochemistry and physiology of digestive, excretory and respiratory systems
CO5	To recognize the fundamentals of biochemistry and physiology of muscular, nervous and endocrine systems

CO-PO Mapping

	PO1	PO2	PO3	PO4	PO5
CO1	X	-	-	-	-
CO2	X	X	-	-	-
CO3	X	-	-	-	-
CO4	X	-	-	-	-
CO5	X	-	-	-	-

Course Content

Sl. No.	Unit/Chapter title	Content	Number of Hours	Skills Developed
1	Cell biology	Fundamentals of cell structure, discovery of cells, basic properties of cells, different classes of cells. Cells as experimental models, Microscopy (light, phase contrast, fluorescence microscopy, electron microscopy) and its applications. Organelles – structure and function of mitochondria, chloroplast, ER, Golgi apparatus, ribosomes, morphology and functions of peroxisomes and glyoxysomes, cytoskeleton, plant cell vacuoles. Centrifugation for subcellular fractionation	15	Cognitive Skills & Research Skills

		Cellular membranes – chemical composition, fluidity, fluid mosaic model, dynamic nature of membranes, transport across cell membranes, membrane potentials. Passive and active transports, permeases, pumps, co-transport, symport, antiport, endocytosis, exocytosis. Cell cycle, restriction point, and checkpoints. Cell division, mitosis, meiosis. Apoptosis and necrosis, brief outline of FACS and its applications.		
2	Cells, tissues and organ systems	Tissues - Classification, epithelial, connective tissues. Extracellular matrix - cell matrix proteins, cell matrix interactions; cell-cell interactions. Skeletal system - role of collagen and elastin in bone composition, growth and remodeling, factors affecting growth. Blood and Body fluids: Composition of body fluids; blood; Properties, composition and functions; Erythropoiesis, blood coagulation - outline of extrinsic and intrinsic pathway. Composition and functions of CSF and Lymph. Anemias, polycythemia, hemophilia and thrombosis. Cardiovascular system: Blood vessels- anatomy and physiology; Blood pressure. Regulation of heart rate.	15	Cognitive Skills & Research Skills
3	Physiology of respiration, digestion and excretion	Respiratory system: Anatomy of Respiratory tract, Mechanism of respiration, Exchange of gases and transport of gases. Acid base balance by lungs and kidneys, Bohr's effect, chloride shift. Digestive system: Outline of digestive system; composition and functions of major digestive secretions. Digestion and absorption of carbohydrates, lipids, proteins and nucleic acids. Excretory system: structure and functions of nephron; glomerular filtration, tubular absorption and secretion; Concentration of urine, GFR, composition of urine, renal failure, nephrites.	15	Cognitive Skills & Research Skills
4	Physiology of muscular, nervous and endocrine systems	Muscular system: Muscle types; smooth, skeletal and cardiac muscle fibers; Muscle proteins –contractile and non-contractile. Definition of sarcomeres and mechanism of contraction. Energetics of muscle contraction. Regulation of skeletal muscle contraction. Muscular dystrophies. Nervous system: Structure and classification of	15	Cognitive Skills & Research Skills

		neurons, membrane potential, resting membrane potential and action potential; Mechanism of synaptic transmission, Neurotransmitters–classification, neurotransmitter receptors. Endocrinology: Introduction to endocrine glands - chemistry of hormones and hormonal action. Functions of the hormones of hypothalamus, pituitary glands, adrenal cortex, thyroid, parathyroid and pancreas (Insulin, Glucagon and Somatostatin).		

Books for Reference:

1. The Cell: A Molecular Approach (2009) 5th ed., Cooper, G.M. and Hausman, R.E., ASM Press & Sunderland (Washington DC), Sinauer Associates, MA, ISBN:978-0-87893- 300-6.
2. Molecular Cell Biology (2012) 7th ed., Lodish, H., Berk, A., Zipursky, S.L., Matsudaira, P., Baltimore, D. and Darnell. J., W.H. Freeman & Company (New York), and ISBN: 13:978- 1-4641-0981-2 / ISBN: 10: 1-4641-0981-8.
3. Molecular Biology of the Cell (2008) 5th ed., Alberts, B., Johnson,A., Lewis, J.,and Enlarge, M., Garland Science (Princeton), ISBN: 0-8153-1619-4 / ISBN: 0-8153-1620-8.
4. Lehninger: Principles of Biochemistry (2013) 6th ed., Nelson, D.L. and Cox, M.M. W.H. Freeman & Company (New York), ISBN: 13: 978-1-4641-0962-1 /ISBN: 10-14641-0962- 1.
5. Vander’s Human Physiology (2008) 11th ed., Widmaier, E.P., Raff, H. and Strang, K.T. McGraw Hill International Publications, ISBN: 978-0-07-128366-3.
6. Endocrinology (2007) 6th ed., Hadley, M.C. and Levine, J.E. Pearson Education (New Delhi), Inc. ISBN: 978-81-317-2610-5.
7. Human Physiology by C. C. Chatterjee.13ed Vol 1 (PB 2020), CBS Publishers and Distributors.
8. Biochemistry By Debajyoti Das, Edition: 14th, Publisher: Academic Publishers, Year: 2010, ISBN: 9789380599175
9. Guyton and Hall, Textbook of Medical Physiology (Guyton Physiology) 2015, Elsevier Publication.

S21 BC 6.2: Physiology and Cell Biology Lab – Practical 6

Total Teaching Hours: 60

No. of Hours per Week: 4

(2 credits)

CObj	Course Objectives

	This course aims to
CObj_1	Familiarize students with cell biology and physiological experimentation on cells and tissues
CObj_2	Provide experimental practice of cellular techniques including microscopy, cell counting and organelle analysis
CObj_3	Enable students to be able to perform analysis and interpret physiological data.

CO	Course Outcomes
CO_1	Evaluate and apply knowledge of techniques in cellular biology and physiology and interpret, analyse, describe and present experimental data
CO_2	Develop skill and proficiency in preparation of slides and identifying structures in permanent slides
CO_3	Evaluate cytological techniques including microscopy and cell counting
CO_4	Perform systematic analysis of cell components like organelles and DNA
CO_5	Understanding simple physiological functions such as sensory perception, heart rates and blood clotting

CO-PO Mapping

	PO_1	PO_2	PO_3	PO_4	PO_5
CO_1	X	X	-	X	-
CO_2	X	X	X	X	-
CO_3	X	X	X	X	-
CO_4	X	X	X	X	-
CO_5	X	X	X	X	X

Course Content

Sl.No	Module title	Module Content	Number of Hours	Skills Developed
1	Practical VI	Study of cell components, mitosis and meiosis using permanent slides	4 Hrs/week	Employable, Research & Analytical Skills
2	Physiology and Cell Biology Lab	Study of divisional stages of mitosis by temporary preparation of onion root tip squash.		
3		Temporary slide preparation of animal cells (squamous epithelium) and cytochemical		

	staining of DNA by fuelgen		
4	Cell counting and viability		
5	ABO Blood grouping		
6	Blood smear preparation and differential cell count		
7	Estimation of hemoglobin by Sahli's haemocytometer		
8	Determination of blood clotting time and bleeding time, ESR and PCV.		
9	Isolation of organelles by sub-cellular fractionation.		
10	Demonstration of diffusion and osmosis		
11	Demonstration of the function of olfactory nerve.		
12	Demonstration of positive and negative feedback mechanism experiments.		

Books for Reference:

1. Analytical techniques in Biochemistry and Molecular Biology; Katoch, Rajan. Springer (2011)
2. Basic Methods for the Biochemical Lab; Martin Holtzhauer, Springer, (2007).
3. Principles and Techniques of Biochemistry and Molecular Biology 7th Edn. Keith Wilson and John Walker, Cambridge University Press, (2010).
4. Laboratory Manual of Cell Biology Paperback – 1. January 2018 by Rina Majumdar and Rama Sisodia. Prestige Publishers.
5. Molecular And Cell Biology Laboratory Manual Book. John S. Choinski, Jr., Dwight Dimaculangan and Jennifer Barwick. 2005. Indo-American Books.
6. Karp, G. 2010. Cell and Molecular Biology: Concepts and Experiments. 6th Edition, John Wiley & Sons. Inc.
7. De Robertis, E. D. P. and De Robertis R. E. 2009. Cell and Molecular Biology, 8th edition. Lippincott Williams and Wilkins, Philadelphia.
8. Cooper G. M. Hausman R. E. 2009. The Cell: A Molecular Approach. 5th edition. ASM Press and Sunderland, Washington D. C.; Sinauer Academic Press.
9. Becker W. M., Kleinsmith L.J. and Bertni G. P. 2009. The World of the Cell. 7th edition. Pearson Benjamin Cummings Publishing, San Francisco.

NEP-Curriculum Framework for Approval
B.Sc.– Matrix for VI Semester (w.e.f. 2021-22 Onwards)

VI Semester							
Category	Course Code	Course	Teaching Hours	Course Components			Credits
				L	T	P	
DSC7	BC 7.1	Enzymology	60	4	-	-	4
DSC8	BC 7.2	Biochemistry Practical VII - Enzymology Lab	60	-	-	4	2
DSC7	BC 8.1	Intermediary metabolism	60	4	-	-	4
DSC8	BC 8.2	Biochemistry Practical VIII - Bioenergetics and Metabolism Lab	60	-	-	4	2
DSC7	S21 GN7.1/ S21 BT7.1/ S21 ZO7.1	Genetics/ Biotechnology/ Zoology (T)	60	4	-	-	4
DSC8	S21 GN7.2/ S21 BT7.2/ S21 ZO7.2	Genetics/ Biotechnology/ Zoology (P)	60	-	-	4	2
DSC7	S21 GN8.1/ S21 BT8.1/ S21 ZO8.1	Genetics/ Biotechnology/ Zoology (T)	60	4	-	-	4
DSC8	S21 GN8.2/ S21 BT8.2/ S21 ZO8.2	Genetics/ Biotechnology/ Zoology (P)	60	-	-	4	2
SEC-4		Professional Communication	45	2	-	1	2
Total							26

DSC- Discipline-Specific Course
DSE- Discipline-Specific Elective
SEC- Skill Enhancement Course

SEMESTER – VI
S21 BC 7.1: Enzymology

Total Teaching Hours: 60

No. of Hours per Week: 4

(4 credits)

CObj	Course Objectives

COBj_1	To provide detailed knowledge about enzymes, the biological catalysts with remarkable properties.
COBj_2	To outline the diverse applications of enzymes in disease diagnosis and therapy as well as in industry
COBj_3	To develop an understanding of enzyme kinetics, mechanism of enzyme action, enzyme inhibition and their regulation.

CO	Course Outcomes
CO_1	To understand the nature and importance of enzymes in living systems.
CO_2	To gain insight into the molecular basis of catalysis by enzymes and the underlying basis of their specificity
CO_3	To comprehend the applications of enzymes in research and medicine as well as in industry, which will bolster their foray into industrial and biomedical research.
CO_4	To analyze the concepts of kinetics of enzyme catalyzed reactions, their mechanisms of enzyme action and clinical importance of enzyme inhibitors
CO_5	To appreciate how enzymes are regulated and the physiological importance of enzyme regulation in the cell

CO-PO Mapping

	PO_1	PO_2	PO_3	PO_4	PO_5
CO_1	X	-	X	-	-
CO_2	X	-	-	X	-
CO_3	X	X	X	X	X
CO_4	X	X	X	X	X
CO_5	X	-	X	-	-

Course Content

Sl. No.	Unit/Chapter title	Content	Number of Hours	Skills Developed
1	Introduction to Enzymes and its classification	General characteristics of enzymes; Nomenclature and classification of enzymes and E.C. No. of enzymes. Co-factor and prosthetic group, apoenzyme, holoenzyme. Activation energy and transition state theory. active site and its characteristics. Enzyme specificity – bond specificity, substrate specificity (absolute and group specificity, optical and geometrical specificity; Theories	15	Cognitive Skills, Research skills and Analytical skills

		related to enzyme substrate interaction – Fischer's lock and key hypothesis, Koshland's induced fit hypothesis.		
2	Enzyme catalysis	Enzyme activity, specific activity, units to express enzyme activity. Factors affecting enzyme activity. Chemical nature of enzyme catalysis-General acid-base catalysis, electrostatic catalysis, covalent catalysis, intramolecular catalysis. Metal activated enzymes and metalloenzymes. Coenzymes in enzyme catalyzed reactions (role of NAD, TPP and PLP). Fundamentals of enzyme assays.	15	Cognitive Skills, Research skills and Analytical skills
3	Enzyme kinetics and inhibition	Michaelis-Menten equation, Lineweaver-Burk plot, Determination and significance of K_M and V_{max}. Monomeric and oligomeric enzymes-Definition with examples. Cooperativity in catalysis. Deviation from Hyperbolic enzyme kinetics-Sigmoidal kinetics (MWC and KNF models). Significance of sigmoidal behavior. Types of bi-substrate reactions (sequential – ordered and random, ping pong reactions), examples. Reversible inhibition (competitive, uncompetitive, non-competitive and mixed) and irreversible inhibition. Substrate inhibition. Structural analogs (allopurinol and methotrexate).	15	Cognitive Skills, Research skills and Analytical skills
4	Enzyme regulation and applications	Enzyme regulations- feedback inhibition, allosteric modulation (aspartate transcarbamylase), regulation by reversible covalent modification (glycogen phosphorylase and glycogen synthase). Proteolytic cleavage (zymogen activation- chymotrypsinogen). Regulation of multi-enzyme complex (pyruvate dehydrogenase). Isoenzymes - properties and physiological significance (lactate dehydrogenase). Applications of enzymes-Enzymes as reagents (glucose oxidase); Marker enzymes in diagnostics (SGPT, SGOT, creatine kinase, alkaline and acid phosphatases); Enzyme linked immunoassay (HRP); Enzyme therapy (streptokinase); Enzymes in research (Taq polymerase, restriction endonucleases). Immobilized enzymes and industrial applications of enzymes.	15	Cognitive Skills, Research skills and Analytical skills

Books for Reference:

1. Dixon, M., and E. C. Webb. "Enzyme inhibition and activation." *Enzymes* 3 (1979): 126-136.

2. Palmer, T. Understanding Enzymes, 4th ed., Prentice Hall/Ellis Horwood, London (1995).
3. Price, Nicholas C., and Lewis Stevens. Fundamentals of Enzymology. Oxford Science Publications. Second edition. New York, 2001.
4. Buchholz, Klaus, Volker Kasche, and Uwe Theo Bornscheuer. Biocatalysts and enzyme technology. John Wiley & Sons, 2012.
5. Copeland, Robert A. Enzymes: a practical introduction to structure, mechanism, and data analysis. John Wiley & Sons, 2004
6. Lehninger: Principles of Biochemistry (2013) 6th ed., Nelson, D.L. and Cox, M.M., W.H. Freeman and Company (New York).
7. Biochemistry (2019) 9th ed., Stryer, L., Berg J., Tymoczko J., Gatto G., W.H. Freeman (New York).
8. Fundamentals of Enzymology (1999) 3rd ed., Nicholas C.P. and Lewis S., Oxford University Press Inc. (New York).

S21 BC 7.2: Enzymology Lab – Practical VII

Total Teaching Hours: 60

No. of Hours per Week: 4

(2 credits)

CObj	Course Objectives
	<i>This course aims to</i>
CObj_1	Enable students to develop basic laboratory skills, implement experimental protocols and carryout investigations of enzymes.
CObj_2	Enable students to understand and learn the methods involved in enzyme isolation, purification and analysis.
CObj_3	Develop skills of performing specific enzyme assays and reporting their activity.

CO	Course Outcomes
CO_1	Learn fractionation and purification of enzymes from different sources
CO_2	Understand the isolation of enzymes from various sources.
CO_3	Learn methods of enzyme assays and their activity assessment.
CO_4	Understand and learn kinetic and inhibition study of enzymes.

CO_5	Evaluate various physical and chemical factors affecting enzyme activity.

CO-PO Mapping

	PO_1	PO_2	PO_3	PO_4	PO_5
CO_1	X	X	X	X	-
CO_2	X	X	X	X	-
CO_3	X	X	X	X	-
CO_4	X	X	X	X	X
CO_5	X	X	X	X	-

Course Content

Sl.No	Module title	Module Content	Number of Hours	Skills Developed
1	PRACTICALS VII – Enzymology Lab	Determination of total activity of salivary amylase a) Standard curve for maltose b) Determination of rate of amylase activity	4 Hrs/week	Employable, Research & Analytical Skills
2		Determination of optimum temperature for salivary amylase		
3		Determination of optimum pH for salivary amylase		
4		Determination of specific activity of salivary amylase		
5		Determination of total activity of acid phosphatase a) Standard curve for p-Nitrophenol b) Determination of rate of acid phosphatase		
6		Determination of optimum temperature for acid phosphatase		
7		Determination of optimum pH for acid phosphatase		
8		Determination of specific activity of acid phosphatase		
9		Fractionation of esterase by ammonium sulphate (Demonstration).		
10		Determination of total activity of esterase in ammonium sulphate fractionated enzyme extracts a) Standard curve for alpha naphthol b) Determination of rate of esterase activity		
11		Determination of the effect of inhibitor on the rate of enzyme activity (Demonstration).		

Books for Reference:

1. Enzymes: Biochemistry, Biotechnology and Clinical Chemistry: Trevor Palmer, Horwood, (2001).
2. Enzymes: A Practical Introduction to Structure, Mechanism, and Data Analysis: Robert A. Copeland, by Wiley-VCH Inc. (2000).
3. Enzymes: A Practical Introduction to Structure, Mechanism and Data Analysis: Robert A. Copeland, John Wiley & Sons (2000).
4. Enzyme Kinetics: A Modern Approach: Alejandro G. Marangoni, John Wiley & Sons (2002)
5. Enzyme Kinetics: Principles and Methods: Hans Bisswanger, Wiley–VCH (2002).
6. Fundamentals of Enzyme Kinetics: 4th ed. Athel Cornish-Bowden, Wiley-Blackwell (2012).
7. Fundamentals of Enzyme Kinetics: Athel Cornish-Bowden, Portland Press (2004)
8. Practical Enzymology: Hans Bisswanger, Wiley–VCH (2004)
9. Practical Enzymology, Second Revised Edition [PDF] [StormRG]: Hans Bisswanger, Wiley

S21 BC 8.1: Intermediary Metabolism**Total Teaching Hours: 60****No. of Hours per Week: 4
(4 credits)**

CObj	Course Objectives
CObj_1	To understand the concepts of biochemical reactions in cells.
CObj_2	To familiarize with understanding of metabolic pathways both catabolism and anabolism, and energy production.
CObj_3	To revisit the fundamental concepts of correlation of macromolecules and their chemical reactions.

CO	Course Outcomes
CO_1	To appreciate the basics of biochemical reactions and its molecular and functional connection to the organization of a cell and sub-cellular components
CO_2	To know the fates of different types of carbohydrates and its regulation that can influence the growth and existence of living organism.
CO_3	To analyze the significance of lipid metabolic pathways

CO_4	To understand degradative and biosynthetic reactions of amino acids and nucleotides and associated metabolic disorders.
CO_5	To evaluate the biochemistry behind photosynthesis process and nitrogen fixation.

CO-PO Mapping

	PO_1	PO_2	PO_3	PO_4	PO_5
CO_1	X	X	X	-	-
CO_2	X	X	X	-	-
CO_3	X	X	X	-	-
CO_4	X	X	X	-	X
CO_5	X	X	X	-	-

Course Content

Sl. No.	Unit/Chapter title	Content	Number of Hours	Skills Developed
1	Carbohydrate metabolism	Definition, phases of metabolism, Anabolism and Catabolism- definition, schematic representation of metabolism. Glycolysis; definition, individual reactions with energetic. Irreversible reactions/ATP dependent reactions. Substrate level phosphorylation reactions of glycolysis. Net reaction of glycolysis. Entry of lactose, sucrose and glycogen into glycolysis. Fate of pyruvate- formation of Acetyl-CoA, Ethanol and Lactate. Stoichiometry and energetics of Glycolysis. Regulation of Glycolysis. TCA cycle- Individual reactions. Net reaction of TCA cycle. Number of ATP molecules production. Functions of TCA cycle- Amphibolic roles (Anapleurosis). Regulation of TCA cycle, energetics of TCA cycle. Pentose phosphate pathways (PPP/ HMP)- Significance, reactions. Gluconeogenesis- Definition and significance, flow chart for gluconeogenesis. CORI cycle-explanation, diagram, purpose. Substrate level phosphorylation (SLP) from TCA cycle. Glycogen metabolism- Glycogenolysis- definition, reactions. Glycogenesis- definition, reaction, Cori-diseases. Regulation of blood glucose level; role of Insulin and Glucagon.	15	Cognitive Skills & Research Skills
2	Lipid metabolism	β -oxidation of saturated fatty acids; individual reactions, enzymes, coenzymes. Energetics of β -	15	Cognitive Skills

		oxidation of palmitic acid and stearic acid (one to be worked in the class room and remaining two may be given as home assignment), role of carnitine, Oxidation fatty acids-with odd number of carbon atoms, fate of propionyl coA, oxidation of unsaturated fatty acids. Fatty acid synthetases; structure and functions. Biosynthesis of fatty acids-general flow chart, fatty acid oxidation v/s fatty acid synthesis. Cholesterol- structure and functions. cholesterol biosynthesis (chemical reactions up to the formation of mevalonate, remaining reactions may be given as flow scheme). Regulation of cholesterol biosynthesis. Atherosclerosis-cause, blood cholesterol levels (mentioning). Ketone bodies-cause for the production. Ketogenesis-reactions, utilization, over production (ketosis).		
3	Amino acid and nucleic acid metabolism	General reactions- transamination- definition, reactions catalyzed by SGOT and SGPT, importance of transamination; Deamination - definition, oxidative and non-oxidative, examples for oxidative deamination- L-glutamate and non-oxidative- serine, aspartic acid and glutamine. Decarboxylation - definition, decarboxylation of glutamic acid, Histidine. Urea cycle- individual reactions, importance of urea cycle, hyperammonemia, regulation of urea cycle. Interrelationship between urea cycle and TCA cycle. Biosynthesis of glycine from serine and choline. Biosynthesis of alanine from transamination reaction. Biosynthesis of cysteine from L- serine. Epinephrine and Nor-epinephrine- importance and biosynthesis from tyrosine. Histamine; biological importance and synthesis. PKU and AKU characteristic features, metabolic reasons. Biosynthesis of purine and pyrimidine nucleotides- sources of nitrogen and carbon atoms of purine and pyrimidine ring. Precursors of purine and pyrimidine biosynthesis. Reactions involved in the biosynthesis. Conversion of nucleotides to deoxynucleotides. Orotic aciduria- general features. Gout; general features.	15	Cognitive Skills & Research Skills
4	Photosynthesis and Biological Nitrogen Fixation	Photosynthetic pigments and Photosynthetic unit. Light reactions – photosystem- I and II and their interactions. Synthesis of NADPH, photolysis of water, synthesis of ATP in cyclic and non-cyclic photophosphorylation. Dark reactions - chemical reactions upto the synthesis of fructose-6-phosphate. Trans- ketolation and aldolation reactions (shall be given in the flow chart). Interdependence of light and dark reactions. C3 and C4 plants- definition pathway	15	Cognitive Skills & Research Skills

		(HSK pathway). Bacterial photosynthesis. Nitrogen cycle, components of nitrogenase complex, stoichiometry of nitrogen fixation, nif genes.		

Books for References:

1. Biochemistry; Voet , D. and Voet, J.G. [Eds.] (1999) 3 Ed. John Wiley and sons.
2. Principles of Biochemistry; Lehninger et al., [Eds.] (1997) 2nd Edn. Worth Publishers.
3. Biochemistry VI Edition; Jeremy M Berg, John L Toymoczko and Lubert Stryer, W H Freeman and Co. (2006).
4. Biochemistry; David Rawn, J, Neil Patterson Publishers (1989).
5. Text Book of Biochemistry with Clinical correlations; Thomas Devlin [Ed.] (2010), Wiley and sons.
6. Principles of Biochemistry; Smith et al., [Ed.] (1986) McGraw Hill.
7. Biochemistry and Molecular Biology; 5th Edn. D. Papachristodoulou, A. Snape, W.H. Elliott, and D. C. Elliott, Oxford University Press (2014).
8. Photosynthesis, D.O. Hall and K. K. Rao, (1999), 6th Edn. Cambridge University Press.

S21 BC 8.2: Bioenergetics and Metabolism Lab - Practical VIII
Total Teaching Hours: 60
No. of Hours per Week: 4
(2 credits)

CObj	Course Objectives
	This course aims to
CObj_1	Familiarize students with the principles of basic analytical skills.
CObj_2	Provide experimental practice of qualitative estimations of various biomolecules and metabolites.
CObj_3	Enable students to prepare standard solutions and perform colorimetric estimations

CO	Course Outcomes
CO_1	Carry out independent and systematic analysis of biomolecules and report the result.
CO_2	Evaluate important metabolites of various metabolic pathways.
CO_3	Perform different methods of estimating metabolites such as colorimetric and

	titrimetric methods.
CO_4	Analyze the basic principles in each estimation and develop analytical skills.
CO_5	Evaluate the presence as well as the concentration of metabolites in different samples

CO-PO Mapping

	PO_1	PO_2	PO_3	PO_4	PO_5
CO_1	X	X	-	X	-
CO_2	X	X	-	X	-
CO_3	X	X	X	X	-
CO_4	X	X	X	X	-
CO_5	X	X	X	X	-

Course Content

Sl.No	Module title	Module Content	Number of Hours	Skills Developed
1	PRACTICALS VIII – Bioenergetics and Metabolism Lab	Buffer preparation – phosphate and acetate buffers	4 Hrs/week	Employable, Research & Analytical Skills
2		Spectrophotometric Determination of Total Protein by Biuret Method		
3		Estimation of protein by FC method		
4		Colorimetric estimation of Inorganic Phosphate by Fiske Subbarow method		
5		Colorimetric Estimation of Lactose in milk by D.N.S method		
6		Estimation of amino acid (alanine/glycine) using ninhydrin by colorimetric method		
7		Preparation of mitochondria from animal liver tissue and marker assay		
8		Glucose Oxidase Method for Estimation of Glucose (Demonstration)		
9		Demonstration of respiration and photosynthesis		
10		Demonstration of amylase activity in agar diffusion		

11		Energy metabolism – BMR, calorie count and energetics		
12		Fermentation – wine making, fermented foods		

Books for Reference:

1. Practical Biochemistry; Principles and Techniques; K. Wilson and J. Walker (1995), Cambridge University.
2. Practical Clinical Biochemistry- Harold Varley CBS, New Delhi
3. An Introduction to practical Biochemistry—Plummer D. T, Tata Mc Graw Hill
4. Introductory Practical Biochemistry – S.K.Sawhney and Randhir Singh.
5. Practical Clinical Biochemistry: Methods and Interpretation, 4th edn. Ranjna Chawla, Jaypee Brothers Medical Publishers



Department of Life Sciences

Syllabus of

M. Sc. Biochemistry

(Program Code: IAMOS02)

Academic Year: 2023-24 onwards

DEPARTMENT OF LIFE SCIENCES

REGULATIONS PERTAINING TO M.Sc BIOCHEMISTRY (CBCS) DEGREE

SCHEME 2023-24 Onwards

I. AIMS AND OBJECTIVES :

1. To provide the required basics, advanced theoretical knowledge and practical skills to the students and thus impart them a strong foundation in Biochemistry.
2. To produce competent graduates with all the required skill sets who can thus be future ready.

I a. Programme Educational Objectives (PEOs) and Programme Outcomes (POs)

	Programme Educational Objectives (PEOs)		Programme Outcomes (POs)
PEO1	To provide students a comprehensive knowledge base in Biochemistry and related fields through analytical and application based courses	PO1	Get a comprehensive understanding of theoretical and practical concepts in the varied disciplines of Biochemistry.
PEO2	To equip students with appropriate theoretical and practical skill sets to tackle issues in the field of Biochemistry	PO2	Be equipped with practical skills in biochemical analysis and develop insight on the modern tools of research necessary to solve real life problems.
PEO3	To inculcate in students the critical analysis, questioning and reasoning skills needed for a future career in higher studies, research and industry.	PO3	Develop analytical and critical thinking abilities to engage in independent research in the advanced multidisciplinary areas of Biochemistry.
PEO4	To encourage students to build their potential for ethical, moral and social inter-disciplinary research and be able to handle scientific and social responsibilities	PO4	Develop the requisite skill sets in order to express their persuasive scientific ideas at bigger scientific platforms and pursue careers in Biochemical research and industry.
PEO5	To produce students with leadership skills and professional integrity and enabling them to work in diverse professional platforms for empowering and promoting scientific advancement of our country.	PO5	Demonstrate expertise and ethical perspective on areas related to life sciences by developing ethical, interpersonal and team management abilities.

I b. Mapping of PEOs with POs:

PEOs	Programme Outcomes (POs)
PEO1	PO 1, PO 2, PO 3
PEO2	PO 1, PO 2, PO 3, PO 4
PEO3	PO 3, PO4
PEO4	PO 3, PO4, PO 5
PEO5	PO 4, PO 5

II. DURATION OF THE COURSE: 2 YEARS (4 Semesters)

III. ELIGIBILITY FOR THE COURSE:

a) B.Sc. graduates with any Life Science with Chemistry or Biochemistry as one of the optional subject at the UG level are eligible. Student with at least 50% marks in aggregate of all optional subjects are eligible.

b) In the absence of candidates in (a), Graduates in Agricultural Science, Dairy Sciences, Horticulture, Forestry, Fisheries, Pharmacy, Engineering (Biotechnology), Medicine / Dental or Agricultural Engineering, with 50% marks in the aggregate are eligible.

IV. MEDIUM OF INSTRUCTION: English

V. ATTENDANCE:

a. Theory: 75%

b. Practical: 75%

VI. TEACHING METHODS (PEDAGOGY):

1. **LECTURES** – a) ICT based b) Chalk and board method, both helps the teacher to maintain eye contact with students and to engage in healthy interaction during lecture, important concept of papers.

2. **SEMINARS** - Students undertake meticulous search for data and citations and are encouraged to present in individual/group on any area from the pertaining curriculum.

3. **PRACTICAL LEARNING** - These sessions aim to give students an insight into the working environment, knowledge of experimental methods, instrumentation and techniques and an even understanding of the academic material taught on the practical course.

4. **PROJECTS** - It helps enhance student's critical thinking skills, their abilities to analyze, interpret, and evaluate information; derive a hypothesis to solve problems and apply course material to achieve a specific outcome and effectively communicate during viva.

5. **E-LEARNING** – Students can venture into e-resources like JGATE, INFLIBNET, NPTEL, COURSERA, Bioinformatics is part of their curriculum as soft core paper.

6. **CO-CURRICULAR ACTIVITIES** – Student involvement in co- curricular activities is another way for students to build upon the knowledge and skills. Pick and speak, model making, collage, quiz are the most common co-curricular activities in which students are involved.

7. EVALUATION:

Post Graduate Program

1. CIA: Seminar / Assignments – 15 Marks
Mid-sem Examination – 05 Marks
End-sem Examination – 10 Marks

} THEORY

- Lab performance – 10 Marks
Observation book – 5 Marks
Test – 15 Marks

} PRACTICAL

2. Theory Examination: Total marks -70 marks/ paper (Part – A: 16 marks, Part B: 54 marks), soft core – 35 marks/paper (Section – A: 10 marks, Section B: 10 marks, Section C: 15 marks).
3. Practical exam: 2 patterns (Major experiment – 30 marks, Minor experiment – 10 marks, Procedure – 10 marks, Record – 5 marks, Viva voce – 15 marks = 70 marks) or (Major experiment – 40 marks, Minor / Procedure – 10 marks, Record – 5 marks, Viva voce – 15 marks = 70 marks)
4. Project Work: Total 70 marks (Viva voce – 25 marks, Thesis – 45 marks).

Regulation for Project Works: Proposed to carry out the project work individually or in group to a maximum of 3 or 4 students. Project shall be allotted at the beginning of the III semester to facilitate students to carry out during semester break. In house projects are encouraged. Students in some cases may be allowed to carry out the project work in other research institutes, but faculty members of the Biochemistry department must serve as principal guide.

8. PROGRAM MATRIX:

Department of Biochemistry Program Matrix (2017-19 Onwards)

First Semester							
Paper Code	Title of the paper	Contact hours	Exam hours	Marks			Credits
				IA	Exam	Total	
MBC - 101	Biophysical and Bio – organic chemistry	4	3	30	70	100	4
MBC - 102	Biomolecules	4	3	30	70	100	4
MBC - 103	Analytical Biochemistry – I	4	3	30	70	100	4
MBC - 104	General Physiology	4	3	30	70	100	4

MBC– 105	Microbiology	3	3	30	70	100	2
MBC - 106	Gen. Biochemistry	8	4	30	70	100	4
MBC - 107	Clinical Biochemistry and Microbiology	8	4	30	70	100	4
Total						700	26

Second Semester							
Paper Code	Title of the paper	Contact hours	Exam hours	Marks			Credits
				IA	Exam	Total	
MBC - 201	Enzymology	4	3	30	70	100	4
MBC - 202	Analytical Biochemistry – II	4	3	30	70	100	4
MBC - 203	Metabolism – I	4	3	30	70	100	4
MBC - 204	Membrane Biochemistry	4	3	30	70	100	4
MBC – 205	Bioinformatics and Toxicology	3	3	30	70	100	2
MBC - 206	Enzymology	8	4	30	70	100	4
MBC - 207	Biochemical techniques	8	4	30	70	100	4
Total						700	26

Third Semester							
Paper Code	Title of the paper	Contact hours	Exam hours	Marks			Credits
				IA	Exam	Total	
MBC - 301	Molecular Biology – I	4	3	30	70	100	4
MBC - 302	Molecular Physiology	4	3	30	70	100	4
MBC - 303	Metabolism – II	4	3	30	70	100	4
OET – 304	Open Elective**	4	3	30	70	100	4
MBC - 304	Molecular Biology	8	4*	30	70	100	4
MBC - 305	Genetic Engineering and Bioinformatics	8	4*	30	70	100	4
Total						600	24

** Non Biochemistry Paper

Fourth Semester							
Paper Code	Title of the paper	Contact hours	Exam hours	Marks			Credits
				IA	Exam	Total	
MBC - 401	Molecular Biology – II	4	3	30	70	100	4

MBC - 402	Biochemical Genetics	4	3	30	70	100	4
MBC - 403	Biotechnology	4	3	30	70	100	4
MBC - 404	Immunology	4	3	30	70	100	4
MBC - 405	Immunology and Toxicology	8	4*	30	70	100	4
MBC - 406	Project work	8	Report	30	70	100	4
Total						600	24

9. RESULTS:

a. Minimum for pass – Theory: 25 marks , Practical paper: 25 marks, Internal marks: Minimum 13 marks (Both theory and practical)

b. Grading System SGPA

inal Result/Grade Description

Semester/Program% Of marks	Semester GPA/Program CGPA	Grade Alpha Sign	Result / Class Description
90.1 - 100	9.01 – 10.00	O	Outstanding
80.1 – 90.0	8.01 – 9.00	A+	First Class Exemplary
70.1 – 80.0	7.01 – 8.00	A	First Class Distinction
60.1 – 70.0	6.01 – 7.00	B+	First Class
55.1 – 60.0	5.51 – 6.00	B	High Second Class
50.1 – 55.0	5.01 – 5.50	C	Second Class
40.0 – 50.0	4.00 – 5.00	P	Pass Class
Below 40	Below 4.0	F	Re-Appeal

c. CGPA Table of Conversion of % Marks to Grade Point

% Marks	Grade Point
96 - 100	10
91 - 95	9.5
86 – 90	9.0
81 – 85	8.5
76 – 80	8.0
71 – 75	7.5
66 – 70	7.0

61 – 65	6.5
56 - 60	6.0
51 – 55	5.5
46 – 50	5.0
41 – 45	4.5
40	4

10. LEARNING OUTCOME:

1. Qualifying for the subsequent career progression opportunities like Ph.D in Biochemistry, Nano-technology, Biotechnology and any other Life Science domains.
2. Understanding concepts of Research Methodology – so that they can get equipped and fetch job opportunities which expect them to have the skills of hypothesis generation and testing, development of theoretical and practical skills in the design and execution of experiments.
3. Learning concepts of scientific communication – so that they can find job opportunities pertaining to clinical data management, protocol writing, scientific proofing, editing, data mining etc.
4. Getting insight on the entrepreneurial opportunities in the Bioscience sector and know the requirements for becoming a Biopreneur.

FIRST SEMESTER M. Sc. BIOCHEMISTRY

MBC – 101: Biophysical and Bioorganic Chemistry

(52 hrs)

	Course Objectives
1	Enable students to learn basic biophysical concepts such as pH and thermodynamics
2	Educate students about the chemical basis of biological systems and the reaction kinetic phenomenon
3	Enable students to understand the role and relevance of different organic compounds in life sciences

	Course Outcomes (COs)
CO1	Understand the physiochemical properties of water, pH, p Ka and biological buffers and their importance.
CO2	Get familiarised with basic concepts of thermodynamics laws, red-ox reactions in biological systems and know the concepts of Stereochemistry
CO3	Learn the mechanism of Bio-organic reactions, rearrangement reactions and Free radicals, their sources, chain reactions, effects on biological molecules and membranes.
CO4	Know the structure and properties of Heterocyclic compounds, their occurrence in biological systems.
CO5	Define Ligand field theory of complexes, kinetics and mechanism of reactions of organometallic moieties of biological molecules like chlorophyll and hemoglobin.

CO – PO Mapping

PO	CO
PO1	CO1, CO2, CO3, CO4, CO5
PO2	CO1, CO2
PO3	CO1, CO2, CO3
PO4	CO1, CO2
PO5	CO1

UNIT 1: Properties of water

Physical and chemical properties of water, ionization and ionic product of water, structure of liquid water and ice. Unusual properties of water. Hydrophilic, hydrophobic and amphipathic molecules in aqueous solution. Effect of solutes on colligative properties of water. Importance of water in biological systems with special reference to the maintenance of native structure of biological molecules. Biological relevance of pH and pKa, determination of pKa of weak acid. Buffers, buffer action, and buffer capacity. Henderson–Hasselbalch equation, preparation of buffers. Importance of buffers in biological systems (cytosol and blood).

6 hrs

UNIT 2: Thermodynamics

First law of thermodynamics, basic concepts of entropy and second law of thermodynamics, free energy changes, standard free energy change and its relation to equilibrium constant. Oxidation – reduction reactions in biological systems.

5 hrs

UNIT 3: Stereochemistry

Optical isomerism, chirality, symmetry elements, enantiomers, diastereomers, DL and RS notations, racemization, stereoisomerism and geometrical isomerism, cis – trans and E – Z conventions.

5 hrs

UNIT 4: Mechanism of Bio-organic reactions

Introduction, meaning of the term, kinetic and non-kinetic. Fundamental aspects: Homo and heterolytic cleavage, structure and reactivity of carbocation (C⁺), carbanion (C⁻) and carbon free radical (C[•]). Characteristic aspects of ionic, radical and concerted reactions, substitution, addition, elimination and rearrangements. Energy profiles of reactions, transition state theory, kinetically and thermodynamically controlled reactions. Reactions SN1, SN2, SN1 neighbouring group participation. E2, Ei, Curtin-Hammett principle. Electrophilic addition to C=O, detailed discussion of all aspects of aldol condensation, related condensations, Michael addition. Esterification and hydrolysis.

12 hrs

UNIT 5: Rearrangements

Migration to electron deficient C, N and O; Wagner-Meerwein, Pinacol, Beckmann, Hoffmann, Bayer-Villiger reactions, allylic rearrangements. Benzilic acid rearrangement, Cannizzaro and Manich reactions, oxidation-reduction.

6 hrs

UNIT 6: Free radicals

Introduction, formation – photolysis, thermolysis, redox reactions, radical reactions with biomolecules.

4 hrs

UNIT 7: Heterocyclic systems

Occurrence in biological systems, structure and properties of furon, pyrrole. Indole, thiazole, imidazole, pyridine, pyrimidine, purine, quinone, pteridine and isoalloxazine containing biomolecules.

8 hrs

UNIT 8: Bioinorganic chemistry

Ligand field theory of complexes, stability of complex ions in solution, kinetics and mechanism of reactions of complexions. Ligand replacement reactions and electron transfer reactions of organometallic moieties of biological macromolecules (cytochromes, chlorophyll and hemoglobin).

6 hrs

References

1. Physical Biochemistry. Kansal Edward Van Halde. Prentice Hall.
2. Physical Biology of the Cell, 2nd Edn. Rob Phillips, Jane Kondev, Julie Theriot, Hernan Garcia, Garland Publishers (2012).
3. Bioinorganic Chemistry; Ei-Ichiro Ochiai, Elsevier (2008).
4. Physical Biochemistry. David Frifielder. 2nd Edn.
5. Organic Chemistry. Vol.I. Fundamental principles. I. L .Finar. 6th Edn. ELBS
6. Inorganic Biochemistry. G.L. Eicharn. Elsevier.

7. Organic Mechanisms, Peter Sykes, Longman, (1977).
8. Biochemical Calculations, Irwin H. Segel (1976) 2nd Ed. John Wiley and Sons.
9. Introduction to Biophysical Chemistry, Bruce Martin
10. Organic Chemistry. R.T. Morrison and R.N.Boyd. 6th Edn. Prentice Hall, India.
11. Lehninger- Principles of Biochemistry; DL Nelson and MM Cox [Eds), 6th Edn. Macmillan Publications (2012).
12. Principles and techniques of practical Biochemistry. K.Wilson and J. Walker. 4thEdn. Cambridge University press (2012).
13. Chemistry- An Introduction to General, Organic and Biological Chemistry, 7th Edn. Karen C. Timberlake, Benjamin Cummings, (1999).
14. Physical Chemistry of Macromolecules, C. Tanford.
15. Molecular Cell Biology Baltimore et al., Scientific American Publication (1995).
16. Reaction Mechanisms at a glance, ed. M. Moloney, Blackwell Science (2000).

MBC– 102: Biomolecules

(52 hrs)

	Course Objectives
1	To train students to appreciate the salient features, basic structure of all biomolecules in the organization of life
2	To acquaint students with the significance of biomolecules and methodology involved in characterizing major biomolecules
3	To familiarize students with the classification, functions and application aspects of bio-molecules

	Course Outcomes (COs)
CO1	To appreciate the structures of carbohydrates that exist in the biological system, their importance in blood groupings, bacterial cell wall and cell surfaces
CO2	To comprehend the classification and structure of amino acids and their properties and mechanisms of peptide synthesis
CO3	To summarize the concepts of levels of protein organization, denaturation and renaturation of proteins and protein folding pathways
CO4	To relate to the structure and importance of lipids as storage molecules and as structural component of biomembranes
CO5	To describe the structures of nitrogenous bases, properties of nucleic acids, their isolation, characterization and sequencing

CO – PO Mapping

PO	CO
PO1	CO1, CO2, CO3, CO4, CO5
PO2	CO1, CO2, CO3, CO5
PO3	CO1, CO5
PO4	CO1, CO5
PO5	CO1, CO5

UNIT 1: Carbohydrates

Brief review of configurational and conformational aspects of carbohydrates. Structure, properties and importance of structural (cellulose and chitin) and storage polysaccharides (starch and glycogen),

glycosaminoglycans, cardioglycosides and bacterial cell wall polysaccharides. Structure elucidation of polysaccharides (starch, glycogen and cellulose). Glycoproteins – structure and functions, blood group antigens, sequence analysis of oligosaccharides. Lectins – characteristics and functions in biological system.

4 hrs

UNIT 2: Lipids

Lipid classification, brief account of the chemical properties and structure of lipids (without structure elucidation) & biological role of the following: fatty acids, acyl glycerols, phospholipids, plasmalogens, sphingolipids, glycolipids, steroids, eicosanoids – prostaglandins, thromboxanes, & leukotrienes, leptin and visfatin.

7 hrs

UNIT 3: Amino acids and Proteins

Review of classification and structure of amino acids, acid – base properties of amino acids. Non – standard, non-protein and biologically active amino acids. UV-light absorption property of amino acids. Ionic properties of peptides and proteins. Naturally occurring peptides. Peptide synthesis– reactive ester method and modified Merrifield solid phase synthesis.

Primary structure: Elucidation of primary structure of proteins – Determination of amino acid composition, end group analysis, cleavage by enzymes and chemicals, separation of fragments. Manual and modern methods of sequencing and reconstructing the protein sequence. Assignment of disulfide bonds.

Secondary structure: Peptide bond – structure and conformation, Ramachandran plot. Regular secondary structure: α – helix and other types of helices, β – pleated sheet, irregular, turns, loops and triple helical structures. Helix stabilizing and destabilizing amino acids. Structure of fibrous proteins: α -keratin, silk fibroin and collagen. Motifs (super secondary structure – triose phosphate isomerase, concanavalin-A and Rossmann fold) and domain structure (glyceraldehyde-3-phosphate dehydrogenase). Secondary structure of insulin, ribonuclease, lysozyme, myoglobin and chymotrypsin.

Tertiary structure: Forces stabilizing tertiary structure of proteins. Protein denaturation and renaturation.

Quaternary structure and symmetry: Structure and function of myoglobin and hemoglobin. Cooperative mechanism of oxygen binding to hemoglobin. Abnormal hemoglobin– sickle-cell hemoglobin.

Protein folding pathways: Protein dynamics – kinetics of protein folding and disulfide bond formation, molecular chaperones and protein disulfide isomerase. Prediction of secondary and tertiary protein structure. Disease related to protein folding – Alzheimer's and mad cow disease.

23 hrs

UNIT 4: Nucleic Acids

Structure and properties of Nucleosides and Nucleotides. Structure of nucleic acids– primary, secondary and tertiary structure of DNA. Isolation, fractionation and characterization of nucleic acids. Properties of nucleic acids in solution. Secondary structure of tRNA and role of secondary structure in mRNA stability. Chemical synthesis of oligonucleotides (phosphate and phosphite method). Nucleic acid sequencing – Maxam and Gilbert and Sangers method. Rapid sequencing methods and new generation DNA sequencers.

12 hrs

References

1. Lehninger- Principles of Biochemistry; DL Nelson and MM Cox [Eds], 6th Edn. Macmillan Publications (2012).
2. Biochemistry VI Edition; Jeremy M Berg, John L Toymoczko and Lubert Stryer, W H Freeman and Co. (2006).
3. Physical Biology of the Cell, 2nd Edn. Rob Phillips, Jane Kondev, Julie Theriot, Hernan Garcia, Garland Publishers (2012).
4. Biochemistry; Voet, D. and Voet, J.G. [Eds.] 3rd Ed. Jhon Wiley and sons, (1999).
5. Biochemistry; David Rawn, J, Neil Patterson Publishers (1989).
6. Complex Carbohydrates, Sharon, N. Addison Wisely, (1975).
7. Methods of Enzymatic Analysis; Berg Meyer Vol. 1-X, (1974).
8. Nucleic acid Biochemistry and Molecular Biology, Mainwaring et al., Blackwell Scientific (1982).

9. Principles of Biochemistry; Smith et al., McGraw Hill (1986).
10. Proteins Structures and Molecular Properties 2nd Edn. Thomas E. Creighton, W H Freeman and Co. (1993).
11. Principles of Protein Structure, Function, & evolution, Dickerson & Geis 2nd Ed. Benjamin-Cummings (1983).
12. Biochemistry Ed. Donald Voet & Judith G. Voet, John Wiley & Sons, Inc.(2010).
13. Practical Biostatistics; Mendel Suchmacher and Mauro Geller, Academic Press (2012).

MBC- 103: Analytical Biochemistry – I

(52 hrs)

	Course Objectives
1	To comprehend the strategies and principles of biochemical investigations employing whole animal studies, isolated organs, tissues, and cell cultures and model organisms
2	To acquaint students with basic instrumentation, principle and procedure of various sophisticated instruments like phase contrast, fluorescence, electron microscopy, Geiger-Muller counter, Liquid scintillation counter, autoradiography and learn about centrifugation & biocalorimetry
3	To understand about biological data collection and the application of various biostatistical methods and tools in research

	Course Outcomes (COs)
CO1	To understand the strategies in biochemical investigations employing whole animal studies, isolated organs, tissues, and cell cultures and model organisms
CO2	To discuss the theory and applications of different types of microscopic techniques such as optical, phase contrast, confocal, fluorescence and electron microscopy and preparation of specimens for these microscopic techniques
CO3	To articulate the principle and applications of different separation techniques utilizing different types of centrifugation as well as biocalorimetry in the studies of thermodynamics and kinetics of biochemical reactions
CO4	To apply the principles of radiochemistry to analytical determination of biomolecules and life processes
CO5	To relate the principles of collection of data to biological experiments and the proper statistical analysis of biological data and its presentation

CO – PO Mapping

PO	CO
PO1	CO1, CO2, CO3, CO4, CO5
PO2	CO1, CO2, CO3, CO4, CO5
PO3	CO1, CO2, CO3, CO4, CO5
PO4	CO1, CO2, CO3, CO4, CO5
PO5	CO1, CO2, CO3, CO4, CO5

UNIT 1: Introduction to Biochemistry and Overview of Biochemical Investigations

Introduction to biochemistry, outline of strategies in biochemical investigations employing whole animal studies, isolated organs, tissues, and cell cultures. Specific investigations with isolated organelles; mitochondria and ER. Investigations with microorganisms and their mutants yeast, *Ceanorhabditis elegans*, *Arabidopsis thaliana* and *Drosophila melanogaster* as model specimen for biochemical investigations. Basic equipments and methods, and safety considerations in animal cell culture. Types of animal cells and their characteristics in culture, culture media and common animal cell lines for laboratory investigation. Plant cell culture, media for plant cell culture, potential of plant cell culture in biochemical investigations.

Extractions; Preparation of extracts for biochemical investigations, physicochemical properties of metabolites and drugs extracts from biological materials. Physico-chemical properties of solvents, solubility and miscibility, ionic bonds, and salting out. Partition, ionization, buffering and their effect on extraction. Choice of solvent for solvent extraction, mixed solvents, solid phase extraction.

12 hrs

UNIT 2: Microscopic techniques

Review of light microscope, resolution of microscopes, Optical contrast, phase contrast, and dark field microscopy, preparation of specimen for biochemical investigations. Electron microscopy; Working principle and applications, specimens for electron microscopy, fixatives, immune-gold microscopy and its advantages. Metal shadowing, design and applications of scanning electron microscopy (SEM), Transmission electron microscopy (TEM), and cryo-electron microscopy. 3-D images, negative staining, single particle reconstruction, Atomic force microscopy.

5 hrs

UNIT 3: Fluorescence Microscopy

Fluorophores, principle and applications of fluorescence microscopy, design and uses of Epifluorescence microscopy, and immuno-fluorescence microscopy. Imaging live cells and tissues; time lapse imaging, fluorescence stains of living cells, reporter molecules, multidimensional imaging. Measuring cellular dynamics; calcium imaging in live cells, fluorescence recovery after photo bleaching (FRAP), single particle tracking, Fluorescence resonance energy transfer (FRET). Use of ion-selective electrodes, light emitting indicators and optical tweezers in study of cellular dynamics.

5 hrs

UNIT 4: Centrifugation

Principle of centrifugation, the Swedberg equation, types of centrifuges and rotors. Density gradient centrifugation- Caesium chloride and sucrose density gradients; examples of separations, Sub-cellular fractionation. Design and working of analytical ultracentrifuges, sedimentation velocity and sedimentation equilibrium analyses.

Ultra-filtration; Principle, instrumentation and application. Dialysis, principle and uses of equilibrium dialysis,. Precipitation; methods and applications.

Flow Cytometry; Principle and design of flow cytometer, cell sorting. Detection strategies in flow cytometry and parameters measured by flow cytometry.

7 hrs

UNIT 5: Biocalorimetry

Arrhenius equation, determination of energy of activation from Arrhenius plots. Main thermodynamic parameters; enthalpy, and entropy. Isothermal titration calorimetry, design of experiments, determination of change in heat capacity, eg., oligomerization of valinomycin, DNA duplex. Determination of specific heat from enthalpy. Differential scanning calorimetry; design of experiment, application of DSC - in study of membrane proteins, microcalorimetry. Determination of thermodynamic parameters by non-calorimetric data.

5 hrs

UNIT 6: Radioisotopic methods of analysis

Atomic stability and radiation, types of decay, rate of radioactive decay, half life, units of radioactivity. Detection and measurement of radioactivity, Design and applications of Geiger-Muller Counter, and types of scintillation counters. Disadvantages of scintillation counters, quenching, Chemiluminescence and phospholuminescence counting efficiency, channel ratio, sample preparation, scintillation cocktails, Cerenkov counting. Autoradiography; types of emulsions and films for exposure to isotopes, suitable

isotopes, times of exposure and processing films, direct autoradiography, fluorography, intensifying screens, quantification. Radio tracer techniques; Supply storage and purity of radio-labeled compounds, specific activity, radio-labeled nucleotides, metabolites. Pulse chase experiments.

8 hrs

UNIT 7: Quantitative biochemical measurements

Analytical considerations and experimental errors, nature of experimental errors- random and systemic errors. Identification of systemic errors, SOPs. Performance of analytical methods, precision, accuracy, detection limit, analytical range, specificity, sensitivity, and robustness. Gaussian distribution (normal) of data, quantification of precision by standard deviation, coefficient of variation and variance, (data to be provided for calculation of each parameter). Assessment of accuracy; Population statistics- confidence limits and confidence intervals, student's t-test, standard error of mean, examples for calculation. Q-tests, examples and applications, Null hypothesis, use of t-test to validate analytical methods-unpaired, paired, one-sample, two-sample tests with examples. Calibration methods; Least mean square method of fitting straight line to data with example. Correlation and regression analyses. ANOVA, one way and two-way ANOVA.

10 hrs

References

1. Analytical techniques in Biochemistry and Molecular Biology; Katoch, Rajan. Springer (2011)
2. Basic Methods for the Biochemical Lab; Martin Holtzhauer, Springer, (2007).
3. Principles and Techniques of Biochemistry and Molecular Biology
7th Edn. Keith Wilson and John Walker, Cambridge University Press, (2010).
4. Principles of Gene Manipulations; 6th Edn. S.B. Primrose, R.M. Twyman, and R.W. Old, Blackwell Science (2012).
5. Techniques in Molecular Biology, Walker and Gastra, Croom Helm, (1983)
6. Biochemistry LabFax, Ed. J.A.A. Chambers and D. Rickwood,, Blackwell Science, (1993),
7. Protein Purification Applications, S.L.V. Harris and Angal IRL Press, (1990)
8. Laboratory Techniques in Biochemistry and Molecular Biology, Work and Work Vol. I & II, North Holland, (1969).
9. Nucleic Acid Blotting; D C Darling, P M Bricknell; Garland Science; (1994)
10. Introduction to Proteomics; Daniel C. Liebler, Humana Press (2002),.
11. Introduction to Bioinformatics; T K Attwood & D J Parry-Smith, Pearson Education (2002).
12. Choosing and Using Statistics; A Biologist Guide, Clavin Dythan, Blackwell Scientific (1999).
13. Basic Mathematics for Biochemists; Cornish Bowden, Oxford University Press (1998),.
14. Biophysical Tools for Biologists *In Vivo* Techniques; John Correia H. Detrich, III Elsevier (2008).
15. Recent Advances in Electron Microscopy- Part-A; B.V. Venkartarmaprasad, and Steve Ludtke, Academic Press (2010).
16. Recent Advances in Electron Microscopy- Part-B; B.V. Venkartarmaprasad, and Steve Ludtke, Academic Press (2011).
17. Introduction to Electron Microscopy for Biologists; Terry Allen, Academic Press (2008).

MBC – 104: General Physiology

(52 hrs)

	Course Objectives
1	To enable the students with general concepts related to tissues and cytoskeleton filaments and proteins.
2	To educate in depth about the physiology of nervous and muscular systems.

3	To educate about the complete physiology related to respiratory, digestive, excretory, circulatory systems along with basics of endocrinology.

	Course Outcomes (COs)
CO1	Understand the general formation of the tissues, its types, junctions and components involved in it and gain knowledge about cytoskeleton filaments and proteins, its organization, dynamics and role in maintaining the integrity of the cell.
CO2	Get familiarized with the detailed knowledge about the nerve signaling, membrane potential, neurotransmitters, its receptors and mechanism of action potential. And also patch clamp technique and understand the structure of different types of muscle tissues, its energetic, mechanism of muscle contraction and its regulation.
CO3	Learn different types of digestive juices, enzymes present and its action. In detail the mechanism of absorption of different nutrients. They also studied detoxification mechanisms and liver function tests and understand different types of circulation, cardiac activity, its regulation, blood composition, clotting, CSF, Lymph and its analysis in diagnosis, was learnt by the students.
CO4	Learn mechanism of respiration and acid base regulation by respiration and understand about the structure of nephron, formation of urine, tubular function test, acid base balance and hormonal regulation.
CO5	Learnt hormones types, synthesis, storage, circulation, functions, mechanism, regulation and its disorders were learnt by the students. Measurement of hormones and receptors and degradation were also studied by the students.

CO – PO Mapping

PO	CO
PO1	CO1, CO2, CO3, CO4, CO5
PO2	CO2, CO3, CO4, CO5
PO3	CO2, CO3, CO4, CO5
PO4	CO2, CO3, CO4, CO5
PO5	CO2, CO3, CO4, CO5

UNIT 1: Tissues

Formation of different kinds of tissues from primary germ layers. Types and functions of epithelial tissue, inter-cellular junctions. Connective tissue – extra cellular matrix, Collagens – types, composition, structure and synthesis, Elastin, fibronectins, and other proteins of the extra – cellular matrix. Basal lamina; laminins and associated proteins and their functions.

6 hrs

UNIT 2: Cytoskeleton and Cellular dynamics

Microfilaments; Assembly and polymerization of G-actin, role of Thymosin-B4, Profilin and Cofilin in polymerization, structural and functional property of F-actin, Capping proteins and assembly of actin filaments, branched and unbranched filament assemblies, Arp2/3, intracellular cellular movement and actin polymerization, use of toxins in study of actin dynamics. Role of cross-linking and adaptor proteins in actin bundling and membrane association.

Structure and organization of microtubules; dynamics of microtubules, assembly by MTOC, dynamic instability, tubulin polymerization as target of drugs. Side and end-binding proteins, capping and severing proteins. *Kinesins and dyneins*; vesicular transport along microtubule, role of kinesin-1 and dynein motors in organelle transport. Role of microfilaments and microtubules in cell migration.

Intermediate filaments; Assembly and tissue specific expression, dynamic nature of intermediate filaments, diseases associated with Lamins and Keratins defects.

7 hrs

UNIT 3: Nervous System

Types and structure of neuron. Myelin sheath; composition and function. Resting membrane and action potential. Nernst and Goldman equations. Mechanism of initiation and propagation of action potential – voltage gated ion channels, ionophores and toxins in study membrane transport. Design and use of Patch-Clamp in measuring membrane potential. Neurotransmitters and receptors; synaptic transmission, post-synaptic potentials. Outline and functions of autonomic and central nervous systems.

6 hrs

UNIT 4: Muscular System

Ultra structure of smooth, skeletal and cardiac muscle fibers. Contractile and other proteins of muscle. Energy metabolism in muscle; Phosphagens, neuro-muscular junctions, excitation of striated muscles. Organization of sarcolemma, transverse-tubular system and sarcoplasmic reticulum, mechanism of muscle contraction. Regulation of contraction in striated and smooth muscle. Calmodulin and its regulatory role, muscular dystrophies.

6 hrs

UNIT 5: Digestive System

Secretion, regulation of secretion, composition and functions of saliva, gastric, pancreatic and intestinal juices and bile. Gastro-intestinal hormones. Digestion, absorption and transport of carbohydrates, proteins, lipids, nucleic acids and vitamins. Liver – structure and functions.

4 hrs

UNIT 6: Cardio – vascular System

Systemic and pulmonary circulation. Structure of blood vessels. Regulation of cardiac activity. Blood volume, blood pressure. Plasma composition and functions of plasma lipoproteins. Mechanism of blood clotting, role of vitamin K, clot dissolution, anticlotting factors, Formation, counting and functions of erythrocytes, leukocytes and thrombocytes. **Lymph, Cerebro spinal fluid (CSF); composition and analysis in diagnosis.**

6 hrs

UNIT 7: Respiratory System

Mechanics and regulation of respiration, pulmonary and alveolar ventilation and its control, transport of respiratory gases, respiratory mechanism of acid-base balance.

5 hrs

UNIT 8: Excretory System

Mechanism of urine formation and composition of urine. **Urine analysis for abnormal constituents, tubular function tests.** Nephritis and nephrosis. Kidney hormones. Regulation of acid-base electrolyte and water balance. Respiratory and metabolic acidosis and alkalosis.

5 hrs

UNIT 9: Endocrine system

General introduction to hormones; biosynthesis, storage, secretion, Circulation in blood. Degradation and peripheral transformation. Tropic hormones-feedback regulation. Measurement of hormones, and receptors. Disorders of endocrine system-growth hormone, thyroid and adrenal.

7 hrs

References

1. The Cell, Copper, Geoffery, M., Oxford University Press, (2001)
2. Text Book of Biochemistry with Clinical correlations; Thomas Devlin [Ed.](1997), Wiley – Liss.
3. Lehninger- Principles of Biochemistry; DL Nelson and MM Cox [Eds], 6th Edn. Macmillan Publications (2012).
4. Principles of Human Physiology; 4th Edn. Cindy L. Stanfield Pearson, (2010).
5. Principles of Biochemistry: Smith et al., [Ed.] (1986) McGraw Hill.
6. Principles of Biochemistry: General Aspects, Smith et al., [Ed.] (1986) McGraw Hill.
7. Human Biochemistry, Orten and Neuhaus, 10th Edn. Mosbey International, (1983).

8. Review of Medical Physiology, Gannong, W.F. 15th Edn., Maruzen Asial, (1991).
9. Human Physiology: The mechanisms of Body functions. A.J. Vander, et. Al., (1985) McGraw-Hill.
10. Molecular Cell Biology, Baltimore et. al. (1995) Scientific American Publication.
11. Cellular Physiology of Nerve and Muscle. Gary G Mathew (1998) Balckwell Scientific Inc.
12. Harper's Review of Biochemistry, Murray et. al., (1997) 24th Edn., Lange
13. Molecular Biology of Cell; Albertis et. al. (2002) Garland Science.
14. Biochemistry Ed. Donald Voet & Judith G. Voet, John Wiley & Sons, Inc. (2010).
15. Mammalian Biochemistry; White, Handler and Smith, McGraw-Hill, (1986).

MBC – 105: Microbiology

39 hrs

	Course Objectives
1	To gain knowledge about bacteriology, eukaryotic microorganisms, food and dairy microorganisms
2	In depth understanding on microbial staining and pure culture techniques
3	Comprehensive theoretical and foundational concept about bacterial and viral pathogenesis and their interventions

	Course Outcomes (COs)
CO1	Learn about the conventional and molecular methods of classification, identification, cultivation and morphology of eukaryotic microorganisms
CO2	Know the basic structure, visualization techniques and function of different components of the bacterial cell.
CO3	Understand the principles of microbial nutrition and know the various Physical and Chemical growth requirements of bacteria and their growth measurement.
CO4	Learn the mechanisms of Bacterial Pathogenesis and know various intervention strategies such as antibiotics.
CO5	Know about viruses classification and discern the replication strategies of few representative viruses.

CO – PO Mapping

PO	CO
PO1	CO1, CO2, CO3, CO4, CO5
PO2	CO1, CO2, CO3, CO4
PO3	CO1, CO2, CO3, CO4, CO5
PO4	CO1, CO2, CO3, CO4, CO5
PO5	CO1, CO2, CO3, CO4, CO5

UNIT 1: Bacteriology

Classification of Bacteria – Conventional and molecular methods; Identification and classification of microorganisms; Eubacteria, Archaeobacteria, Cyanobacteria, Bergy's classification of bacteria. Brief study of important groups of bacteria: Coliform, spore formers, photosynthetic bacteria, lactic acid producing bacteria, actinomycetes, ricketisiae, mycoplasmas.

5 hrs

UNIT 2: Eukaryotic Microorganisms

Fungi- classification, cultivation and morphology of yeasts and molds. Control of fungal growth. Mycotoxins and their actions. Brief study of algae and protozoa. Media for culture of algae and protozoa.

4 hrs

UNIT 3: Staining techniques

Gram, Acid fast & flagellar. Detailed study of bacterial cell structures-genetic elements, ribosomes, membranes, cell envelope, capsule, flagella, pili and endospores. Mechanism of bacterial motility.

3 hrs

UNIT 4: Pure culture techniques

Principles of microbial nutrition: Nutritional requirements, different kinds of media, factors affecting growth. Enrichment culture techniques for isolation of chemoautotrophs, chemoheterotrophs and photosynthetic microorganisms. Modes of reproduction, Biosynthesis of cell wall components, enumeration, growth curve, generation time, synchronous growth, Chemostat. Adaptation to stationary phase, heat and cold shock, osmolarity and salinity, oxidative stress.

6 hrs

UNIT 5: Food and Dairy Microbiology

Food spoilage, food preservation, fermented foods, Contamination of milk by micro-organisms and reactions, Pasteurization and sterilization, Fermented milk products, cheese.

4 hrs

UNIT 6: Bacterial Pathogenesis and Interventions

Normal microbial flora of human body; role of the resident flora; Classic strategies used by bacteria to initiate and maintain infection: Microbial colonization and adherence strategies, Microbial invasion strategies.

Selected mechanisms of bacterial pathogenesis: Bacterial type 1-IV secretion systems, Bacterial surface structures, Antigenic variation, Biofilms and quorum sensing, modulation of cellular processes, toxins.

Quantitative measures of virulence: minimal lethal dose (MLD), LD 50, ID 50, TCID 50. Mechanisms of control of pathogens: Sterilization methods and sterility testing, Physical and chemical methods of controlling bacterial growth, Antiseptic and disinfectant action.

Mechanisms of action of antibiotics-targets, Emergence of drug resistance, Antibiotic assay; Determination of minimum inhibitory concentration (MIC).

9 hrs

UNIT 7: Virology

Classification and General Properties and structure of plant, animal and bacterial viruses.

Bacteriophages; one step growth experiment, single burst and premature lysis experiments, productive cycles of λ and ϕ x-174 viruses, lysogeny – P1, P2, P22 and Mu1 phages, RNA phages, isolation and cultivation of bacterial viruses.

Plant viruses- transmission, effect on plants, common diseases, TMV. Slow viruses and DI viruses- discovery and importance.

Animal viruses- productive cycle of DNA viruses- parvo, adeno and SV40. RNA viruses- reo, rhabdo, picorna, polio, Influenza Retrovirus (RSV and HIV)

Cultivation and enumeration of viruses; cultivation in cell culture, chick embryo and animal inoculation. Persistent chronic and acute viral infections. Inhibition and inactivation of viruses by physical and chemical agents.

Interferon- types, nomenclature and classification, induction, antiviral effect, antiviral proteins-ds RNA dependent and independent pathways.

8 hrs

References:

1. Microbial physiology, 2 nd Edn. I.W. Dawes and I.W. Sutherland (1991) Blackwell Scientific.
2. Microbial physiology, 4 Edn. Albert G. Moat, John W. Foster and Michael P. Spector, Wiley-Liss (2002) .
3. Modern Food Microbiology; James M.Jay (1996) CBS Publishers.
4. A Modern Introduction to Food Microbiology; Board, R.G. (Ed.) (1983) Blackwell Scientific Publications.
5. Biology of Microorganisms, Brock Prentice Hall (1996).
6. Industrial Microbiology; Miller and Litsky (Eds.) (1976) McGraw Hill Publishers.
7. Microbiology; Lansing M. Prescott, Hartley and Klein, 5 th Edn. McGraw Hill (2002).
8. Microbiology; Essentials and Applications, Larry Mckane and J.Kandel (19) McGraw Hill publishers.
9. Applied Microbial Physiology: A practical approach Rhodes and Stanbury (1997) IRL Press.
10. Microbes in Action, A Laboratory Manual of Microbiology Seley et al., (19) W.H. Freeman.
11. Basic and Practical Microbiology, Ronald L. Atlas (1986) McMillan Publication Co.
12. General Microbiology, Stainer et al., 4 th Edn. McMillan (1975).
13. Microbiology, Pelczer, Reid and Kreig Tata McGraw Hill (1996).
14. Biology of Microorganisms, Brock Prentice Hall (1996).
15. Bacterial Pathogenesis: A molecular approach by Salyers AA and Whitt DD eds. American Society for Microbiology Press, Washington, DC USA. 2002.

**MBC – 106: General Biochemistry Lab
(4 Credits)**

	Course Objectives
1	Enable students to develop basic laboratory skills, implement experimental protocols and carryout investigations on biomolecules
2	Enable students to understand and learn operating pH meter and learn buffer preparation
3	Enable students to utilize various biochemical techniques for biomolecular analysis

	Course Outcomes (COs)
CO1	Prepare standard solutions and different buffer solutions
CO2	Perform analysis and estimation of carbohydrates and fats by different methods
CO3	Analyze amino acids, proteins, DNA and RNA by colorimetry and spectrophotometry
CO4	Analyze and estimate molecules like lipids and vitamins and ions like calcium and phosphate
CO5	Extract biomolecules from natural sources and analyse them

CO – PO Mapping

PO	COs
PO1	CO1, CO2, CO3, CO4, CO5
PO2	CO1, CO2, CO3, CO4, CO5
PO3	CO1, CO2, CO3, CO4, CO5

PO4	CO1, CO2, CO3, CO4, CO5
PO5	-

1. Preparation of buffers; Acetate, phosphate and tris buffer.
2. Determination of iodine number and peroxide value of oils and fats.
3. Determination of pKa of weak acids and amino acids by pH metric titration.
4. Estimation of vitamin C by dichlorophenol indophenol method.
5. Estimation of reducing sugars (lactose in milk) by DNS method.
6. Estimation of protein by Lowry's method.
7. Estimation of inorganic phosphate by Fiske-Subbarao method.
8. Estimation of tyrosine by Millon's method.
9. Estimation of DNA by Diphenylamine method.
10. Estimation of RNA by Orcinol method.
11. Estimation of calcium and magnesium by EDTA methods
12. Absorption spectra of proteins and nucleic acids and determination of molar extinction coefficient.
13. Extraction of potato starch / liver glycogen and estimation by iodine
14. Extraction of proteins from seeds and estimation by Bradford's method.
15. Extraction of lecithin and cholesterol from egg yolk.

References

1. Analytical techniques in Biochemistry and Molecular Biology; Katoch, Rajan. Springer (2011).
2. Basic Methods for the Biochemical Lab; Martin Holtzhauer, Springer, (2007).
3. Principles and Techniques of Biochemistry and Molecular Biology 7th Edn. Keith Wilson and John Walker, Cambridge University Press, (2010).
4. Biochemistry LabFax, Ed. J.A.A. Chambers and D. Rickwood,, Blackwell Science, (1993),
5. Protein Purification Applications, S.L.V. Harris and Angal IRL Press, (1990)
6. Laboratory Techniques in Biochemistry and Molecular Biology, Work and Work Vol. I & II, North Holland, (1969).
7. Physical Biochemistry. Kansal Edward Van Halde. Prentice Hall.

MBC – 107: Clinical Biochemistry and Microbiology Lab (4 Credits)

	Course Objectives
1	Enable students to develop basic laboratory skills, implement experimental protocols and carry out investigations on biomolecules.
2	Enable students to understand and learn human blood and urine sample handling.
3	Develop skills of performing basic biochemical tests important in clinical investigations.

	Course Outcomes (COs)
CO1	Understand the importance of biochemical techniques in clinical laboratory setup.
CO2	Perform biochemical laboratory analysis on blood samples to assess the levels of normal and abnormal constituents.
CO3	Perform biochemical laboratory analysis on urine samples to assess the levels of normal and abnormal constituents.

CO4	Learn basic microbiology techniques to apply for microbiological investigations.
CO5	Learn the skill of growing microorganisms.

CO – PO Mapping

PO	COs
PO1	CO1, CO2, CO3, CO4, CO5
PO2	CO1, CO2, CO3, CO4, CO5
PO3	CO1, CO2, CO3, CO4, CO5
PO4	CO1, CO2, CO3, CO4, CO5
PO5	CO1, CO2, CO3, CO4, CO5

Clinical Biochemistry

1. Estimation of glucose by Folin Wu method.
2. Estimation of cholesterol by Zack's method.
3. Estimation of haemoglobin by Wong's method.
4. Estimation of urea in blood by Diacetylmonoxime method.
5. Determination of A/G ratio by Biuret method.
6. Analysis of SGOT-SGPT (AST, ALT) / creatine kinase / acid or alkaline phosphatase.
7. Estimation of uric acid in serum and urine by Caraway's method.
8. Estimation of creatinine and creatine in serum and urine by Zaffe's method.
9. Estimation of urea in urine by Nesslerization method (Urease method).
10. Glucose estimation by GOD-POD method.

Microbiology

1. Preparation and sterilization of culture media (Complete and Synthetic)- Broth and Plates
2. Propagation of bacteria (Gram Positive and Negative, each one)
3. Staining of bacteria – Simple staining, differential staining (Gram), staining of spores
4. Quantification of Bacteria (Serial Dilution and Plate count)
5. Determination of growth curve of bacteria and Calculation of Generation Time
6. Biochemical tests (2 each for Gram Positive and Negative) and motility for the identification of bacteria (1 each for Gram Positive and Negative)
7. Antibiotic sensitivity test

References

1. Practical Clinical Biochemistry, ed. Harold Varley, 4th edn. CBS Publishers (1988).
2. Practical Clinical Biochemistry: Methods and Interpretation, ed. Ranjna Chawla, Jaypee Brothers Medical Publishers (1996).
3. Practical and Clinical Biochemistry for Medical Students, ed. T.N. Pattabhiraman, Gajanna Publishers (1994).
4. Hawk's Physiological Chemistry, ed. Oser, 14th Edn.(1976), Tata-McGrawHill.
5. Biochemistry, ed. Plummer Tata-McGraw Hill, (1971).
6. Applied Microbial Physiology; A practical approach Rhodes and Stanbury (1997) IRL Press
7. Microbes in Action, A Laboratory Manual of Microbiology Seley et al., (19)W.H. Freeman.
8. Basic and Practical Microbiology, Ronald L. Atlas (1986) McMillan Publication Co.
9. General Microbiology, Stanier, et al., (1975) 4th Edn. McMillan.
10. Microbiology, Pelczar, Reid and Krieg (1996) Tata-McGrawHill.
11. Biology of Microorganisms, Brock (1996) Prentice Hall.

	Course Objectives
1	To provide students with the concepts and principles of biochemical catalysts.
2	To survey the methodologies involved in assessing the enzyme activity and mechanism of enzyme action.
3	To illustrate the enzyme catalysis, kinetics and regulatory aspects

	Course Outcomes (COs)
CO1	To discuss the basic characteristics, classification, purification and applications of enzymes
CO2	To evaluate the 3D structure of an enzyme active site and the techniques used to investigate the active site structure
CO3	To become familiarized with types of enzyme catalysis and the mechanism of important enzymes
CO4	To describe the various theories behind enzyme action, factors affecting enzyme action and enzyme kinetics
CO5	To acquaint with the kinetics of enzymatic reactions and sigmoidal kinetics of allosteric enzymes, along with their various regulation

CO – PO Mapping

PO	CO
PO1	CO1, CO2, CO3, CO4, CO5
PO2	CO1, CO2, CO4
PO3	CO1, CO2, CO4
PO4	CO1, CO2, CO4
PO5	CO1, CO2, CO4

UNIT 1: Introduction to Enzymes

Nomenclature and classification of enzymes. Specificity and active site. Fundamentals of enzyme assay – enzyme units, coupled kinetic assay, immobilized enzymes. Enzyme localization. Criteria of purity of enzymes. Monomeric enzymes; serine proteases, zymogen activation, multifunctional enzymes, oligomeric enzymes and multi- enzyme complexes.

Enzyme Technology: Industrial and clinical applications of enzymes, Immobilization of enzymes- methods and applications. Enzyme engineering. Designer enzymes (Abzymes, Ribozymes).

5 hrs

UNIT 2: investigation of active site structure

The identification of binding sites and catalytic sites –trapping the E-S complex, use of substrate analogs, enzyme modification by treatment with proteolytic enzymes, photo – oxidation and chemical modification of amino acid side chains (cys, met, his, ser, asp, glu, lys, and tyr). Affinity labeling studies (chymotrypsin triose phosphate isomerase) and super reactive amino acid chains (chymotrypsin and glutamate dehydrogenase). The 3-D structural features of active sites as revealed by X-ray crystallographic and chemical studies (chymotrypsin trypsin, elastase and triose phosphate isomerase). Site directed mutagenesis.

7 hrs

UNIT 3: Enzyme catalysis

Chemical nature of enzyme catalysis-General acid-base catalysis, electrostatic catalysis, covalent catalysis, intramolecular catalysis and enzyme catalysis. Mechanisms of action of the following

enzymes-lysozyme, ribonuclease, lactate dehydrogenase, serine proteases (chymotrypsin, trypsin, elastase), sulphhydryl enzymes (papain and alcohol dehydrogenase), and multi-enzyme complexes (pyruvate dehydrogenase complex). Metal-activated and metallo-enzymes (mechanism of action of pyruvate kinase, creatine kinase, superoxide dismutase & carboxypeptidase – A).

7 hrs

UNIT 4: Coenzymes

The mechanistic role of the following coenzymes in enzyme catalyzed reactions – nicotinamide nucleotides, flavin nucleotides, pyridoxal phosphate, coenzyme-A, lipoic acid, thiamine pyrophosphate, biotin, tetrahydrofolate and coenzyme B₁₂.

6 hrs

UNIT 5: Kinetics of enzyme-catalyzed reactions

Methods used in the investigation of the kinetics of enzyme-catalyzed reactions, initial velocity studies, rapid reaction techniques and relaxation technique. Enzyme kinetics of single substrate reactions – Michaelis-Menten and Briggs and Haldane theory (rapid equilibrium and steady state theory). Kinetic data evaluation-linear transformation of Michaelis-Menten equation. Pre-steady state kinetics. Integrated velocity equation. Haldane equation. King-Altman procedure for deriving the rate equation. Effect of pH & temperature on enzymatic reactions, Arrhenius plot, determination of activation energy.

9 hrs

UNIT 6: Enzyme Inhibition

Types of reversible inhibitors; competitive, non-competitive, uncompetitive, and mixed inhibitors. Partial inhibition, substrate inhibition and allosteric inhibition. Irreversible inhibition.

6 hrs

UNIT 7: Kinetics of bi- substrate reactions

Sequential mechanism, compulsory order and random order mechanism, non-sequential mechanism, ping pong mechanism, distinction between different kinetic pathways using primary and secondary plots. Inhibition studies in the characterisation of bisubstrate reactions. Investigations of reaction mechanisms using isotopic exchange at equilibrium.

5 hrs

UNIT 8: Allosteric enzyme action

Binding of ligands to proteins, Co-operativity, the Hill equation, Adair equation, Scatchard plot and equilibrium dialysis techniques. *Sigmoidal kinetics*: MWC and KNF models. Significance of sigmoidal behavior. Allosteric enzymes and metabolic regulation. Study of ATCase as typical allosteric enzyme.

7 hrs

References

1. Fundamentals of Enzymology; 3rd Edn. Nicholas C. Price and Lewis Stevens, Oxford University Press (2012).
2. Enzymes; Trevor Palmer, East – West Press Pvt. Ltd., Delhi (2004).
3. Enzymes: A Practical Introduction to Structure, Mechanism, and Data Analysis; Robert A. Copeland, Wiley-VCH Publishers (2000).
4. Enzyme Kinetics and Mechanism; Paul F. Cook, W. W. Cleland, Garland Science (2007).
5. Biochemical Calculations, Irwin H. Segel (1976) 2nd Ed. John Wiley and Sons.
6. Methods in Enzymology; Colowick S.P. et al., Vol. 152, Academic Press, (1987).
7. Methods of Enzymatic Analysis; Berg Meyer Vol. 1-X, (1974).
8. Basic Biochemical Laboratory Procedures and Computing, R. Cecil Jack (1995) Oxford University.
9. Enzyme Kinetics; Roberts, D.V. (1977), Cambridge University Press.
10. The Enzymes; Boyer, Academic Press, (1982).
11. Enzyme Kinetics; Irwin H. Segel (1976) Interscience-Wiley.
12. Enzyme Kinetics; the Steady state approach; Engel, P.C. (1981) 2nd Edn. Chapman and Hall.
13. Nature of Enzymology; Foster, (1980), Croom Helm.
14. Principles of Enzymology for Food Sciences; Whitaker, Marcel Dekker (1972) Academic Press.
15. Enzymes: Biochemistry, Biotechnology and Clinical Chemistry; Trevor Palmer (Edn) Horwood Chemical Science Series.

16. Introduction to Enzyme and Co-enzyme Chemistry. Ed. T. Bugg, (2000), Blackwell Science.
17. An Introduction to Enzyme and Coenzyme Chemistry; Timothy B. Bugg, (1997) Jones and Bartlett publishers.
18. Lehninger Principles of Biochemistry; D.L.Nelson and M.M. Cox, 6th Edn. MacMillan publications (2012).
19. Principles of Biochemistry; Smith et al., Ed. McGraw Hill,(1986).

MBC – 202: Analytical Biochemistry – II

(52 hrs)

	Course Objectives
1	To learn the fundamental principles behind chromatography and electrophoresis and choose and apply suitable separation techniques to different biomolecules
2	To discuss the principle and applications of spectroscopic techniques and to implement the use of instruments like UV-VIS spectroscopy, NMR, CD, ORD, MS, X-Ray diffraction in biological research
3	To describe large-scale analysis of proteins and metabolites in biological samples and to define their concentrations, molecular states, structures, functions and connections

	Course Outcomes (COs)
CO1	To appraise the handling of various biochemical techniques and apply them in isolating and characterizing different biological molecules
CO2	To discuss the theory of purification of biomolecules by advanced techniques like affinity chromatography, HPLC, FPLC and Gas chromatography
CO3	To comprehend the principles of different types of Electrophoresis and their applications in biological investigations and experiments
CO4	To apply the fundamental laws of different types of spectroscopy and applications in analytical determination and characterization of biomolecules
CO5	To understand about techniques used in proteomics and metabolomics, and their significance and applications

CO – PO Mapping

PO	CO
PO1	CO1, CO2, CO3, CO4, CO5
PO2	CO1, CO2, CO3, CO4, CO5
PO3	CO1, CO2, CO3, CO4, CO5
PO4	CO1, CO2, CO3, CO4, CO5
PO5	CO1, CO2, CO3, CO4, CO5

UNIT 1: Chromatography

Introduction, partition coefficient phase systems, liquid and solid phases, principle procedure and application of paper chromatography, parameters employed in column chromatography, retention, resolution, physical basis of peak broadening, plate height equation, capacity factors, peak symmetry, standard systems of chromatography and its components, stationary phase, elution. Principle procedure and application of paper chromatography.

Thin layer chromatography: Introduction; phases used in TLC preparative TLC, metabolic profiling, solvent systems for TLC. Detection of compounds on TLC plates.

Modes of chromatography: Ion exchange, major ion exchange matrices, elution in ion exchange chromatography. Examples of cation and anion exchangers, chromate-focusing. Gel filtration: matrix used fractionation range and matrices, determination of native mass of protein by gel filtration. Reverse phase principle and procedure.

Hydrophobic interactions and affinity chromatography: Affinity ligands immobilization of ligands. Activation of matrices, coupling affinity ligands (example–GSH). Metal affinity chromatography, His tag, open column chromatography, hydroxyl apatite chromatography.

HPLC: Instrumentation, column, pumps, plumbing, injectors, mobile phases in HPLC, two dimensional HPLC, factors affecting resolution in HPLC chromatography, flow rate and linear velocity. Separate modes: normal and reverse, gradient reverse phase, ion suppression and ion pairing. Chiral-HPLC, chiral columns. Detectors: types, UV, visible fluorescence, electrochemical detectors. Fast protein liquid chromatography (FPLC).

Gas chromatography: Principle and design of instrument. Factors affecting GC, stationary phase, mobile phase, column length, diameter, film thickness, flow rate temperature, sample introduction. Detectors: flame ionization, thermal ionization, electron capture, mass selective detection. G.L.C; principle and application.

18 hrs

Unit 2: Electrophoresis

Historical developments, principle, non-denaturing PAGE, activity staining for enzymes, zymogram, denaturing electrophoresis (PAGE), SDS-PAGE, SDS-PAGE in reducing conditions, chemical cross linking of proteins - urea electrophoresis, isoelectrofocusing. Agarose gel electrophoresis of nucleic acids, Electrophoresis in DNA sequencing, Sanger- deoxynucleotide sequencing. Foot printing of DNA. *Capillary electrophoresis:* Principle, instrumentation, electro-osmotic flow, free solution capillary electrophoresis. Choice of buffers and ionic strength. Organic modifiers electro chromatographic-electrically driven HPLC. Capillary sample introduction and detection in capillary electrophoresis.

Immuno-electrophoresis: Dot blotting and immune-diffusion tests with antibodies, zone electrophoresis/immune-electrophoresis. Rocket electrophoresis, counter immune-electrophoresis, pulsed field electrophoresis, physical basis, equipment and applications. *Electroblotting:* western, southern, northern equipments and application.

10 hrs

UNIT 3: Spectroscopic techniques

Wave particle duality of light, electromagnetic spectrum, transition in spectroscopy. Principle, design and application of UV-Vis spectrophotometry. Principle, design and application of fluorescence spectroscopy. Measurement of fluorescence and chemiluminescence, use of fluorescence in binding studies. Spectroscopy techniques using plane polarized light, circular dichroism (CD), equipment for CD measurement, CD of biomolecules (proteins) and LD (linear dichroism) of biomolecules.

IR spectroscopy: Physical basis of IR spectroscopy. Instrumentation, use of IR in structure determination, Fourier transfer, IR spectroscopy, Raman IR spectroscopy.

NMR: Principle, effect of atomic, identity on NMR, chemical shift, spin coupling NMR, measurement of NMR spectra, biochemical application of NMR, P31 NMR to study transition in phases.

ESR: Principle, measurement of ESR spectra uses of ESR in chemistry.

Mass spectroscopy: Principle, overview of MS- experiment, ionization modes, equipments in MS analysis (Identification of metabolites) MS of protein/ peptides. Interfacing MS with other methods; MS/MS, LC/MS, GC/MS, electrophoresis/MS. Uses of MS in Biochemistry: MS and heterogeneity in proteins, peptide mapping, post translation modification analysis, determination of disulfide bridges, analysis of DNA compounds.

X ray diffraction – principle, Braggs law, X-ray crystallography of proteins, growing crystal sample preparation, X-ray sources, data collection, electron density maps, the phase problem, Molecular replacement, MIR (multiple Isomorphous replacement) Anomalous scattering, Model building.

14 hrs

UNIT 4: Proteomics

Introduction, electrophoresis in proteomics, 2D SDS–PAGE, basic principle, instrumentation, analyses of cell proteins, free flow electrophoresis, blue native gel electrophoresis, Mass spectrometry in proteomics, tagging methods for MS proteomics, isotope coded affinity tagging, tagging for tandem MS.

Microarrays, protein biochips. Post translational modifications in proteomics, proteolysis, glycosylation, oxidation, protein disulfides, phospho-proteins.

5 hrs

UNIT 5: Metabolomics

HPLC and FPLC based approaches in metabolomics. Criteria for the selection of chromatography methods and their importance in metabolomics. Application for cellular metabolomics for metabolic pathway structure. Size of metabolome, metabolite identification, pathway identification and pathway integration. Metabolite profiling for infectious disease. Metabolite profiling in heart disease-application. Metabonomics in preclinical pharmaceutical discovery and development.

5 hrs

References

1. Analytical techniques in Biochemistry and Molecular Biology; Katoch, Rajan. Springer (2011)
2. Principle and techniques in Biochemistry and Molecular biology; Keith Wilson and John Walker (2005).
3. Biochemistry and Molecular Biology; 5th Edn. D. Papachristodoulou, A. Snape, W.H. Elliott, and D. C. Elliott, Oxford University Press (2014)
4. Discovering Genomics, Proteomics and Bioinformatics, Campbell A M & Heyer L J, 2nd Edn. Benjamin Cummings, (2007).
5. Principle and Practice of Bioanalysis; Richard F. Venn (Ed.) Taylor and Francis (2000).
6. Hydrophobic interaction Chromatography, Principles and Methods, Stuart E. Builder, Amersham-Pharmacia Biotech.(1993).
7. Biochemical, Physiological, and Molecular Aspects of Human Nutrition, Stipanuk Elsevier (2012).
8. Protein Bioinformatics; M. Michael Gromiha, Academic Press (1983).
9. Immuno Assay Hand Book; David Wild, Elsevier (2013).
10. Isoelectric Focusing; Theory, Methodology and Applications; P.G. Righetti, Elsevier (2013).
11. Fluorescence Microscopy; Anda Carnea and P. Michael Conn; Academic Press (2014).
12. Fluorescence Spectroscopy; Ludwig Brand and Michael Johnson, Academic Press (2008).

MBC – 203: Metabolism – I

(52 hrs)

	Course Objectives
1	Enable students to learn and understand the concepts of carbohydrate metabolism and related disorders.
2	Enable students to learn and understand the concepts of lipid metabolism and related disorders.
3	Educate students about the biochemistry related to Photosynthesis.

	Course Outcomes (COs)
CO1	Learn about glucose oxidative metabolic pathways in living things.
CO2	Understand the detailed metabolism of glycogen molecule.
CO3	Understand the important metabolic disorders in detail.
CO4	Understand in detail about the metabolism of lipids.
CO5	Learn the photosynthetic reaction mechanism, phases, adaptations of C4 & CAM plants and also bacterial photosynthesis.

CO – PO Mapping

PO	CO
PO1	CO1, CO2, CO3, CO4, CO5
PO2	CO1, CO3, CO4
PO3	CO1, CO3, CO4
PO4	CO1, CO3, CO4
PO5	CO1, CO3, CO4

UNIT 1: Carbohydrate metabolism

Introduction, glycolytic pathway and regulation. Gluconeogenesis. pathway and regulation. Role of LDH. The TCA cycle and its regulation. Alternate pathways: HMP pathway, Enter – Doudoroff, Glucuronate and Glyoxylate pathway, Cori's cycle, Futile cycles and anaplerotic reactions. **12 hrs**

UNIT 2: Glycogen and starch metabolism

Degradation, synthesis and regulation, glycogen storage disorders. Pasteur effect, fermentative pathways in microorganisms.

Regulation of blood glucose level, hypoglycemia and hyperglycemia. Diabetes mellitus: introduction, biochemical and clinical changes associated with IDDM and NIDDM, control of hyper glycemia, diagnosis of Diabetes mellitus and GTT. Pentosuria, Hexose interconversion, fructose and lactose intolerance, fructosuria, galactosemia. Glycosylation of proteins

18 hrs

UNIT 3: Lipid metabolism

Oxidation of fatty acids: even and odd numbered, unsaturated and branched chain fatty acids. Alternate routes for fatty acid oxidation. Degradation of triacylglycerols and phospholipids. Energetic of β -oxidation. Metabolism of ketone bodies; their formation, oxidation and clinical significance.

Biosynthesis of triacylglycerols, phospholipids and sphingo-lipids. Sphingolipidodystrophies. Biosynthesis of steroids, related biosynthesis from Isoprenoid units. Metabolism of prostaglandins and related compounds. Cholesterol biosynthesis, catabolism and regulation. Transport of cholesterol –LDL receptor pathway. Lipoproteinemias, fatty liver, hypercholesterolemia. Chemical composition, biological functions and metabolic fate of VLDL, LDL and HDL. Arachidonic acid metabolism-Leukotrienes

13 hrs

UNIT 4: Photosynthesis

Introduction, chloroplast/thylakoid structure. Ultra structure and organization of chloroplast membranes, lipid composition of chloroplast membranes. Photosynthetic reaction centre, photosynthetic apparatus, Hill reaction, light reaction, cyclic- and non-cyclic photophosphorylation. Dark reactions, CO₂ fixation into C₄-dicarboxylic acids. Bacterial photosynthesis, photorespiration, RUBISCO.

9 hrs

References

1. Biochemistry; Voet, D. and Voet, J.G. [Eds.] (1999) 3 Ed. John Wiley and sons.
2. Biochemistry; David Rawn, J. (1989) Neil Patterson Publishers.
3. Principles of Biochemistry; Smith et al., [Ed.] (1986) McGraw Hill.
4. Bioenergetics; A Practical Approach, G.C. Brown and C.E. Cooper (1995) IRL- Oxford University Press.
5. Photosynthesis, D.O. Hall and K. K. Rao, (1999), 6th Edn. Cambridge University Press.
6. Hawk's Physiological Chemistry, Oser (1976) 14th Edn Tata-McGrawHill.
7. Advances in Carbohydrate Chemistry and Biochemistry; Horton, Elsevier (1994).
8. Biochemistry of Foods, Eskin Elsevier (2012).
9. Text Book of Biochemistry with Clinical correlations; 6th Edn. Thomas M. Devlin, Wiley-Liss (2012).
10. Lehninger- Principles of Biochemistry; D. L. Nelson and M.M. Cox 6th Edn. Macmillan Publications (2012).

11. Biochemistry and Molecular Biology; 5th Edn. D. Papachristodoulou, A. Snape, W.H. Elliott, and D. C. Elliott, Oxford University Press (2014).
12. Biochemistry; David Rawn, Panima Publishers (2012).

MBC – 204: Membrane Biochemistry

(52 hrs)

	Course Objectives
1	Enable students to understand the concept of biomembrane physiology and biochemistry
2	Educate students about the role of biomolecules in membrane associated physiological processes
3	Make students understand the concepts of protein targeting and membrane transport mechanisms

	Course Outcomes (COs)
CO1	Understand structures of membrane lipids their dynamics and techniques involved in membrane structure determination.
CO2	Understand concept of membrane topology, role of membrane proteins, and their structures.
CO3	Understand protein targeting, signal sequence, its functions and mechanism of targeting.
CO4	Know the detailed mechanisms of membrane transportation and bacterial transport systems.
CO5	Know about nuclear transport mechanism and protein targeting in various subcellular organelles.

CO – PO Mapping

PO	CO
PO1	CO1, CO2, CO3, CO4, CO5
PO2	CO1, CO2, CO3, CO4, CO5
PO3	CO1, CO2, CO3, CO4, CO5
PO4	CO1, CO3
PO5	CO1, CO4

UNIT 1: Introduction

Review of structure, nomenclature and properties of glycerolipids, sphingolipids, glycolipids and sterols. Properties of lipids in solution, hydrophobic and hydrophilic interactions, Polar lipids and their ability to form mono, bi-layers and micelles, Langmuir trough.

Cell and organelle membranes; Physical properties of bi-layers, Polymorphic phases and molecular shapes exhibited by lipids. Effect of lipid composition and modification on viscosity and fluidity; role of cholesterol, cardiolipin, engineering membrane lipid composition. Models of membranes; Metamorphic mosaic model, Singer-Nicolson fluid mosaic model, Isolation and characterization of membrane lipids. Composition of plasma- and organelle membranes; transbilayer asymmetry; methods to determine membrane sidedness. Asymmetry of lipid distribution in bacterial, plant, and animal membranes, Lateral heterogeneity of membrane lipids; lipid domains, lipid rafts, caveoli, Non bilayer lipids and their role in membranes.

Physical organization of bilayers; human erythrocyte membrane as a prototype plasma membrane, role of cytoskeleton in organization of bilayers. *Liposomes*; preparation, properties and application in membrane biochemistry.

13 hrs

UNIT 2: Membrane proteins

Isolation and characterization of cell membranes. Detergent solubilization of membrane proteins. Purification and reconstitution of membrane proteins. Erythrocyte ghosts; proteins of RBC membrane and their interaction with cytoskeleton. Classification of membrane proteins based on membrane-protein interaction. Types of integral membrane protein, forces responsible for holding integral proteins in membranes, secondary structure of membrane spanning portions of integral membrane proteins; transmembrane α -helices and β -barrels, hydropathic plots. 3-D structures of typical integral membrane proteins: glycophorin, bacteriorhodopsin, photosynthetic reaction centre. Role of integral proteins in cell-cell interaction and adhesion; selectins, integrins, cadherins. Lipid-anchored membrane protein-acyl-prenyl- and GPI-anchors. Techniques for determination of membrane protein topology: Freeze-fracture electron microscopy, Fluorescence photobleaching recovery (FRAP). (Other techniques like DSC, NMR, ESR, AFM and X-ray applied for Membrane studies already discussed in Analytical Biochemistry –I & II).

8 hrs

UNIT 3: Topology of membrane protein

Protein translocation, cotranslational, post translational translocation. Start transfer and stop transfer signals for single pass transmembrane protein and multipass transmembrane proteins. ER retention signals, Glycosylation in ER. N-linked oligosaccharide, Dolichol-linked oligosaccharides. Folding of proteins in ER, role of chaperons – Calnexin and Calreticulin. N-linked oligosaccharides as timers for protein turnover, ubiquitination and protein degradation (improperly folded proteins), GPI-anchored proteins.

6 hrs

UNIT 4: Membrane transport

Relative permeability of pure phospholipid bilayer to various molecules. Diffusion across the plasma membrane. Partition coefficient and hydrophobicity. Energetics of moving non polar and polar molecules across lipid bilayer (PM). Experimental methods for study of membrane transport: Assay of membrane transport, use of liposomes to study single types of transporters. Mechanism for transport: Properties of passive diffusion, facilitated diffusion, active transport and co-transport. Electrically neutral and electrogenic transport, Kinetics and model of Glut-1 uniport ATP-driven pumps; classification, and working mechanism. ABC-transporters; MDR1, CFTR Channels and pores. Transport across organelle membranes. Ion channels; working and voltage gating, ionselectivity, electrochemical gradients, Nernst Equation, working of bacterial K-channels, aquaporins, ionophores. Bacterial transport systems; Lactose permease, Phospho transferase and sugar binding proteins.

7 hrs

UNIT 5: Intracellular compartments

Proteins sorting; Membrane enclosed organelles of eukaryotic cells, evolutionary origin and topological relationships. Protein trafficking: Sorting signals.

Mechanisms: Gated transport, transmembrane transport, vesicular transport. Signal sequences: Experimental evidence, Genetic experiment to demonstrate protein translocation.

Transport of molecules between nucleus and cytosol. Nuclear pore, nuclear localization signals, nuclear transport receptors, nuclear export: Ras-GTPases- directionality. Regulation of nuclear import and export.

Transport of protein into mitochondria and chloroplast, signal sequence, experimental setup to study protein translocators, working of TOM & TIM complexes. Energy requirement in protein import. Signal sequence for thylakoid membranes, peroxisomes. Endoplasmic reticulum, structural and functional diversity of endoplasmic reticulum, isolation of rough ER and signal sequence for protein import.

Signal Hypothesis: Signal Sequence, SRP-receptors for protein import to ER. Organization of translocation pore, Sec61 complex.

9 hrs

UNIT 6: Biogenesis of lipid bilayers

Intracellular vesicular trafficking: Maintenance of compartmental diversity, pathways of endocytosis and secretory. **Vesicles: types, study of cell free system, genetic approach, use of GFP.** Clathrin coated-Assembly and disassembly, Structure and function. significance. Coatmer coated-Assembly and disassembly, Structure and function. Retromer assembly on endosomal membrane. Coat assembly control by monomeric GTPases. Role of Rab proteins in vesicular targeting. SNARE proteins and their role in vesicular transport and membrane fusion. Experimental proof for SNARE requirement in vesicular fusion. Entry of enveloped viruses into cell. Coatmer coated vesicles: COP-II-coated transport vesicles, transport of cargo from ER to Golgi, homotypic membrane fusion. Retrieval pathway to ER.

Compartments of Golgi: processing of oligosaccharide chain in Golgi, N-linked, proteoglycan assembly in Golgi. Transport through *trans* Golgi network to lysosomes. Mannose-6-phosphate receptors. Signal patch for mannose-6-phosphate lysosomal storage disease. Endocytosis: Phagocytosis, Pinocytosis-vesicles, receptor mediated endocytosis. Retrieval of proteins in endosomes, multivesicular bodies sequestration of endogenous proteins.

9 hrs

References

1. Biochemistry 5th Edn. Jeremy M. Berg, John L. Tymoczko, Lubert Stryer.
2. Harper's Illustrated Biochemistry; 27th Edn. Robert K. Murray, Daryl K. Granner, Victor W. Rodwell, The McGraw-Hill (2006).
3. Lipid Biochemistry; 5th Edn. Michael I. Gurr, John L. Harwood and Keith N. Frayn, Blackwell Science (2002).
4. Biochemistry of Lipids, Lipoproteins and Membranes; 5th Edn. Dennis E. Vance and Jean E. Vance, Elsevier (2008).
5. Membrane Protein Purification and Crystallization; Carola Hunte, Gebhard von Jagow and Hermann Schagger, Academic Press (2011).
6. Membrane Proteins,; Douglas Rees, Academic Press (2003).
7. Introduction to Biological Membranes; William Stillwell, Elsevier (2013).
8. Molecular Biology of the Cell, Alberts et al., Garland Publications (2012).
9. Molecular Biology of the Cell; 6th Edn. Bruce Alberts, Alexander Johnson, Julian Lewis, David Morgan, Martin Raff, Keith Roberts and Peter Walter; Garland Science (2014).
10. Molecular Cell Biology; Lodish et al., 7th Edn. W.H. Freeman and Co. (2012).

MBC-205: Bioinformatics and Toxicology

(39 hrs)

	Course Objectives
1	To gain knowledge about Computers and computer programming languages.
2	In depth understanding on Databases; Biological databases; and tools to analyse sequences.
3	Comprehensive theoretical and practical foundation concept about protein structure prediction, Molecular interaction and Toxicology studies.

	Course Outcomes (COs)
CO1	Know about the fundamental operation of computer, C programming, PERL, Bioperl, Database management system and biological databases.
CO2	Understand the algorithms to analyse DNA and protein sequences by alignment and phylogenetic analysis.
CO3	Learn about various computational methods and tools used for protein secondary and tertiary structure prediction
CO4	Gain knowledge about molecular docking concepts employed in

	drug discovery and its applications.
CO5	Understand in detail about the core concepts of toxicology, and its effect at multiple levels of biological organization.

CO – PO Mapping

PO	CO
PO1	CO1, CO2, CO3, CO4, CO5
PO2	CO1, CO2, CO3, CO4, CO5
PO3	CO1, CO2, CO3, CO4, CO5
PO4	CO1, CO2, CO3, CO4, CO5
PO5	CO1, CO2, CO3, CO4, CO5

UNIT 1: Introduction to Computer

Computer softwares- operating system- Windows, UNIX, Linux, Application software- word processor, spread sheet. Introduction to statistical software (SPSS).

2 Hrs

UNIT 2: Computer Programming Languages

C Programming - Algorithm and flowchart, Structure of C program, Header file, Global declaration, Main function, variable declarations, Control statement-conditional and unconditional - sub functions. Introduction to PERL, Application of Bioperl.

4 Hrs

UNIT 3: Databases and Biological Databases

Introduction - Relational Databases Management (RDMS) - Oracle, SQL; Datamining and applications; accessing bibliographic databases-Pubmed; Nucleic acid sequence database – NCBI, EMBL, genome database- ENSEMBLE, EST tag databases and OMIM database. Protein sequence database - NBRF, PIR, SWISSPROT, Uniprot. Enzyme database – BRENDA, KEGG; Structural databases - protein data Bank (PDB), PROSITE, SCOP. Pathway and Interactome databases – KEGG, Reactome, INTACT, BIOGRID; Metabolome database – human metabolome database (HMD), PubChem; Cell line database (ATCC); Gene ontology database.

7 Hrs

UNIT 4: Tools to analyse sequences

Pairwise sequence alignment - global and local alignment, scoring matrices. Restriction mapping - NEB CUTTER, Similarity searching (FASTA and BLAST), Multiple Sequence alignment, Phylogenetic analyses, Identification of genes in genomes, Identification of motifs.

8 Hrs

UNIT 5: Protein Structure and Molecular Interaction

Introduction to protein structure - secondary structure prediction , hydropathic plots, prediction of secondary structure and identification of protein families, Tertiary structure database; Cambridge database, PDB, specialist structural databases. Programs for analysis and visualization of tertiary structure-RasMol/Pymol, Swiss-prot Pdb viewer; tertiary structure prediction- principles of homology and comparative modelling, *ab initio* Modelling, structure evaluation and validation; Molecular docking – Autodoc and application in drug discovery etc.

11 Hrs

UNIT 6: Toxicology

Toxicological chemistry, factors influencing toxicity; Dose response relationship – LD50, ED50, NOEL. Reversibility and sensitivity. Xenobiotics and endogenous substances. Detoxification enzymes. Mutations-genotoxicity, Ames test. Carcinogenic toxins. Cytotoxicity, methods to test toxicogens. Diagnosis of toxic effects in liver and kidney. Metal toxicity–Arsenic and lead. Non metal–oxygen and ozone.

7 hrs

References:

1. Dhananjaya (2002). Introduction to Bioinformatics, www.sd-bio.com series
2. Jan (2001). Nucleic acid research, Genome Database issue
3. Higgins & Taylor (2000). Bioinformatics, OUP.
4. Baxavanis (1998). Bioinformatics.
5. Fry, J.C. (1993). Biological Data Analysis. A practical Approach. IRL Press, Oxford.
6. Swardlaw, A.C. (1985). Practical Statistics for Experimental Biologists, Joh
7. Introduction to Exotoxicology, En. D.W. Connell, Blackwell Scientific (2000)
8. Molecular Cell Biology Baltimore et al., Scientifica Americal Publication (1995).
9. Molecular Pharmacology, ed. T. Kenakin, Blackwell Science Inc (1997).
10. Toxicological Chemistry and biochemistry; Manahan, Stanley E. CRC Press LLC (2003).

MBC – 206: Enzymology Lab (4 credits)

	Course Objectives
1	Enable students to develop basic laboratory skills, implement experimental protocols and carryout investigations of enzymes.
2	Enable students to understand and learn the methods involved in enzyme isolation , purification and analysis.
3	Develop skills of performing specific enzyme assays and reporting their activity.

	Course Outcomes (COs)
CO1	Learn fractionation and purification of enzymes from different sources
CO2	Have a hands on experience of protein analytical method like electro-phoresis
CO3	Learn methods of enzyme assays and their activity assessment.
CO4	Understand and learn kinetic and inhibition study of enzymes.
CO5	Know the different physical and chemical factors affecting enzyme activity.

CO – PO Mapping

PO	COs
PO1	CO1, CO2, CO3, CO4, CO5
PO2	CO1, CO2, CO3, CO4, CO5
PO3	CO1, CO2, CO3, CO4, CO5
PO4	CO1, CO2, CO3, CO4, CO5
PO5	- -

1. Fractionation of esterase by ammonium sulphate and dialysis.
2. Analysis of Purity by SDS-PAGE.
3. Determination of total activity of pea esterase.
4. Determination of Specific activity of pea esterase.
5. Determination of optimum pH of pea esterase.
6. Determination of optimum temperature and activation energy of pea esterase.
7. Determination of K_M and V_{max} of pea esterase.
8. Determination of type of inhibition (reversible or irreversible) of pea esterase.
9. Determination of I_{50} of pea esterase using organophosphate inhibitor.
10. Determination of total activity of salivary amylase.
11. Determination of Specific activity of salivary amylase.
12. Determination of optimum pH of salivary amylase.
13. Determination of optimum temperature of salivary amylase.
14. Determination of K_m and V_{max} of salivary amylase.
15. Determination of I_{50} of salivary amylase.

References

1. Enzymes: Biochemistry, Biotechnology and Clinical Chemistry: Trevor Palmer, Horwood, (2001).
2. Enzymes: A Practical Introduction to Structure, Mechanism, and Data Analysis: Robert A. Copeland, by Wiley-VCH Inc. (2000).
3. *Enzymes: A Practical Introduction to Structure, Mechanism and Data Analysis*: Robert A. Copeland, John Wiley & Sons (2000).
4. Enzyme Kinetics: *A Modern Approach*: Alejandro G. Marangoni, John Wiley & Sons (2002)
5. Enzyme Kinetics: *Principles and Methods*: Hans Bisswanger, Wiley-VCH (2002).
6. Fundamentals of Enzyme Kinetics: 4th ed. Athel Cornish-Bowden, Wiley-Blackwell (2012).
7. *Fundamentals of Enzyme Kinetics*: Athel Cornish-Bowden, Portland Press (2004)
8. *Practical Enzymology*: Hans Bisswanger, Wiley-VCH (2004)
9. Practical Enzymology, Second Revised Edition [PDF] [StormRG]: Hans Bisswanger, Wiley – Blackwell; 2 edition (2011)

MBC – 207: Biochemical Techniques Lab (4 credits)

	Course Objectives
1	Enable students to develop familiarity with advanced laboratory biochemical techniques. .
2	Enable students to investigate the biomolecules using their physico chemical properties .
3	Develop hands-on experience of handling analytical instruments.

	Course Outcomes (COs)
CO1	Learn various techniques useful for separation of biomolecules
CO2	Perform chromatography methods for separation of amino acids and carbohydrates
CO3	Separate and purify proteins by various chromatographic methods
CO4	Analyze proteins and nucleic acids by spectrophotometry

CO5	Separate and analyze nucleic acids and proteins by electrophoresis.

CO – PO Mapping

PO	COs
PO1	CO1, CO2, CO3, CO4, CO5
PO2	CO1, CO2, CO3, CO4, CO5
PO3	CO1, CO2, CO3, CO4, CO5
PO4	CO1, CO2, CO3, CO4, CO5
PO5	--

1. Ascending descending and circular paper chromatography of amino acids / carbohydrates
2. Two-dimensional chromatography of amino acid / carbohydrates.
3. Thin layer chromatography of carbohydrates / amino acids.
4. Separation of proteins by non-denaturing PAGE.
5. Determination of molecular weight of Proteins by SDS–PAGE
6. Separation of isoenzymes by isoelectric focusing
7. Ion exchange chromatography of nucleic acids / proteins.
8. Purification of proteins by cation exchange chromatography.
9. Gel –permeation chromatography of pigments/proteins.
10. Separation of nucleic acid by Urea PAGE.
11. Absorption spectra of proteins and nucleic acids and determination of molar extinction coefficient.
12. Purification of proteins by affinity chromatography.

References

1. Basic Methods for the Biochemical Lab; Martin Holtz hauer, Springer, (2007).
2. Principles and Techniques of Biochemistry and Molecular Biology 7th Edn. Keith Wilson and John Walker, Cambridge University Press, (2010).
3. Laboratory Techniques in Biochemistry and Molecular Biology, Work and Work Vol. I & II, North Holland, (1969).
4. Principle and Techniques of Practical Biochemistry; Keith Wilson and John M. Walker, Cambridge University Press (2000).
5. Biochemistry LabFax, Ed. J.A.A. Chambers and D. Rickwood,, Blackwell Science, (1993),
6. Protein Purification Applications, S.L.V. Harris and Angal IRL Press, (1990)
7. Laboratory Techniques in Biochemistry and Molecular Biology, Work and Work Vol. I & II, North Holland, (1969).

Third Semester M. Sc. Biochemistry

MBC – 301: Molecular Biology – I

(52 hrs)

	Course Objectives
1	To learn and understand the fundamentals of molecular biology like

	nature of genetic material, features of genomes, damage and repair
2	To categorize possible modes of replication and its regulation, and roles of enzymes in replication of both prokaryotes and eukaryotes
3	To sketch the intricate levels of molecular mechanisms underlying the process of transcription and its regulation and post translational modifications

	Course Outcomes (COs)
CO1	To describe the characteristics of DNA as genetic material and acquire basic concepts of genome, its composition and organization
CO2	To comprehend the basic steps involved in DNA replication in prokaryotes and eukaryotes, emphasizing the enzymes involved in different types of replication, including plasmids and viruses
CO3	To assess the molecular mechanisms behind DNA damage and repair in both prokaryotes and eukaryotes
CO4	To analyze the basic steps involved in transcription in prokaryotes and eukaryotes, emphasizing the enzymes involved in transcription and the techniques used to understand transcription
CO5	Understand the post transcriptional modifications of the eukaryotic mRNA and their significance and functions

CO – PO Mapping

PO	CO
PO1	CO1, CO2, CO3, CO4, CO5
PO2	CO1, CO2
PO3	CO1, CO3
PO4	CO3
PO5	CO3

UNIT 1: Introduction

Historical account of DNA discovery. Relationship between genes and proteins, overview of flow of genetic information; central dogma of molecular biology. Nature of genetic material, experiments confirming DNA as genetic material. Review of physical chemistry of DNA. RNA as genetic material. Variation in size and shape of genomes; ultracentrifugation and electron microscopic methods to study the shape and size of genomes. Relationship between size of genome and genetic capacity; C-value paradox. Organelle genomes, Genome sequence and gene numbers, measurement of expressed genes.

Clusters and repeats; tandem repeats, mini- micro- satellites and interspersed genome-wide repeats and their significance. Pseudo genes and transposable elements. Globin gene clusters, gene duplication and gene evolution, biases in mutations, gene conversion and codon usage.

Topological problems; Topo-isomerases, gyrases and helicases - mechanism and classification. Mechanism and classification of topoisomerases, assay of topoisomerases.

11 hrs

UNIT 2: Prokaryotic DNA Replication

Replicon, single and multi copy replicons, linear and circular replicons, unidirectional and bidirectional replication, experimental methods, mapping origin of replication, semi-conservative and semi-discontinuous replication; experimental demonstrations. Priming DNA synthesis in bacteria; experimental evidence, components of primosome,. Initiation at origin (*oriC*) of E. Coli. Creation of replication forks. Regulation of initiation at origins, sequestration of origins after replication, role of helicase, assay of helicase.

Enzymology of DNA replication; DNA polymerases, chemistry of nucleotide polymerization and in vitro assay. Use of conditional lethal mutants and in-vitro complementation methods for identification of replicative polymerase. Properties and functions of DNA polymerase-I, Kornberg enzyme. Subunit composition of polymerase γ -III holoenzyme, identification of functions of individual subunits by complementation and mutational studies. Mechanism of replication of *E. coli* DNA-trombone model, termination of replication. Hand-palm structure of DNA polymerases. Processivity and fidelity of replication. Bacterial replication and its connection to cell cycle

Eukaryotic DNA replication; Replicative and repair enzymes of eukaryotes. Initiation, elongation by eukaryotic DNA polymerases. Isolation of ARS of yeast, ORC, Licensing factors and control of eukaryotic DNA replication, role of MCM proteins. Replication of organelle genomes, maintenance of ends of linear DNAs; telomeric DNA and telomerase. Regulation of eukaryotic DNA replication and inhibitors of DNA replication.

12 hrs

UNIT 3: Extra chromosomal replication

Replication of phage DNA ϕ X174, T7, SV-40, rolling circle model of replication. Linear DNA-ends, terminal proteins, replication of plasmid DNA. **Replication of RNA viruses**: ss +RNA viruses; Picorna (Polio) and corona virus, ss-RNA viruses; rhabdo virus (VSV), orthomixovirus (influenza virus). dsRNA- reovirus (Rota virus), **Structure and mechanism of RDR pol. Retroviruses; Structure and mechanism of reverse transcriptase and integrase (HIV)**, replication of tumor virus (RSV). Replication of Q β virus.

7 hrs

UNIT 4: DNA repair

Experimental demonstration of repair in prokaryotes, damaging agents and damage recognition, direct repair, Miss-match repair assay for mismatch repair, Base excision repair (BER), Nucleotide excision repair (NER) systems; components and mechanism of repair, error prone repair, SOS and Rec-A. Eukaryotic BER and NER, controlling direction of mismatch repair, DNA damage in chromatin

4 hrs

UNIT 5: Transcription in prokaryotes

The transcriptome, prokaryotic RNA polymerase; molecular composition, and mechanism of transcription. Initiation of prokaryotic transcription; Structure of bacterial promoters. Effect of sigma factor on binding of RNA pol. to promoters. Structure and function of sigma factor, reuse of sigma factor (sigma cycle). Sigma movement relative to DNA: FRET assay. DNA melting at promoters, promoter clearance. Role of α -subunit in upstream element recognition. Foot-printing of upstream elements with α -subunit. *Elongation*: Role of β -subunit in phosphodiester bond formation. Structure of elongation complex and core polymerase. Termination of transcription: Rho- dependent and independent, termination, RNA product under Rho dependent termination.

5 hrs

UNIT 6: Transcription in eukaryotes

Separation of nuclear RNA polymerases- rat liver RNA pol. Roles of the RNA polymerases. Sensitivity to α -amanitin. Subunits of RNA pol-II (yeast pol-II). Heterogeneity of Rpb1 subunit. Formation and maintenance of transcription bubble. Eukaryotic promoters: Class-II core promoter, modular organization, SV40 early promoter. Inker-scanning mutagenesis, TATA Box, downstream promoter elements, proximal promoter elements, TATA-less promoters and initiators. Class-I and Class-III promoters, Enhancers and silencers. Class-II pre-initiation complex, foot-printing DAB. Structure and function of TFIID, TBP and associated factors (TAFs). Phosphorylation of CTD of RNA pol-II, Mediator complex and RNA pol-II. Elongation factors: Effect of TFIIS, reversal of transcription arrest, proof reading of transcripts. Composition and working of transcription units at class-I and class-III promoters.

RNA processing: split genes, RNA splicing; R-looping experiments, splicing signals, effect of splicing on gene expression. Splicing of nuclear mRNA precursors. Branched intermediate, mechanism of RNase T₁ and T₂, direct evidence for a branched nucleotide. Signal at branch.

Spliceosomes: snRNPs, U1snRNP, detection of spliced product by RNase protection assay. U6snRNP, U2snRNP and U4snRNP. Spliceosome assembly and function. Alternative splicing, exon-intron

definition. Commitment of precursor RNA to splicing, role of sr protein. Yeast two hybrid assay. Role of RNA pol-II in splicing, control of splicing. Self splicing RNase. Group-I introns, demonstration of exon ligation, Group-II introns.

Post transcriptional modification of mRNA: Structure of cap, purification of caps, capping substrate. Cap structure of Reovirus, functions of cap.

Polyadenylation: Function of poly A, mechanism and signals for polyadenylation. Cleavage and Polyadenylation for mRNA elongation of poly-A, poly-A binding protein (PABP), turnover of poly-A. Coordination of mRNA processing with Coupling termination and mRNA 3' end processing.

13 hrs

References

1. Biochemistry and Molecular Biology of Plant; Buchanan, Gruissum and Jones, (2000), ASPP, USA.
2. Biochemistry; David Rawn, Panima Publishers (2012).
3. The Bacteriophages; Richard Calendar, 2nd Edition, Oxford University Press (2005).
4. Basic Virology; Wagner and Hewlett; Blackwell Science, (2004)
5. LEWINS Gene XI; J.E. Krebs, E.S. Goldstein, and S.T. Kilpatrick, Jones and Bartlett Publishers (2012).
6. Molecular Biology of the Cell, Alberts et al., Garland Publications, (2012).
7. Molecular Biology, David Freifelder, Narosa Publishers, (1997).
8. Molecular Biology Robert F. Weaver, McGraw Hill (2012).
9. Microbial Genetics; Maloy et al., Jones and Bartlett Publishers, (1994).
10. Modern Microbial Genetics; Uldies N. Streips and Ronals E. Yasbin, Wiley Leis Inc. New York, (2002).
11. Principles of Developmental Genetics; S.A. Moody, Academic Press (2007).
12. Developmental Biology; S. P. Gilbert, 8th Edn, Sinauer Associates Inc.,(2006)
13. Molecular biology and Biotechnology; 4th Edn., J.M. Walker and R. Rapley, RSC (2000).
14. Molecular Biology of Gene; Watson, J.D. et al., 5th Edn. Pearson Education; (2004).
15. Principles of Virology; S.J. Flint et al., ASM Press (2000).
16. Biochemistry and Molecular Biology; 5th Edn. D.Papachristodoulou, A. Snape, W.H. Elliott, and D. C. Elliott Oxford University Press (2014)
17. Chromatin structure and Gene Expression; 2nd Edn. Sarah Elgin, Jerry Workman, Oxford University Press (2000)
18. Molecular Cell Biology; Harvey Lodish 5th Edn. (2010)
19. Biochemistry 5th Edn. Jeremy M. Berg, John L. Tymoczko, Lubert Stryer (2011).
20. Genome Stability: DNA Repair and Recombination; James Haber, Garland Science (2013)
21. Retroviruses; Coffin JM, Hughes SH, Varmus HE, editors; CSH Press, (1997)
22. Viruses: Biology, Applications, and Control; David Harper, Garland Science (2011).

MBC – 302: Molecular Physiology

(52 hrs)

Course Objectives	
1	To gain knowledge about Nerve signalling and Endocrine signalling mechanisms.
2	In depth understanding on Cell cycle regulations; apoptosis mechanisms and stem cells
3	Comprehensive theoretical and foundational concept about Cancer, important signalling pathways in humans and plants.

Course Outcomes (COs)	
CO1	Learn in detail about different types of neurotransmitters, its receptor structure and sub-classes, mechanism of action and its termination. Important understanding of agonists

	and antagonists functions.
CO2	Complete understand about different classes of hormone molecules, its signal transduction pathways, its proteins, nuclear signaling and its biochemistry of vision.
CO3	Learn in detail about cell cycle checkpoints, stem cells and its properties. Also in this unit, apoptosis and its pathways has been understood.
CO4	Know about cancer signs, symptoms, pathophysiology, diagnosis and treatment and its signalling cascades.
CO5	Understand the general mechanism of action of plant hormones and pheromones signalling mechanism in plants.

CO – PO Mapping

PO	CO
PO1	CO1, CO2, CO3, CO4, CO5
PO2	CO1, CO2, CO3
PO3	CO1, CO2, CO3, CO4
PO4	CO1, CO2, CO3, CO4, CO5
PO5	CO3, CO4

UNIT 1: Nerve signaling

Acetylcholine receptor (AChR) channel, origin and mechanism of actions of neurotransmitters (Acetylcholine, catecholamine, serotonin; amino acids (glutamate, aspartate, GABA, and glycine) and neuropeptides (somatostatin/enkephalins).

Trafficking proteins of synaptic vesicles, vesicle cycle – exo – and endocytosis of synaptic vesicles.

Structure, subtypes and functions of receptors of ACh, GABA, Glycine, Serotonin and glutamate and peptide neurotransmitters, activation by ligands & interaction with effectors. Role of agonists & antagonists of neurotransmitters. Biochemical basis of neurological diseases. Natural, genetic and environmental factors affecting the development of CNS, Co – ordination between nervous and endocrine systems.

13 hrs

UNIT 2: Endocrine signaling

Signal transduction, extra – cellular signaling; hormones as signal molecules – peptide, amino acid derivatives, steroid, eicosanoids.

Signal transduction pathways of – 1) G – protein linked (epinephrine, serotonin, glucagons), 2) Ion-channel (ACh), 3) Tyrosine kinase {(RTK), [EGF, IGF, insulin]}, and 4) Intrinsic enzyme / cytokine, receptors.

Biochemistry of vision: Structure of an eye, lens and retina, perception of light, rods and cones, rhodopsin, primary events in visual excitation, cGMP and transduction in generation of nerve impulse, colour vision

Intracellular signaling proteins: {adaptors, activators, bifurcators, integrators, effectors, etc.}.

Second messengers; and their regularization: cAMP, CREB, cGMP, phosphoinositides, arachidonic acid, Ca^{2+} , and NO. Signal amplification cascades; Cascades downstream of RTK; Erk – fos – jun – cyclin – D, MAPK – Ras – Raf – Sos, specificity of protein kinases.

Effectors on intercellular signaling: Adenylate cyclase, Phospholipase- C, Nitric oxide synthase, guanylate cyclase and their activation, negative modulation.

Nuclear signaling: Steroid, thyroid, Vitamin-D and retinoic acid receptors and transcriptional activation.

Transcriptional activation by phosphorylation cascade; CREB.

18 hrs

UNIT 3: Cell Cycle

Cell cycle (entry of cell from G₂ to M – phase) Role of M – Cdk, MPF. Promotion of G₁/S by growth factors, cell cycle arrest at G₁, role of Rb proteins in cell cycle arrest. Regulation of M- phase (role of mitogen, survival factor and TGF- β). Role of ubiquitin.

Growth factors and cytokines, growth phases and check points of cell cycle (DNA replication and spindle- attachment checkpoint) and their regulation. Cyclins and cyclin-dependent kinases.

Stem Cells: Embryonic and adult stem cells; unique properties, and potential applications.

Apoptosis: Discovery, morphological changes, mitochondrial regulation. Direct signal transduction (TNF pathway, Fas pathway, caspases, execution and removal of dead cells). Distinguishing apoptotic cells from necrotic cells. Role of HeLa cells, Hyperactive apoptosis and treatments.

Cancer: Introduction, Signs and symptoms, causes pathophysiology, diagnosis, prevention and management. Signaling cascades in cancer (MAP kinases, Ras pathways, JAK-STAT and TGF- pathways). Etiology of breast, colon and prostate cancer.

19 hrs

UNIT 4: Signaling in Plants

Outline of plant hormones and pheromones signaling.

2 hrs

References

1. Signal transduction and human disease; Toren Finkel, and J. Silvio Gutkind, John Wiley & Sons, Inc. (2003)
2. Greenspan's Basic and Clinical Endocrinology; 9th Edn. David Gardner and Dolores Shoback Lange Clinical Medicine (2012).
3. Biochemistry of Signal Transduction and Regulation; Gerhard Krauss, Wiley-VCH (2003).
4. Elements of Molecular Neurobiology; 3rd Edn. C. U. M. Smith, John Wiley & Sons Ltd, (2002).
5. Basic Neurochemistry; George Siegel et al., (1999) Wippincott, Williams and Wilkins.
6. Neuroscience; 2nd edn. Purves, Dale; et al., Sinauer Associates, Inc. (2001).
7. G-Proteins coupled Receptors; P. Michael Conn Academic Press (2013).
8. Molecular Biology of the Cell; 6th Edn. Bruce Alberts, Alexander Johnson, Julian Lewis, David Morgan, Martin Raff, Keith Roberts, Peter Walter; Garland Science (2014).
9. Molecular Cell Biology; Lodish et al., 7th Edn. W.H. Freeman and Co. (2012).
10. Cell Signaling; Wendell Lim, Bruce Mayer, Tony Pawson; Garland Science (2014).
11. Cell Biology; A short course; Stephen R. Bolsover et al., John Wiley & Sons, Inc. (2004)
12. Electrochemical methods for neuroscience; Michael AC, Borland LM, editors. Boca Raton (FL): CRC Press (2007).
13. Signal Transduction; Lewis Cantley, CSHL Press (2014).
14. When Cells Die; A Comprehensive Evaluation of Apoptosis And Programmed Cell Death; Richard, A. Lockshin, and Zahra Zakeri, Wiley Liss (2004).
15. Neuroscience; 2nd edn. Purves, Dale; et al., Sinauer Associates, Inc.; (2001).
16. Biochemistry of Signal Transduction and Regulation; 3rd Edn. Gerhard Krauss, Wiley-VCH, (2003).
17. The Biology of Cancer; Robert A. Weinberg; Garland Science (2013).

MBC -303: Metabolism – II

(52 hrs)

	Course Objectives
1	Educate the students about the concepts of metabolic energy capture and transfer mechanisms.
2	Enable the students to understand the different stages of nitrogen cycle and its importance in life.
3	Educate the students about the metabolism of various nitrogen molecules and discuss about its significance.

	Course Outcomes (COs)
CO1	To understand the basic concepts of metabolic energy capture and transfer, biological oxidation, oxidative phosphorylation, ATP synthesis in mitochondria, plants and bacte-

	ria.
CO2	To understand nitrogen cycle with detailed mechanism of nitrogen fixation and its importance in the assimilation of atmospheric nitrogen
CO3	To learn the synthesis and degradation of purines and pyrimidines by salvage and denovo pathways, disorders related to the nucleotide metabolism.
CO4	To understand the mechanism of degradation of essential and non essential amino acids in plants ,microbes and animals.
CO5	To learn how amino acids are synthesized in living things along with inborn errors of amino acid metabolism and synthesis, degradation and regulation of heme along with related disorders of heme.

CO – PO Mapping

PO	CO
PO1	CO1, CO2, CO3, CO4, CO5
PO2	CO5
PO3	CO5
PO4	CO3, CO5
PO5	CO3, CO5

UNIT 1: Bioenergetics

Basic concepts of metabolic energy capture and transfer. Biochemical energetic-group transfer reactions of ATP, phosphate group transfer potential of ATP and other high energy phosphate donors. Stages in extraction of energy from fuel molecules.

2 hrs

UNIT 2: Biological oxidation

Biological redox couplers, participation in oxidative metabolism. Free energy changes in electron transfer reactions. Mitochondrial electron transfer system- Chemical nature, topology and thermodynamic design of electron carriers. Sequence of electron carriers-isolation of mitochondrial complexes, reconstitution experiments and study of specific inhibitors of Electron Transport Chain.

4 hrs

UNIT 3: Oxidative phosphorylation

Mechanism of proton pumping. Proton motive force and the Mitchell hypothesis. FoF1-ATPase-structure and mechanism, O¹⁸ exchange. Coupling of electron transfer to ATP synthesis. Uncouplers, inhibitors and ionophores, partial reactions of OP, P/O ratios and their use in localization of sites of ATP synthesis along the chain. Mechanism of oxidative phosphorylation, mitochondrial specific transport systems and energy charge. Microsomal electron transport. Proton motive force in Halobacteria, ATP synthesis in bacteria. H⁺ pumping by bacteriorhodopsin Photosynthetic electron transport. Structure and function of chloroplast ATP- synthase.

7 hrs

UNIT 4: Nitrogen Cycle

Introduction, biological and non-biological nitrogen fixation, *nif* genes, regulation and utilization of nitrate and nitrite, regulation of nitrate reductase. Assimilation of ammonia, formation of amino acid amides by glutamine synthetase and its regulation.

4 hrs

UNIT 5: Nucleotide Metabolism

Biosynthesis of purine and pyrimidine nucleotides and their inter conversion, regulation of biosynthesis. Other pathways of purine nucleotide formation. Biosynthesis of deoxyribonucleotides and coenzymes nucleotides. Chemical inhibition of the biosynthesis of nucleic acid precursors. Degradation of purine and pyrimidines, and disorders associated with their metabolism; gout, Lesch-Nyhan syndrome, oroticaciduria, and xanthinuria.

7 hrs

UNIT 6: Amino acid Metabolism

General metabolic reaction of amino acids– transamination, pseudotransamination, glucose – alanine cycle, oxidative deamination (glutamate dehydrogenase), minor pathways of amino acid degradation – transdeamination, amino acid oxidase, and non – oxidative deamination (α -deaminase, dehydrase, asparaginase and glutaminase). Urea cycle– regulation and metabolic disorders.

Biosynthesis of creatine and creatine phosphate, polyamines– putrescine, spermidine and spermine, glutathione (γ -glutamyl cycle), physiologically active amines (γ -amino butyric acid, serotonin, α – histamine and catecholamines – dopamine, epinephrine and epinephrine). **7 hrs**

UNIT 7: Degradation of the individual amino acids

Pathways in animal, plant and microbial systems; Amino acids forming from pyruvate (alanine, glycine, threonine, serine, cystine and cysteine), oxaloacetate (aspartic acid and asparagine), α - ketoglutarate (glutamic acid, glutamine, arginine, histidine and proline), succinyl CoA (valine, isoleucine and methionine), acetoacetate and/or acetyl CoA (leucine and lysine), pyruvate, formaldehyde, acetoacetate and/or acetyl CoA (tryptophan), and fumarate, acetoacetate and/or acetyl CoA (phenylalanine and tyrosine). Inherited disorders associated with glycine, aromatic, branched chain, basic and sulfur containing amino acid metabolism. **9 hrs**

UNIT 8: Biosynthesis of the individual amino acids

Pathways in animal, plant and microbial systems– biosynthesis of non – essential amino acids from pyruvate (alanine), intermediates of glycolysis (serine) and TCA cycle (aspartic acid, asparagine, glutamic acid and glutamine), essential amino acid (tyrosine), non – essential amino acid (glycine, proline and arginine), and essential & non – essential amino acid (cysteine). Biosynthesis of essential amino acids from aspartate family of amino acids (threonine, lysine and methionine), pyruvate family of amino acids (valine and leucine), pyruvate and α -ketobutyrate family of amino acid (isoleucine), aromatic family of amino acids (phenylalanine, tyrosine and tryptophan) and histidine. Regulation of amino acid biosynthesis by sequential & concerted feedback inhibition. **9 hrs**

UNIT 9: Heme Metabolism

Biosynthesis and degradation of porphyrin and their regulation, porphyrias, jaundice and Hemoglobinopathies. **3 hrs**

References

1. Biochemistry- R. Garret, Charles M Grisham, Belmont (2013)
2. Biochemistry; Geoffrey Zubey, (1998), WCB Publishers.
3. Biochemistry; David Rawn, Panima Publishers, (1989).
4. Text Book of Biochemistry with Clinical correlations; 6th Edn. Thomas M. Devlin (2012), Wiley-Liss.
5. Lehninger- Principles of Biochemistry; D. L. Nelson and M.M. Cox 6th Edn. Macmillan Publications (2012).
6. Principles of Biochemistry; Smith et al., [Ed.] (1986) McGraw Hill.
7. Bioenergetics; A Practical Approach, G.C. Brown and C.E. Cooper (1995) IRL- Oxford University Press.
8. Biochemistry Ed. Donald Voet & Judith G. Voet, John Wiley & Sons, Inc. (2010).
9. Bioenergetics; David Nicholls and Stuart Ferguson, Elsevier (2013).

MBC – 304: Molecular Biology Lab (4 credits)

	Course Objectives
1	Enable students to develop familiarity with basic molecular techniques useful

	for advanced research.
2	Enable students to isolate and investigate nucleic acids.
3	Develop hands-on experience of handling analytical instruments.

	Course Outcomes (COs)
CO1	Perform isolation of genomic DNA from plant, bacteria and yeast.
CO2	Perform basic molecular characterization techniques on the isolated DNA
CO3	Separate plasmid DNA and RNA from biological samples.
CO4	Experience handling PCR instrument for DNA amplification.
CO5	Perform blotting techniques for nucleic acid detection.

CO – PO Mapping

PO	COs
PO1	CO1, CO2, CO3, CO4, CO5
PO2	CO1, CO2, CO3, CO4, CO5
PO3	CO1, CO2, CO3, CO4, CO5
PO4	CO1, CO2, CO3, CO4, CO5
PO5	-

1. Isolation of genomic DNA from bacteria (E. Coli).
2. Quantification and characterization of isolated genomic DNA from bacteria (E. Coli) by agarose gel electrophoresis and spectrophotometer.
3. Isolation of genomic DNA from a plant source.
4. Quantification and characterization of isolated genomic DNA from a plant source by agarose gel electrophoresis and spectrophotometer.
5. Isolation of plasmid DNA from bacteria (E. Coli).
6. Quantification and characterization of isolated plasmid DNA from bacteria (E. Coli) by agarose gel electrophoresis and spectrophotometer.
7. Isolation of total RNA from yeast.
8. Quantification and characterization of isolated RNA from yeast by agarose gel electrophoresis and spectrophotometer.
9. Spectroscopic determination of melting temperature (T_m) of calf thymus DNA.
10. Rapid amplification of polymorphic DNA.
11. Southern Blotting
12. Northern Blotting

References

1. Molecular Biology Techniques; Sue Carson, Heather Miller and D. Scott Witherow, Academic Press (2011).
2. Principles and Techniques of Biochemistry and Molecular Biology; 7th Edn. Keith Wilson and John Walker (2012).
3. Principles of Gene Manipulations; 6th Edn. S.B. Primrose, R.M. Twyman, and R.W. Old, Blackwell Science (2012).

4. Gene Cloning and DNA analysis- An Introduction; T. A. Brown, 5th Edition, Wiley-Blackwell (2006).
5. Laboratory methods in Enzymology; Part-A; Jon Lorsch, Academic Press (2014).
6. Gene Cloning Laboratory Manual 4th Edn. Michael R. Green and Joseph Sambrook, CSHL Press (2014).
7. Current Protocols in Molecular Biology; S Gallagher, Wiley Interscience (2008).

**MBC – 305: Genetic Engineering and Bioinformatics Lab
(4 Credits)**

	Course Objectives
1	Enable students to develop familiarity with advanced molecular techniques useful for research.
2	Enable students to perform experiments with vectors and plasmid DNA.
3	Develop acquaintance with the modern <i>insilico</i> tools of biological research.

	Course Outcomes (COs)
CO1	Perform advanced molecular biology experiments like transformation, primer design, ligation and screening.
CO2	Perform expression experiments in microbial vectors.
CO3	Perform restriction digestion and mapping of plasmid DNA.
CO4	Understand the basic concepts of Bioinformatics, online resource (software) utilization and their applications in Biochemical research.
CO5	Understand the basic biostatistical parameters useful for inference drawing in biochemical research.

CO – PO Mapping

PO	COs
PO1	CO1, CO2, CO3, CO4, CO5
PO2	CO1, CO2, CO3, CO4, CO5
PO3	CO1, CO2, CO3, CO4, CO5
PO4	CO1, CO2, CO3, CO4, CO5
PO5	CO1, CO2, CO3, CO4, CO5

1. Preparation of Competent cells by Calcium chloride method.
2. Transformation of plasmid in competent cells.
3. Primer Design, DNA Amplification by (PCR) and Gel elution of the PCR fragment.
4. Ligation and screening.
5. Expression of GFP in E. coli

6. Restriction Mapping of Nucleotide Sequences using NEBCUTTER and Restriction digestion of isolated plasmid DNA.
7. Retrieval of Protein and Nucleotide Sequences from NCBI and UniProt and identification of ORFs using NCBI-ORF FINDER.
8. Pair wise Sequence Alignment, Multiple Sequence Alignment and Evolutionary studies / Phylogenetic analysis.
9. Retrieval of Protein Structure from PROTEIN DATA BANK, and Molecular Visualization of Protein Structure using RasMol.
10. Visualization of Secondary Structure of Protein in Ramachandran Plot and Protein Secondary Structure Prediction.
11. Introduction to Auto Doc.
12. Inferential statistics (t-test and ANOVA) and Correlation and regression analyses in MS-Excel.

References

1. Molecular Biology Techniques; Sue Carson, Heather Miller and D. Scott Witherow, Academic Press (2011).
2. Principles and Techniques of Biochemistry and Molecular Biology; 7th Edn. Keith Wilson and John Walker (2012).
3. Principles of Gene Manipulations; 6th Edn. S.B. Primrose, R.M. Twyman, and R.W. Old, Blackwell Science (2012).
4. Gene Cloning and DNA analysis- An Introduction; T. A. Brown, 5th Edition, Wiley-Blackwell (2006).
5. Laboratory methods in Enzymology; Part-A; Jon Lorsch, Academic Press (2014).
6. Gene Cloning Laboratory Manual 4th Edn. Michael R. Green and Joseph Sambrook, CSHL Press (2014).
7. Current Protocols in Molecular Biology; S Gallagher, Wiley Interscience (2008).
8. Dhananjaya (2002). Introduction to Bioinformatics, www.sd-bio.com series
10. Jan (2001). Nucleic acid research, Genome Database issue
11. Higgins & Taylor (2000). Bioinformatics, OUP.
12. Practical Statistics for Experimental Biologists, Swardlaw, A.C. (1985).

Fourth Semester M. Sc. Biochemistry

MBC – 401: Molecular Biology – II

52 hrs

	Course Objectives
1	To illustrate the concepts of gene regulation in prokaryotes, eukaryotes and viruses and discuss the role of chromatin organization in gene regulation
2	To analyze the principles of regulation of gene expression by transcriptional modulators and RNA regulators
3	To categorize the process of translation in prokaryotes and eukaryotes along with comprehension of the genetic code

	Course Outcomes (COs)
CO1	To summarize the basic steps in gene regulation that includes positive and negative regulation in prokaryotes and viruses
CO2	To describe the role of chromatin organization, modification and chromatin remodeling in gene expression regulation in eukaryotes
CO3	To analyze the structure and mechanism of gene expression regulation eu-

	karyotic transcription activators, repressors and coactivators, regulation of gene expression by mRNA stability, siRNA and miRNA
CO4	To comprehend the mechanism of protein translation in both prokaryotes and eukaryotes and understand the basic structure and function of the ribosome and enzymes involved in translation
CO5	To interpret how the genetic code was deciphered, wobble hypothesis and properties of the genetic code and its deviation

CO – PO Mapping

PO	CO
PO1	CO1, CO2, CO3, CO4, CO5
PO2	CO3
PO3	CO2, CO5
PO4	CO3
PO5	CO3

UNIT 1: Gene Expression in Prokaryotes

Definition of regulon, operon, cis and trans acting elements. Bacterial transcription control; the lac operon, induction and diauxy. Discovery and structure of lac operon. Positive control of lac operon. Utility of merodiploids in understanding regulation of operon. Molecular basis of repression. Isolation of repressor, assay of binding of lac operator and repressor. Effect of repressor on dissociation of RNA pol. Positive control of lac operon; mechanism of action of CRP/CAP, transcription activation by recruitment, characterization of binding of cAMP-CAP-DNA. Activation of lac PL transcription by CAP-cAMP. Catabolite repression, inducer exclusion and prevention mechanism. Anatomy and regulation of arabinose and tryptophan operons. Riboswitches; discovery and models of riboswitch action. *Phage strategies*; Regulatory cascade controlling lytic development. Functional clustering of phage genomes. Antitermination in lambda phage, maintenance of lysogeny by lambda phage. Characterization of λ -repressor-DNA binding, molecular properties of λ -repressor, establishment of lysogeny. Sigma switching in phage infection.

11 hrs

UNIT 2: Gene Expression in Eukaryotes

Stages/levels of regulation of gene expression in eukaryotes; Chromatin structure and its effect on transcription. Organization of chromatin- 30 nm fiber, higher order chromatin folding. Effect of histones on transcription activation. Nucleosome positioning; SV 40 mini chromosome, experimental location of nucleosomal positions; DNase hypersensitive sites and mapping. Locus control regions.

Histone modifications; Acetylation of histone tails. Identification of histone acetyl transferases (HATs). Properties and roles of P₅₅ and Gcn-5 HATs. Histone deacetylases; experimental demonstration of HDACs in repressor complexes.

Chromatin remodeling; Major classes of remodeling complexes; assay of remodeling; ChIP. Composition of SWI2/SNF2 and ISWI complexes. Model of SWI2/SNF2 mechanism. Remodeling in yeast HO gene and human IFN- β promoter. Histone code. Heterochromatin silencing; chromo and bromo domains, histone methylation, HMTases, SFR and RAP-proteins. Transcription elongation through nucleosomes; FACT and PARP.

Mapping and quantifying transcripts; Northern blots; S1 mapping of 5' and 3' ends of transcripts. Primer extension, Runoff transcription and G-less cassette transcription, measuring *in-vivo* transcription rate-nuclear run on transcription. Quantification of gene expression by measuring protein product.

11 hrs

UNIT 3: Transcriptional activators

Classification, structure and function, domains of activators. DNA binding motifs; Zn fingers- Gal 4 activator of yeast. Nuclear receptor- structure and function of glucocorticoid, thyroid and orphan

receptors. Domains of nuclear receptors; homeo, bZIP and bHLH domains. Modularity of domains of activators; chimeric transcription factors- Gal4-LexA, two hybrid assay. Dimerization of activators, modular arrangement of enhanceosomes. Recruitment of TFIID and holoenzyme; evidence, role of enhancers, interaction between enhancer and promoter-control region of human metallothionein gene. Insulators-working, insulator bodies, working of imprinting control region (ICR). Transcription factories, detection. Co-activators and mediators; discovery of mediators- mediators factors; activation of CRE-linked gene model for nuclear receptor activation. Regulation of transcription factors; modification of activation by ubiquitination, sumoylation and acetylation. Signal transduction pathways; Ras, Raf, JAK stat pathway.

Regulation of gene expression via stability of mRNA; Casein mRNA and transferring-receptor mRNA, gel mobility shift assay for IRE binding protein, model for TFR mRNA destabilization by iron. *RNA interference*; post transcriptional gene silencing (PTGS) and quelling. Definition, mechanism of RNAi. Classical experiments with petunia and *C. elegans*.

Simplified model, composition and function of Dicer and RISC. Role of Argonaute. siRNAs, role of RNAi machinery in heterochromatin formation and gene silencing- EF1A gene. miRNAs; control of gene expression by miRNAs example and experimental proofs, pathways of gene silencing by miRNA. Stimulation of translation by miRNAs. Translation repression; processing bodies.

12 hrs

UNIT 4: Translation

Ribosomes: Prokaryotic ribosomes; molecular components, *in vivo* assembly, dissociation of subunits, and polysomes. Eukaryotic components and their assembly, organelle ribosomes.

Genetic code: breaking the code, experimental results leading to deciphering genetic code, coding properties of mRNA, Co-linearity of genes and proteins, Coding properties of tRNA, triplet binding assay, use of synthetic oligo nucleotides (works of Khorana and Neirenberg), base pairing between codon and anti-codon, Wobble base pairing. Properties of genetic code, deviation from universal genetic code.

Translation: Initiation of protein synthesis in prokaryotes, Shine-Dalgarno sequence, formation of 30 S and 70 S initiation complexes; effect of GTP hydrolysis by IF2. exchange of ribosomal subunits. Eukaryotic translation initiation-scanning model, eukaryotic initiation factors, role of eIF4E, F, and G. Formation of stable 48S initiation complex, role of eIF1 and eIF1A, toeprint assay, direction of polypeptide synthesis and mRNA translation. Control of translation in bacteria and eukaryotes. Amino acyl-tRNA synthetases, formation of ternary complex among amino-acyl tRNA, EF-T, and GTP, three site model of ribosome, peptide bond formation, G-protein and translation, stop codon suppression, release factors, aberrant termination, non-stop mRNAs, termination of transcription, termination codon, no-go-decay of mRNA. **Inhibitors of prokaryotic and eukaryotic translation. Post-translational modifications of proteins.** Mechanism of translational control.

11 hrs

UNIT 5: Genomics

Basics of genomics, Fundamentals of Whole-Genome Sequencing, Shotgun sequencing, Next Generation Sequencing (NGS) Technology. Sequencing of Phage (phiX174), Viral and Bacterial Genomes. Human Genome sequencing, the human genome project, Positional cloning, identification of mutation in Huntington disease, significance of RFLP and CAG repeats, VNTR and STS markers and microsatellites, mapping with STS.

Functional genomics: Transcriptomics, Microarray and microchips, SAGE, and CAGE, Whole Chromosome Transcriptional Mapping, genomic functional profiling, Genome-wide search for DNA-protein interactions in yeast by ChIP analysis, mapping transcription factor binding site by ChIP, locating enhancers and promoters, in situ expression pattern, SNP and pharmacogenomics. Micro/si RNA technology and applications in studying gene functions.

Whole genome - de novo sequencing or resequencing; exome sequencing; RNA sequencing; small RNA sequencing; metagenomics; Ribosomal RNA depletion (RNA-Seq) and small RNA enrichment; 16S rRNA based sequencing for metagenomics, comparative genomics, personal genomics, minimal genome, barcode of life. Gene Expression and Gene Regulation Networks RNA-seq analyses. Alternate

splicing, ENCODE. Epigenomic analyses and cancer/ diseases. Bisulfite sequencing.

7 hrs

References

1. Molecular biology and Biotechnology; 4th Edn., J.M. Walker and R. Rapley, RSC (2000).
2. Molecular Biology of Gene; Watson, J.D. et al., 5th Edn. Pearson Education; (2004).
3. LEWINS Gene XI; J.E. Krebs, E.S. Goldstein, and S.T. Kilpatrick, Jones and Barlett Publishers (2012).
4. Molecular Biology; Robert F. Weaver, Mc Graw-Hill (2012).
5. Epigenetics and Epigenomics; Christopher J. Payne, INTECH, (2014).
6. Gene Control; David Latchman, Garland Science (2010).
7. Molecular Cell Biology; Harvey Lodish, Arnold Berk, Chris A. Kaiser, 7th Edition, W. H. Freeman (2012).
8. Molecular Biology of the Cell; 7th Edn. Bruce Alberts et al., (2008), Garland Publications
9. Molecular Biology; David Freifelder, J. (1997) Narosa publishers.
10. Nuclear Organization; Chromatin Structure and Gene Expression, Roen Van Driel and Arie P. Otte (1997) Oxford University Press.
11. Genome 2; T.A. Brown, John Wiley & sons (2002).
12. Principles of Developmental Genetics; SA Moody, Academic Press (2007).
13. Developmental Biology; S. P. Gilbert, 8th Edn. Sinauer Associates Inc. (2006).
14. Principles of Biochemistry; Lehninger et al., [Eds.] 2nd Edn. Worth Publishers (1997).
15. Human Molecular Genetics; Peter Sudbery, (2002) Printice Hall.
16. The Cell- A Molecular Approach; Geoffery M. Cooper, Robert E. Hausman, 6th Edition, Sinauer Associates Inc. Publishers (2013).
17. Long Range Control of gene Expression; Veronica van Heyningen and Robert Hill, Academic Press (2008).

MBC – 402: Biochemical Genetics

52 hrs

	Course Objectives
1	To gain knowledge about Nature of genetic material, chromosomes, genes and mutations.
2	In depth understanding on Classical genetics; Quantitative geneics; and Human genetics
3	Comprehensive theoretical and foundational concept about Bacterial genetics and Viral genetics.

	Course Outcomes (COs)
CO1	Know about the gene, organization in chromosomes, mutation and its types and the beneficial and harmful effects of mutations.
CO2	Learn about the history of genetics through the study of various experimental organisms and understand quantitative genetics mechanisms and population genetics including methods such as Hardy Weinberg equilibrium.
CO3	Understand about the biochemical events occurring in mitosis and meiosis, higher orders of organization of chromosomes in humans, transposition in humans and chromosomal abnormalities that cause diseases.
CO4	Know about construction of a genome map of the microorganisms through the methods of gene transfer.
CO5	Learn about the life cycle of bacteriophages, fine structure of T-phage and how Benzer used bacteriophages to learn about concept of cistrons and the process of transduction.

CO – PO Mapping

PO	CO
PO1	CO1, CO2, CO3, CO4, CO5
PO2	CO1, CO4
PO3	CO1, CO2, CO3, CO4, CO5
PO4	CO1, CO4
PO5	CO1, CO2, CO3, CO4

UNIT 1: Introduction

Nature of genetic material. Chromosomes and genes. Mutation: types of mutation, mutagens, mechanism of mutation, induction and isolation of mutants and their role in genetic studies.

5 hrs

UNIT 2: Classical Genetics

Review of classical genetics; work on *Pisum sativum*, *Drosophila Melanogaster*, *Neurospora Crassa* etc. inheritance (sex-linked and others). Population genetics, extranuclear inheritance. Sex determination, Morgan's discovery of sex linked inheritance of sex linked genes, X;linked traits in humans. Identification of sex chromo;somes, XX,XY, mechanism of sex determination.

10 hrs

UNIT 3: Quantitative Genetics

Human quantitative traits, discontinuous traits and continuous traits, Breeding analysis, genetics basis of quantitative variation, Multiple factor hypothesis and analysis of polygenes. Genotype-Environment Interaction and models for their measurement, estimation of Heritability Index.

8 hrs

UNIT 4: Human Genetics

Biochemical events occurring during mitosis and meiosis. Structure of chromatin; nucleosomes and higher orders of organization. Chromosome banding, Chromosome mapping based on recombination frequency data. Transposons. Overview of human genome project, mapping of human genes; techniques used, assignment of important genes. Transposition in human chromosomes. Chromosomal abnormalities.

13 hrs

UNIT 5: Bacterial Genetics

Bacterial chromosomes, plasmids; fertility, resistance, colicinogenic and others. Recombination in bacteria. Mechanism of recombination, transposable genetic elements, transformation and conjugation in bacteria. Linkage map of bacterial chromosomes.

8 hrs

UNIT 6: Viral Genetics

Life cycles of bacteriophages, lytic cycle; replication of T-phages. Lysogeny and its regulation. Transduction; specialized, generalized and abortive. Fine structure analysis of T-phages; Benzers work, concept of cistrons.

8 hrs

References

1. Genetics, Strick Berger, M.W. (1990) 3rd edn. McMillan.
2. Human Molecular Genetics; Peter Sudbery, (2002) Printice Hall.
3. Introduction to Modern Virology, Primrose and Dimmock (1988), Blackwell Sc.
4. Genetics and Molecular Biology; Robert Schleif, The Johns Hopkins University Press Baltimore, (1993).
5. Discovering Genomics, Proteomics and Bioinformatics, Campbell A M & Heyer L J, 2nd Edn. Benjamin Cummings, (2007).
6. Introduction to Genetics: A Molecular Approach; T A Brown, Garland Science (2011).
7. Molecular Cell Biology; Lodish et al., 7th Edn. W.H. Freeman and Co. (2012).

8. Molecular Biology of the Cell; 7th Edn. Bruce Alberts et al., Garland Publications (2008).
9. Nuclear Organization; Chromatin Structure and Gene- Expression, Roen Van Driel and Arie P. Otte Oxford University Press (1997).
10. Principles of Developmental Genetics; S.A. Moody, Academic Press (2007).
11. The Cell; Geoffrey Cooper, and Robert E.; 5th edn. Hausman Sinauer Associates (2009).
12. The Science of Genetics, George W. Burns and Paul J. Bottino (1989), Maxwell-McMillan.
13. Human Genetics; Lewis, 7th Edn. WCB & McGraw Hill (2007).
14. Essential Genetics: A Genomics Perspective; Daniel L. Hartl, 6th Edition, Jones and Barlett Learning (2012).
15. Bacterial and Bacteriophage Genetics; Edward A. Birge, 5th Edition, Springer (2006).
16. Nucleosome Histone, and Chromatin; Part-A; Carl Wu and C. Allis, Academic Press (2012).

MBC – 403: Biotechnology

52 hrs

	Course Objectives
1	Educate the basic concepts related to the field of Biotechnology
2	Learn the methodologies involved in Biotechnology.
3	Understand the overview of transgenic strategies.

	Course Outcomes (COs)
CO1	To learn and understand the basic concepts related to the field of Biotechnology such as cloning strategies, characteristics of enzymes and vectors involved in genetic engineering.
CO2	To outline of methodology for genomic and cDNA libraries construction
CO3	To describe the principle, types and applications of PCR and Learn various advanced gene sequencing methods for the identification of gene products.
CO4	To illustrate the over view of transfection strategies involved in gene transfer to animals cells.
CO5	To illustrate the over view of gene transfer strategies involved in plant cells.

CO – PO Mapping

PO	CO
PO1	CO1, CO2, CO3, CO4, CO5
PO2	CO1, CO2, CO3, CO4, CO5
PO3	CO1, CO2, CO3, CO4, CO5
PO4	CO1, CO2, CO3, CO4, CO5
PO5	CO1, CO2, CO3, CO4, CO5

UNIT 1: Introduction

Introduction and over view of cloning procedures.

1 hr

UNIT 2: Restriction endonucleases and DNA modifying enzymes

Restriction enzymes Discovery, classification, properties, and applications. Reactions, application of the following modifying enzymes employed in rDNA technology; DNA- and RNA ligase, Phosphatases and kinases DNase (DNase-I) and RNases (RNase A, H), S1- and Micrococcal nuclease, double and single stranded exonucleases. DNA and RNA polymerases (Klenow fragment), template independent RNA polymerases. Topoisomerase. Linkers and adapters, TA-cloning.

6 hrs

UNIT 3: Cloning Vectors

Basic properties of plasmids, desirable properties of vectors, plasmids as vectors. Directional cloning in plasmid vectors, blunt end cloning in to plasmids. Preparation and transformation of competent E.coli. electroporation, Screening colonies using X-gal and IPTG (α -complementation), screening by hybridization. Bacteriophage lambda vectors; Insertional and replacement lambda vectors, transfection, in vitro packaging, screening recombinant phages. Cloning in M13 vector and COSMID vectors and their applications. Expression vectors: Characteristics of expression vectors, expression vectors for cloning and expression in bacteria, yeast and mammalian cells. Super vectors; characteristic features and utility of BAC and YAC vectors.

7 hrs

UNIT 4: Genomic and cDNA libraries

Outline of methodology for genomic library construction, creation of genomic libraries using lambda and cosmid vectors. Growth, evaluation and storage of genomic libraries. cDNA libraries; methodology, random arrayed and ordered cDNA libraries, screening cDNA libraries; probe selection, hybridization. Screening with antibodies, rescreening and sub-cloning. Characterization of plasmid clones, restriction digestion, southern blot, PCR and sequence analysis.

6 hrs

UNIT 5: PCR

Discovery, principle and procedure, variants of PCR- RT-PCR, long PCR, differential PCR, and inverse PCR. Application of PCR; Rapid amplification of cDNA ends (5' and 3' RACE), Cloning PCR products, PCR in screening clones, colony PCR, Diagnostic application of PCR.

4 hrs

UNIT 6: DNA Sequencing

Principle of DNA sequencing, automated sequencing, extending the sequence, shot gun sequencing. Analysis of sequence data; annotation, ORF, exon-intron boundaries, identification of genes and their products.

4 hrs

UNIT 7: Gene transfer to animal cells

Over view of strategies, transfection methods, phospholipids as delivery vehicles, electroporation and direct transfer, transient and stable transformation, Cotransformation and selection of stable transformants, selectable markers for animal cells. Mammalian plasmid expression vectors, reporter genes. Gene transfer by viral vectors; adeno and baculo viruses, retroviral vectors.

6 hrs

UNIT 8: Gene transfer to plants

plant cell culture and protoplast, callus and their manipulations. Agrobacterium mediated transformation, Ti plasmid, mechanism of T-DNA transfer, Function of T-DNA genes, Ti-plasmid derivatives as plant vectors (disarmed T-DNA), cointegrate and binary vectors, high capacity binary vectors, selectable markers for plants, control of transgene expression in plants. Direct DNA transfer to plants; protoplast transformation, particle bombardment, in-planta and chloroplast transformation. Plant expression vectors; CaMV and TMV vectors.

6 hrs

UNIT 9: Bioprocess technology

Fermentation: Fermentation process design, operation and characteristics of fermentation processes; batch, fed-batch and continuous culture systems, instrumentation and bioprocess control. Downstream process: Introduction to various downstream process operations in biopharmaceutical manufacturing such as centrifugation, filtration, tangential flow filtration, cell disintegration, solvent-solvent extraction, supercritical fluid extraction etc.

4 hrs

UNIT 10: Industrial Biotechnology

Major areas of biotechnology in the pharmaceutical industry such as antibiotics, vaccines, diagnostics, antibodies, biopharmaceuticals (insulin, interferon, GSF, CSF and therapeutic proteins etc.); commercial aspects, priorities for future biotechnological research.

3 hrs

UNIT 11: Nanobiotechnology and Biosensors

Basic overview of nanomaterials, introduction to general terminologies, synthesis methodologies, physical and chemical characterization. Definition and methods of preparation of nano-bioparticles. Applications in drug designing, drug delivery & protein engineering. Biosensors – concept and design of biosensors, types and uses of biosensors food and fermentation processes, environment monitoring, and clinical diagnostics.

5 hrs

References

1. Molecular Cloning; A laboratory manual; Michael R. Green, CSHL Press (2012).
2. Molecular Cell Biology; Lodish et al., 7th Edn. W.H. Freeman and Co (2012).
3. Molecular Biology of the Cell; 7th Edn. Bruce Alberts et al., (2008), Garland Publications
4. Molecular Biology; Robert F. Weaver, McGraw Hill (2012).
5. Principles and Techniques of Biochemistry and Molecular Biology; 7th Edn. Keith Wilson and John Walker (2010).
6. Principles of Gene Manipulations; 6th Edn. S.B. Primrose, R.M. Twyman, and R.W. Old, Blackwell Science (2012).
7. Gene Cloning and DNA analysis- An Introduction; T. A. Brown, 5th Edition, Wiley-Blackwell Publishing (2006).
8. Molecular biology and Biotechnology; 4th Edn., J.M. Walker and R. Rapley, RSC (2000).
9. Plant Biotechnology and Agriculture; Arie Altman and Paul Hasegawa Academic Press (2011).

MBC – 404: Immunology

(52 hrs)

	Course Objectives
1	To provide knowledge and understanding of immunology and the way it is applied in diagnosis and therapy
2	To familiarize students with the essential molecules, cells, tissues, and organs involved in body defense mechanism concepts at molecular and genetic level
3	To facilitate the learning of techniques involved in understanding the immunological aspects of physiological and biological samples

	Course Outcomes (COs)
CO1	To explain the nature of various infective agents and the mechanism of defense
CO2	To interpret the roles of various cells and organs involved in immune response
CO3	To comprehend the defensive mechanism against antigens and study of antigens by various immunochemical techniques
CO4	To assess natural and acquired immunity and self recognition of the immune system
CO5	To describe types of antibodies, antibody production and purification and immunotherapy, TCR gene organization and combination

CO – PO Mapping

PO	CO
PO1	CO1, CO2, CO3, CO4, CO5
PO2	CO3, CO5
PO3	CO2, CO3, CO4, CO5
PO4	CO2, CO3, CO4, CO5

UNIT 1: Infection

Types of infection and nature of infective agents. Nonspecific host defense mechanisms. Anatomical barriers; lysozyme and other antimicrobial agents.

3 hrs**UNIT 2: Organs and Cells of the Immune System**

Lymphoid organs; Primary- bone marrow and thymus, Secondary – lymph nodes, spleen, MALT and skin; tertiary Lymphoid tissue; lymphatic system; Immune Cells- neutrophils, monocytes macrophages, basophils, natural killer cells, eosinophils, dendritic cells, phagocytosis, oxygen dependent and independent killing.

6 hrs**UNIT 3: Complement system**

Introduction, alternate and classical pathway, regulation.

4hrs**UNIT 4: Immunity**

States of immunity; innate and acquired immunity, naturally and artificial acquired passive and active immunity. Immunization practices, use of toxoids, killed and attenuated organisms. Surface components and newer vaccines, production of vaccines.

4 hrs**UNIT 5: Immunoglobulins**

Structure and functions of immunoglobulins Types; isotypes and idiotypes, isoantibodies. Methods of raising antibodies. Monoclonal antibodies, production and purification.

6 hrs**UNIT 6: The Immune System**

Recognition of self and non self, the major histocompatibility antigens, H-2 and HLA antigens, Antigenicity; humoral and cell mediated immunity. T and B lymphocytes; origin, differentiation, characteristics and functions, nature of surface receptors, antigen processing and presentation. T cell and B cell interaction. Cytokines, monokines, lymphokines and their functions. FACS.

10 hrs**UNIT 7: Molecular Immunology**

Theories of antibody formation; clonal selection and network, Genetics of antibody diversity, germ line and somatic mutation theories, immunoglobulin, MHC a TCR gene organization and their recombination, class switch of Ig genes.

7 hrs**UNIT 8: Clinical Immunology**

Immune disorders- Pathogenesis, diagnosis and treatments.

Hyper sensitivity reactions: Types , haemolytic disease of new born-Erythroblastosis fetalis. Immunity to infectious diseases : viral - influenza, bacteria – tuberculosis, parasite – Plasmodium falciparum, helminthes. Autoimmune disorders (Hemolytic anemia, Hashimoto's thyroiditis, Rheumatoid arthritis, Myasthenia gravis, Multiple sclerosis) and Immunodeficiency diseases (SCID and AIDS). Tissue transplantation; auto – iso -, allo-, and xenografts, tissue matching, transplantations rejection, mechanism and control. Cancer immunology: Tumor antigens, immune response to tumors, tumor evasion, cancer immunotherapy. immunotherapy.

7 hrs**UNIT 9: Immuno assay methods**

Antigen – antigen interaction – affinity and avidity, determination of affinity and avidity constants. Principle, procedure and applications of Immunoprecipitation, neutralization, agglutination, complement fixation, immunodiffusion, immunofluorescence, RIA, ELISA – direct, indirect, sandwich, multiplex, micro ELISA Techniques. Western Blotting.

5 hrs**References**

1. Antibodies– A Laboratory Manual; E. D. Harlow, David Lane, 2nd Edn. CSHL Press (2014).
2. Basic and Clinical Immunology; Stites et al., [Ed] (1982) Lange.
3. Roitt's Essential Immunology; Ivan, M. Rohitt & Petrer J Delves (2001) Blackwell Science.

4. Immunology; Roitt et al., Mosby (2001),
5. Kuby Immunology; Owen, Punt, Stranford, 7th Edn. W. H. Freeman (2013).
6. Immune System; M. C. Connel et al., Eds. (1981) Blackwell Science.
7. Immunology at a Glance: J.H.L. Playfare [ed.] Blackwell Science, (1987).
8. Immunology; Jan Klein [Ed.], Blackwell Science (1990).
9. Introduction to Immunology; Kim Bell [Ed.,] 3rd Edn. McMillan (1990).
10. NMS for Immunology; Hyde and Patnide [Eds.] John Wiley (1990).
11. Microbiology; Prescott, Harley and Klein, McGraw-Hill (2003).
12. Molecular Toxicology; Nick Plant, Garland Science (2003).
13. Understanding Immunology (Cell and Molecular Biology in Action); Peterwood, Pearson Education Ltd. (2006).
14. Introduction to Exotoxicology, En. D.W. Connell, Blackwell Scientific (2000)
15. Molecular Cell Biology Baltimore et al., Scientifica Americal Publication (1995).

**MBC – 405: Immunology and Toxicology Lab
(4 Credits)**

	Course Objectives
1	Enable students to develop familiarity with immuno assays.
2	Enable students to perform various antigen / antibody detection techniques.
3	Develop acquaintance with the basic phenomenon of toxicology and investigation of toxicants.

	Course Outcomes (COs)
CO1	Perform immunochemical methods for assessment of antibodies
CO2	Know the different methods of assessing the presence and absence of antigen in biological samples.
CO3	Perform immunosorbent assays for analyzing the antibody or antigen titre values.
CO4	Perform immunodetection techniques for analyzing the antigens.
CO5	Detect the presence of toxicants and their estimation.

CO – PO Mapping

PO	COs
PO1	CO1, CO2, CO3, CO4, CO5
PO2	CO1, CO2, CO3, CO4, CO5
PO3	CO1, CO2, CO3, CO4, CO5
PO4	CO1, CO2, CO3, CO4, CO5
PO5	--

1. Qualitative analysis of antibodies

- i) ODD
- ii) RID
2. Determination of direct agglutination reaction using human blood group antigens
3. Rocket electrophoresis
4. Purification of antibodies using ammonium sulphate precipitation
5. Antibody titration – ELISA
 - i) Dot ELISA
 - ii) Sandwich ELISA
6. Western blotting of proteins and immunodetection.
7. Determination of antigen concentration using turbidometry
8. Estimation of heavy metals in contaminated water.
9. Estimation of pharmaceuticals in contaminated water.
10. Cytotoxicity assay in bacteria and estimation of LD50.

References

1. Methods in Immunology and Immunochemistry; Curtis Williams, Academic Press (1971).
2. Immuno Assay Hand Book; David Wild, Elsevier (2013)
3. Antibodies– A Laboratory Manual; E. D. Harlow, David Lane, 2nd Edn. CSHL Press (2014).
4. Molecular Toxicology; Nick Plant, Garland Science (2003).
5. Practical Clinical Biochemistry Methods And Interpretations. Ranjna Chawla (2014).
6. Practical Pharmaceutical Chemistry. A. H. Beckett and J. B. Stenlake. 1962.

MBC – 406: Project Work (4 Credits)

	Course Objectives
1	Enable students to understand the basic research methodology tools, their significance and applications.
2	Enable students to perform experiments and learn team management skills.
3	Enable students to learn safe laboratory practices understand the ethics of doing good research.

	Course Outcomes (COs)
CO1	Define problem for a group project, formulate an experimental design to analyze the problem, learn about review of literature, analyze current published literature and rationalize the research gap in their project problem
CO2	Execute the experiments to solve and analyze the formulated problem, work independently as well as in small groups, show self-direction and motivation, trouble shoot failures in any experiments and contribute to group project
CO3	Able to analyze the data obtained from experiments, perform statistical analysis, visual representation of the data as graphs and power point presentations
CO4	Learn how to prepare a dissertation including different sections such as introduction, review of literature, methodology, results, conclusions and discussion.
CO5	Learn to present the results of their project to an audience of peers and faculty and external examiners and defend their results.

CO – PO Mapping

PO	
PO1	CO1, CO2, CO3, CO4, CO5
PO2	CO1, CO2, CO3, CO4, CO5
PO3	CO1, CO2, CO3, CO4, CO5
PO4	CO1, CO2, CO3, CO4, CO5
PO5	CO1, CO2, CO3, CO4, CO5

Regulation for Project Works: Proposed to carry out the project work individually or in group to a maximum of 3 or 4 students. Project shall be allotted at the beginning of the III semester to facilitate students to carry out during semester break. In house projects are encouraged. Students in some cases may be allowed to carry out the project work in other research institutes, but faculty members of the Biochemistry department must serve as principal guide.

Open elective for Non-Biochemistry PG students

MBC – 304: Biochemistry in Daily Life

(52 hrs)

	Course Objectives
1	Educate about the basic phenomenon of Biochemistry related to Nutrition , Health and Disease for a non Biochemistry PG student.
2	Make the student get aware about the functions and uses of Food additives and functional foods.
3	Make the students understand the applications of enzymes in food industry and principles of food processing.

	Course Outcomes (COs)
CO1	Understand the basics of nutrition, health and associated diseases
CO2	Define functional foods, their health benefits
CO3	Know additives used in processed food products and their health effects.
CO4	Understand the importance of enzymes in food and allied industries.
CO5	Know the principles of food processing and about fortified food products.

Definition of Biochemistry: Definition of life, The different forms of life, micro-organisms to human beings. Building blocks of life. Introduction to the common macro- and microconstituents

of unicellular and multicellular organisms. Differences encountered in plant and animal kingdoms. **5 hrs**

Food and Nutrition: Importance of food for existence of life. Modes of nutrition in life forms – Comparable and contrasting features. **3 hrs**

Human Health and Disease: Nutrition (Health), definition, classification, food and non food sources. Nutraceuticals; use of nutraceuticals in traditional health sciences. Role of omega-3 fatty acids, carotenoids, dietary fiber, phytoestrogens; glucosinolates; organosulphur compounds in health and disease (prevention and control). **6 hrs**

Prebiotics and probiotics: Mechanics and usefulness of probiotics and prebiotics in gastro intestinal health and other benefits. Beneficiary microbes; prebiotic ingredients in foods; types of prebiotics and their effects on gut microbes. Functional foods: Definition, development of functional foods, benefits and sources of functional foods in Indian diet. Effects of processing conditions and storage. Development of nutraceutical and functional foods; Standards for health claims. Process of developing-preclinical & clinical studies. **10 hrs**

Food additives: Definitions, functions and uses in processed food products. Chemical, technological and toxicological aspects of acid, base buffer systems, salts and chelating/sequestering agents, leavening agents, antioxidants, emulsifying and stabilizing agents, anti-caking agents, thickeners, firming agents, flour bleaching agents and bread improvers. Sweetening agents: Artificial sweeteners, composition, uses. Natural and synthetic colors, food Flavors, Spices and flavoring constituents, flavors in food industries. **9 hrs**

Enzymes: Introduction and essentiality to life forms. Use of enzyme in beverages- fruit juices, beer, wine, and distilleries; dairy, baking, oils and fats, plantation products, animal products. Malting and germination of grains – process, characteristics, nutritional benefits and uses. Domestic use products like detergents. Textiles-Denim processing. Leather industry. **7 hrs**

Food processing and fortification: Principles, objectives and rationale, selection and basis of fortificants. Technology of fortifying cereal products. Characteristics of nutrients used in cereal fortification. Fortification methods. Fortification premixes, Design and composition of premixes and quality control. Fortification of bread, pasta, noodles, biscuits, and breakfast cereals. Beverages; importance of beverage fortification, Health benefits of fortification, Selection of nutrients for fortification, Levels to be added, Characteristics of fortificants and method of fortification, Bioavailability, Organic Vs inorganic salts. Health foods; selection of nutrients, Technology of incorporation of fortificants, bioavailability. **12 hrs**

References

1. Biochemistry Ed. Donald Voet & Judith G. Voet, John Wiley & Sons, Inc.(2010).
2. Lehninger- Principles of Biochemistry; D.L.Nelson and M.M. Cox, 6th Edn. MacMillan Publications (2012).
3. Nutrition: Science and Applications, 3rd Edn. Lori A. Smolin, Mary B. Grosvenor, Wiley (2013).
4. Introduction to Human Nutrition, 2nd Edn. Michael J. Gibney, Susan A. Lanham-New, Aedin Cassidy, Hester H. Vorster, Wiley-Blackwell (2009).
5. Nutrition: Everyday Choices, 1st Edition; Mary B. Grosvenor, Lori A. Smolin Wiley (2006).
6. Bioactive Food as Dietary Interventions for Liver and Gastrointestinal Disease; Watson Elsevier (2012).
7. Food, Nutrition and Health. Tapsell L. Oxford University Press (2010).

Department of Life Sciences
Genetics - Biotechnology

PEOs	Programme Educational Objectives
PEO1	To prepare graduates who can exhibit quality of excellence, critical thinking, creativity, inventiveness and self-motivation.
PEO2	To produce graduates who are globally acceptable professionals for academic and research organizations along with entrepreneurial skills.
PEO3	To groom graduates who can demonstrate competence and problem solving abilities in the field of Life sciences.
PEO4	To produce graduates who can lead and work as a team with high ethical standards.
PEO5	To enable the graduates pursue multiple professional pursuits and enhance their own achievements while serving the society at large.

PO	Programme Outcomes
PO1	Develop comprehensive knowledge and understanding in the field of Life Sciences.
PO2	Inculcate complex problem solving ability using analytical thinking, reasoning, and creativity along with good communication skills.
PO3	Demonstrate research related skills along with coordinating and collaborating abilities.
PO4	Develop leadership abilities with a knowledge of time management, community engagement and service.
PO5	Demonstrate capability to use advanced digital and technological skills for the benefit of society.

PSOs	Programme Specific Outcomes
PSO1	To analyze how Biotechnology and Genetic concepts address broad societal issues including health and diseases, bioremediation, biofuel production etc.
PSO2	To provide hands on experience in molecular biology and genetic engineering techniques, thus enabling the students to begin their career in industry and research laboratories.
PSO3	To demonstrate various tools and techniques in the field of biotechnology and applied genetics research. Identify the appropriate strategies to solve problems with respect to agriculture, medicine and environment.
PSO4	To imbibe a robust interdisciplinary knowledge base and practical skill sets in molecular diagnostics, recombinant proteins, vaccines, crop improvement and transgenic technology suitable for academia and industry.
PSO5	To equip students with expertise in laboratory, computational and analytical proficiencies indispensable for research and development.



MATRIX AND SYLLABUS

For the Programme B.Sc. (Genetics & Biotechnology)

NEP Based Curriculum (2021 onwards)

I Semester

NEP- Curriculum Framework for Approval

B.Sc. (Genetics & Biotechnology) - Matrix for I Semester (w.e.f. 2023-24 onwards)

I Semester							
Code	Course Code	Course	Teaching Hours	Course Components			Credits
				L	T	P	
AECC	S21KN 1.1/ S21HN 1.1/ S21AE 1.1	Language I (Kannada/Hindi/Additional English)	45	3	1	-	3
AECC	S21GE 1.1	Language II (Generic English)	60	3	1	-	3
DSC1	S23GN 1.1	Principles of Genetics (Theory)	60	4	-	-	4
DSC 1	S23GN 1.2	Principles of Genetics (Practical)	60	-	-	4	2
DSC 1	S23BT 1.1	Cell Biology (Theory)	60	4	-	-	4
DSC 1	S23BT 1.2	Cell Biology (Practical)	60	-	-	4	2
OE-1	S23OE/ S21OE	Genes and Diseases/ Biotechnology for Human Welfare	45	2	1	-	3
SEC-SB	21SBC 1.1	Digital Fluency-I	30	1	-	2	2
SEC-VB	21VBC 1.1	Health and Well-being	30	-	-	2	1
SEC-VB	21VBC 1.2	Yoga	30	-	-	2	1
Total							25

Note:

AECC- Ability Enhancement Compulsory Course

DSC - Discipline-Specific Course

OE- Open elective (course offered by the department to students of other stream)

DSE – Discipline-Specific Elective

SEC - VB Skill Enhancement Course -Value Based

SEC - SB Skill Enhancement Course -Skill Based

Continuous Internal Assessment – Scheme of Evaluation

For Theory Courses

End Semester Examination: 60%

Continuous Internal Assessment: 40%

Activities (CIA: 40 Marks)	Proposed and Approved Scheme		Total Marks (40)
	IA-1	IA-2	
Session Test Maximum Marks	30	30	
1. Weightage (Marks)	10	10	20
2. Assignment (Marks)	20		20
i. Writing	10		
ii.Quiz / Presentation / Creating diagrams /charts / Classwork / Case study / Viva / Field work etc.	05		
iii. Classroom participation	05		
Total			40

Continuous Internal Assessment
Scheme of Evaluation for Practical Courses
End-Semester Examination: 50%
Continuous Internal Assessment: 50%

CIA (25 marks) + End Semester Exam (25 marks)	
Maximum Marks (Internal Assessment)	25
1. Weightage (Marks)	15
2. Record work (Marks)	05
3. Quiz/Presentation/creating diagrams/ charts/Lab work/	05
Total (Marks)	25

S23 BT 1.1: CELL BIOLOGY

THEORY

Total Teaching Hours: 60

No. of Hours per week: 4

(4 Credits)

CObj	Course Objectives
CObj_1	To introduce the fundamentals of Cell Biology.
CObj_2	To educate the students about the origin and reproduction of cells.
CObj_3	To impart the knowledge of cell to cell interactions and their functions.

CO	Course Outcomes
	After completion of this module, students should be able to:
CO1	Comprehend the knowledge of structure and functions of various cell organelles.
CO2	Apply the general principles of cell to cell communication.
CO3	Describe the fundamentals of cell growth and reproduction.
CO4	Compare the mechanism of cell aging and cell death.
CO5	Elucidate and interpret the cellular responses.

CO-PO Mapping

	PO_1	PO_2	PO_3	PO_4	PO_5	PSO_1	PSO_2	PSO_3	PSO_4	PSO_5
CO_1	X	X	X	-	-	-	-	-	-	-
CO_2	X	X	X	-	-	X	-	X	-	-
CO_3	X	X	X	-	-	-	-	-	X	-
CO_4	X	X	X	-	-	-	-	X	-	-
CO_5	X	X	X	-	-	X	-	X	X	-

Course Content

Sl. No.	Unit/Chapter title	Content	Number of hours	Skills developed
1	Unit: I Cell as a Basic unit of Living Systems and Cellular Organelles	Concept, Development and Scope of cell biology. Historical perspectives. Discovery of cell, the Cell theory, Ultra structure of prokaryotic cell – <i>E. coli</i> and eukaryotic cells – plant and animal cell, Cellular Organelles: Structure and functions of cell organelles – Endoplasmic reticulum, Golgi complex, Mitochondria, Chloroplast, Ribosomes, Lysosomes, Peroxisomes, Nucleus, Vacuole and Cytosol. Structural organization and functions of plasma membrane and cell wall of eukaryotes.	15 Hrs	Cognitive/ Research Skills 1. EMP 2. SKD 3. EDP

2	Unit: II Cell to Cell Communications	Cytoskeleton - (Microtubules, Microfilaments and Intermediate filaments). Extracellular matrix (collagen, proteoglycans, fibronectin and laminins). Cell adhesion molecules (Immunoglobulin super family, integrins, selectins and cadherins) Cell Junctions (Tight and gap junctions, Desmosomes and plasmodesmata). General principles of cell signaling, types of signaling (Paracrine, autocrine, juxtacrine and endocrine), Signaling via G-protein coupled receptors and kinase receptors.	15 Hrs	Cognitive/ Research Skills 1. EMP 2. SKD 3. EDP
3	Unit: III Chromosomes and Cell division	Introduction, Discovery, Morphology and structural organization – Centromere, Secondary constriction, Telomere, Chromonema, Euchromatin and Heterochromatin, Chemical composition of chromosome. Single-stranded and multi-stranded hypothesis, folded - fibre and nucleosome models. Types of cell division: Mitosis and meiosis: interphase nucleus, achromatic apparatus, synaptonemal complex and significance. Karyotypes – Normal male and female Karyotype and abnormal Karyotype: Down's Syndrome, Klinefelter's Syndrome and Turner Syndrome. Special type of chromosomes: Salivary gland and Lamp brush chromosomes.	15 Hrs	Cognitive/ Research/ Analytical Skills 1. EMP 2. SKD 3. EDP
4	Unit: IV Cell cycle and Cell Death	Cell Cycle and regulation: phases of the cell cycle, Cell cycle checkpoints, and enzymes involved in regulation, Significance of cell cycle, Cancer cells and their properties, Programmed cell death - concept, examples and pathways. Necrosis: concept, patterns and types. Cell Senescence - concepts and theories of ageing.	15 Hrs	Cognitive/ Research/ Analytical Skills 1. EMP 2. SKD 3. EDP

Books for Reference:

1. Arumugam N (2017). Cell Biology, 10th Edn, Saras Publications.
2. Bruce Alberts (2022) Molecular Biology of Cell, 8th Edn. Garland publications.
3. David Freifelder (1998). Molecular Biology. 2nd Edn. Narosa publishing house.
4. EDP Roberties and EMF Roberties (2017) Cell Biology & Molecular Biology. 8th Edn. B.I. Waverly Pvt. Ltd.
5. Gupta. P.K. (2018). Cytology, Genetics and Evolution, 8th Edn.
6. Lodish et al (2000). Molecular Cell Biology. 4th Edn. W.H.Freeman and Company.
7. Old and Primrose (2003) Principles of Gene Manipulations, 3rd edn, Black Well Scientific Publications.
8. Powar C.B. (2007) Cell Biology. 3rd Edn. Himalaya Publishing House.
9. Purohit S.S. (2008). The cell and Molecular Biology: Fundamentals and Applications. 1st Edn. AGROBIOS (India).
10. Satyesh Chandra Roy and Kalyan Kumar De (2005). Cell Biology, 2nd Edn. New Central Book Agency (P) Ltd.

Web Resources:

1. <https://sites.google.com/dhtepdy.edu.in/igcascellbiology/home>
2. <http://www.cellimagelibrary.org/home>
3. <https://www.biology-pages.info/>

Journals:

1. Cell
2. Nature Cell Biology
3. Journal of Cell Biology
4. Trends in Cell Biology

S23 BT 1.2: CELL BIOLOGY**PRACTICAL****Total Teaching Hours: 60****No. of Hours per week: 4****(2 Credits)**

Sl. No.	Unit/chapter title	Content	Number of hours	Skills developed
1	Module 1	Study of simple and compound microscope	04 Hrs	Research/ Analytical Skills
2	Module 2	Micrometry: Calibration, measurement of Onion epidermal cells and Yeast.	08 Hrs	Research/ Analytical Skills
3	Module 3	Haemocytometry: Counting of RBC and Yeast cells.	08 Hrs	Research/ Analytical/ Employable Skills
4	Module 4	Study of divisional stages in Mitosis from Onion root tips.	08 Hrs	Research/ Analytical Skills
5	Module 5	Study of divisional stages in Meiosis in Grasshopper testes/Onion flower buds.	08 Hrs	Research/ Analytical Skills
6	Module 6	Mounting of Polytene chromosomes from <i>Drosophila melanogaster</i>	04 Hrs	Research/ Analytical Skills
7	Module 7	Localization of Barr bodies from Buccal smear.	04 Hrs	Research/ Analytical/ Employable Skills
8	Module 8	Karyotype analysis: Human - Normal male and female Karyotype and abnormal Karyotype – Down's Syndrome, Klinefelter's Syndrome and Turner Syndrome.	04 Hrs	Research/ Analytical/ Employable Skills
9	Module 9	Vital staining of mitochondria from Yeast cells.	04 Hrs	Research/ Analytical Skills
10	Module 10	Isolation of chloroplasts from Spinach leaves.	04 Hrs	Research/ Analytical Skills

11	Module 11	Study of amyloplasts from Potato.	04 Hrs	Research/ Analytical Skills

Books for Reference:

1. Dr. Renu Gupta , Dr. Seema Makhija and Dr. Ravi Toteja (2018). Cell Biology: Practical Manual, Prestige Publishers.
2. Rina Majumdar and Rama Sisodia (2018). Laboratory Manual of Cell Biology, Prestige Publishers.
3. K. V. Chaitanya, (2013). Cell and Molecular Biology : A Lab Manual, PHI Publishers.
4. Dr. Tripurari Mishra and Dr. B.D. Singh (2020). Cell Biology, Mahaveer Publication.

S21OE: BIOTECHNOLOGY FOR HUMAN WELFARE
THEORY

Total Teaching Hours: 45

No. of Hours per week: 3

(3 Credits)

CObj	Course Objectives
CObj_1	To impart basic knowledge and understanding of industrial biotechnology and imparting resource information.
CObj_2	To educate and familiarize with the applications in environmental biotechnology.
CObj_3	To impart deeper understanding in forensic biotechnology and prepare for the expert qualities.

CO	Course outcomes
	After completion of this module, students should be able to
CO1	Grasp and understand the types of biotechnological applications in diverse fields with standard examples in the day to day context.
CO2	Comprehend the industrial applications of biotechnology in production of alcoholic beverage, enzyme, protein, antibiotic, detergent and pharmaceutical products.
CO3	Competitively utilize the application of biotechnology in support to environmental aspects for degradation of pollutants, agricultural wastes, PHB production and its varied uses.
CO4	Familiarize with the wide forensic applications of biotechnology related solving the complex problems faced by public.
CO5	In depth understanding of health applications of biotechnology in the use of recombinant insulin, recombinant vaccine, gene therapy, diagnostic technique using ELISA and PCR and their uses in turning down cancer and human genome project.

CO-PO Mapping

	PO_1	PO_2	PO_3	PO_4	PO_5	PSO_1	PSO_2	PSO_3	PSO_4	PSO_5
CO_1	-	X	X	X	X	X	-	X	X	X
CO_2	X	X	-	X	-	-	X	X	X	X
CO_3	X	-	X	X	X	X	-	X	X	X
CO_4	-	X	X	X	X	-	X	X	X	X
CO_5	-	-	X	X	X	X	X	X	X	X

Course Content

Sl. No.	Unit/Chapter title	Content	Number of hours	Skills developed
1	Unit: I Industry	Application of biotechnology in industry: Industrial production of alcoholic beverages, antibiotic (Penicillin), Applications of enzymes in food, detergent and pharmaceutical industry. SCP and its importance.	11Hrs	Cognitive/ Research/ Analytical Skills 1. EMP 2. SKD 3. EDP
2	Unit: II Environment	Application of biotechnology in environmental aspects: Degradation of pollutants - chlorinated and non-chlorinated compounds; degradation of hydrocarbons and agricultural wastes, PHB –production and its futuristic applications.	11Hrs	Research/ Analytical Skills 1. EMP 2. SKD 3. EDP
3	Unit: III Forensic science	Application of biotechnology in forensic science: Solving crimes of murder and rape; solving claims of paternity and theft by using DNA finger printing techniques	11Hrs	Research/ Analytical Skills 1. EMP 2. SKD 3. EDP
4	Unit: IV Health	Application of biotechnology in health: Genetically engineered insulin, recombinant vaccines, gene therapy and molecular diagnostics using ELISA, PCR; monoclonal antibodies and their use in cancer.	12Hrs	Research/ Analytical Skills 1. EMP 2. SKD 3. EDP

Books for Reference:

1. Crueger W and Crueger A. (2000). Biotechnology: A textbook of Industrial Microbiology. 2nd edition. Panima Publishing Co. New Delhi.
2. Patel AH. (1996). Industrial Microbiology. 1st edition, Macmillan India Limited.
3. Stanbury PF, Whitaker A and Hall SJ. (2006). Principles of Fermentation Technology. 2nd edition, Elsevier Science Ltd.
4. Environmental Biotechnology, Pradipta Kumar Mohapatra
5. Environmental Biotechnology – Concepts and Applications, Hans-Joachim Jordening and Jesef Winter.
6. B.B. Nanda and R.K. Tiwari, Forensic Science in India: A Vision for the Twenty First
7. Century, Select Publishers, New Delhi (2001).

8. M.K. Bhasin and S. Nath, Role of Forensic Science in the New Millennium, University of Delhi, Delhi (2002).
9. S.H. James and J.J. Nordby, Forensic Science: An Introduction to Scientific and Investigative Techniques, 2nd Edition, CRC Press, Boca Raton (2005).
10. W.G. Eckert and R.K. Wright in Introduction to Forensic Sciences, 2nd Edition, W. G. Eckert (ED.), CRC Press, Boca Raton (1997).

Web resources

1. <https://www.coursera.org/courses?query=biotechnology>
2. https://onlinecourses.swayam2.ac.in/nos20_sc24/preview

Journals

1. <https://onlinelibrary.wiley.com/journal/18607314>
2. <https://www.sciencedirect.com/journal/biocatalysis-and-agricultural-biotechnology/special-issue/10SN2VHL1P8>
3. <https://www.sciencedirect.com/journal/journal-of-biotechnology>



MATRIX AND SYLLABUS

For the Programme B.Sc. (Genetics & Biotechnology)

Genetics

NEP Based Curriculum (2021 onwards)

II Semester

NEP- Curriculum Framework for Approval

B.Sc. (Genetics & Biotechnology) - Matrix for II Semester (w.e.f. 2023-24 onwards)

II Semester							
Code	Course Code	Course	Teaching Hours	Course Components			Credits
				L	T	P	
AECC	S21KN 2.1/ S21HN 2.1/ S21AE 2.1	Language I (Kannada/Hindi/Additional English)	45	3	1	-	3
AECC	S21GE 2.1	Language II (Generic English)	60	3	1	-	3
AECC	21SBC 2.1	Environmental Studies	45	2	1	-	3
DSC2	S21GN 2.1	Bioinstrumentation and Animal Cell Culture (Theory)	60	4	-	-	4
DSC2	S21GN 2.2	Bioinstrumentation and Animal Cell Culture (Practical)	60	-	-	4	2
DSC2	S23BT 2.1	Microbiology (Theory)	60	4	-	-	4
DSC2	S23BT 2.2	Microbiology (Practical)	60	-	-	4	2
OE-2	S23OE/ S21OE	Health and Lifestyles / Applications of Biotechnology in Agriculture	45	2	1	-	3
SEC-VB	21VBC 2.1	NCC/NSS/Cultural	30	-	-	2	1
SEC-VB	21VBC 2.2	Sports	30	-	-	2	1
Total							26

Note:

AECC- Ability Enhancement Compulsory Course

DSC - Discipline-Specific Course

OE- Open elective (course offered by the department to students of other stream)

SEC - VB Skill Enhancement Course -Value Based

SEC - SB Skill Enhancement Course -Skill Based

Continuous Internal Assessment – Scheme of Evaluation**For Theory Courses****End Semester Examination: 60%****Continuous Internal Assessment: 40%**

Activities (CIA: 40 Marks)	Proposed and Approved Scheme		Total Marks (40)
	IA-1	IA-2	
Session Test Maximum Marks	30	30	
1. Weightage (Marks)	10	10	20
2. Assignment (Marks)	20		20
i. Writing	10		
ii.Quiz / Presentation / Creating diagrams /charts / Classwork / Case study / Viva / Field work etc.	05		
iii. Classroom participation	05		
Total			40

Continuous Internal Assessment

Scheme of Evaluation for Practical Courses

End-Semester Examination: 50%

Continuous Internal Assessment: 50%

CIA (25 marks) + End Semester Exam (25 marks)	
Maximum Marks (Internal Assessment)	25
1. Weightage (Marks)	15
2. Record work (Marks)	05
3. Quiz/Presentation/creating diagrams/ charts/Lab work/	05
Total (Marks)	25

S23 BT 2.1: MICROBIOLOGY THEORY

Total Teaching Hours: 60

No. of Hours per week: 4

(4 Credits)

CObj	Course Objectives
CObj_1	To impart basic knowledge and understanding modern microbiology and the technologies involved in it.
CObj_2	To assist with hands on laboratory experience in fundamental techniques like culturing and maintaining the microorganisms related to biotechnology.
CObj_3	To familiarize and educate the students with the antimicrobial strategies, modalities in applying for research area.

CO	Course Outcomes
	After completion of this module, students should be able to:
CO1	Comprehend the basic understanding about the technologies involved in modern microbiology.
CO2	Apply the knowledge about the fundamental techniques involved in culture and maintenance of microorganisms pertaining to biotechnology.
CO3	Analyze the lifecycle of microbial growth and the parameters that can influence it.
CO4	Interpret on the antimicrobial strategies associated in maintenance of sterility.
CO5	Evaluate the various antimicrobial modalities available in natural and pharmaceutical domain and their applications in present day research arena.

CO-PO Mapping

	PO_1	PO_2	PO_3	PO_4	PO_5	PSO_1	PSO_2	PSO_3	PSO_4	PSO_5
CO_1	X	X	-	-	-	X	-	X	-	-
CO_2	X	X	X	-	-	X	-	-	-	X
CO_3	X	X	X	-	-	X	-	-	-	-
CO_4	X	X	-	-	-	X	-	X	-	-
CO_5	X	X	-	-	X	X	-	X	-	-

Course Content

Sl. No.	Unit/Chapter title	Content	Number of hours	Skills developed
1	Unit: I Introduction and Microscopy	Introduction, scope and history of microbiology. Microscopy: Working principles and applications of various microscopy-resolving power, numerical aperture and oil immersion objective lenses. Compound microscope, Dark field microscope, Phase contrast microscope, Fluorescence Microscope, confocal microscope, Electron Microscopes- TEM and SEM.	15 Hrs	Cognitive/ Research skills 1. EMP 2. SKD 3. EDP
2	Unit: II Sterilization- Principles and Methods	Definition of terms-sterilization, disinfectant, antiseptic, sanitizer, germicide, microbicidal agents, microbiostatic agent and antimicrobial agent. Physical methods of sterilization: Principle, construction and applications of moist heat sterilization- Boiling, Pasteurization, Fractional sterilization-Tyndallization and Autoclaving. Dry heat sterilization-Incineration and Hot air oven. Filtration- membrane filters and HEPA filters and Laminar Air Flow Unit. Radiation : Ionizing radiation-γ rays and non-ionizing radiation- UV rays Chemical methods of sterilization: Alcohols, aldehydes, phenols, halogens, metallic salts, Quaternary ammonium compounds and sterilizing gases.	15 Hrs	Cognitive/ Research skills 1. EMP 2. SKD 3. EDP
3	Unit: III Microbial Growth, Enumeration and Culture Techniques	Bacterial Growth: Growth of bacterial culture-phases of bacterial growth and growth curve, enumeration and measurements of bacterial growth. Biofilm. Culture media: Components of media, natural and synthetic media, chemically defined media, complex media, selective, differential, indicator, enriched and enrichment media with suitable examples. Pure culture techniques: Serial dilution and plating methods (pour plate, spread plate and streak plate methods); cultivation, methods of culture preservation; cultivation of aerobic and anaerobic bacteria. Stains and staining techniques: Principles of staining-dyes, stains, smear, fixatives and mordants. Types of stains and staining techniques-simple stains, structural stains	15 Hrs	Research Skills 1. EMP 2. SKD 3. EDP

		and differential stains.		
4	Unit : IV Antimicrobial Agents	Antibacterial Agents: Modes of action of antibiotics-Inhibitors of cell wall synthesis; cell membrane function; nucleic acid biosynthesis and protein biosynthesis and inhibitors of metabolism. Antifungal agents: Mechanism of action of Amphotericin B, Griseofulvin; Antiviral agents: Mechanism of action of Amantadine, Acyclovir, Azidothymidine. Antibiotic resistance, MDR, XDR, MRSA, NDM-1. Antibiotic sensitivity testing methods: Disc diffusion and Agar well diffusion techniques and their significance.	15 Hrs	Research/ Analytical skills 1. EMP 2. SKD 3. EDP

Books for Reference:

1. Atlas RM. (1997). Principles of Microbiology. 2nd edition. WM.T. Brown Publishers.
2. Black JG. (2008). Microbiology: Principles and Explorations. 7th edition. Prentice Hall
3. Madigan MT, and Martinko JM. (2014). Brock Biology of Micro-organisms. 14th edition. Parker J. Prentice Hall International, Inc.
4. Pelczar Jr MJ, Chan ECS, and Krieg NR. (2004). Microbiology.
5. 5th edition Tata McGraw Hill.
6. Srivastava S and Srivastava PS. (2003). Understanding Bacteria. Kluwer Academic Publishers, Dordrecht
7. Stanier RY, Ingraham JL, Wheelis ML and Painter PR. (2005). General Microbiology. 5th edition McMillan.
8. Tortora GJ, Funke BR, and Case CL. (2008). Microbiology: An Introduction. 9th edition Pearson Education.
9. Willey JM, Sherwood LM, and Woolverton CJ. (2013). Prescott's Microbiology. 9th edition. McGraw Hill Higher Education.
10. Cappuccino J and Sherman N. (2010). Microbiology: A Laboratory Manual. 9th edition. Pearson Education Limited
11. Microbiology- Concepts and applications by Paul A. Ketchum, Wiley Publications
12. Fundamentals of Microbiology –Frobisher, Saunders & Toppan Publications
13. Introductory Biotechnology-R.B Singh C.B.D. India (1990)
14. Fundamentals of Bacteriology - Salley
15. Frontiers in Microbial technology-P.S. Bison, CBS Publishers.
16. Biotechnology, International Trends of perspectives A. T. Bull, G.
17. General Microbiology –C.B. Powar

Web Resources:

1. <https://microbe.net/resources/microbiology-web-resources/>
2. <https://mtccindia.res.in/>
3. <https://www.cdc.gov/labtraining/training-courses/basic-microbiology/index.html>
4. <https://www.coursera.org/courses?query=microbiology>

Journals:

1. BMC Microbiology
2. International Journal of Microbiology

3. Archaea
4. Frontiers in Microbiology
5. mBio
6. PLoS Pathogens

S23 BT 2.2: MICROBIOLOGY**PRACTICAL****Total Teaching Hours: 60****No. of Hours per week: 4****(2 Credits)**

Sl. No.	Unit/chapter title	Content	Number of hours	Skills developed
1	Module 1	Microbiological safety measures and study of the principles and applications of important instruments (biological safety cabinets, autoclave, incubator, BOD incubator, hot air oven, light microscope, pH meter).	04 Hrs	Research/ Employable Skills
2	Module 2	Sterilization of media using autoclave, glassware using hot air oven and heat sensitive materials by membrane filtration and assessment for sterility.	04 Hrs	Research skills
3	Module 3	Preparation of various culture media for bacteria, fungi.	08 Hrs	Research/ Employable skills
4	Module 4	Isolation and enumeration of bacteria and fungi from soil, water and air samples (Exposure plate method). Use of plating techniques: spread plate, pour plate and streak plate. Slant and broth cultures.	12 Hrs	Research/ Employable skills
5	Module 5	Study of colony characteristics of bacteria and fungi isolated from various samples.	04 Hrs	Research Analytical skills
6	Module 6	Study of fungi by using temporary mounts (Lactophenol cotton blue staining).	04 Hrs	Research skills
7	Module 7	Staining techniques: Bacteria– Simple staining, Gram's staining, Negative staining, Capsule and Endospore staining.	08 Hrs	Research/ Analytical skills
8	Module 8	Biochemical Tests: IMViC Tests, Starch and Gelatin hydrolysis, Catalase test.	08 Hrs	Research/ Employable skills

9	Module 9	Study of bacterial cell motility - Hanging drop technique.	04 Hrs	Analytical skills
10	Module 10	Determination of antibiotic sensitivity – Disc Diffusion Method.	04 Hrs	Research/ Employable skills

Books for Reference:

1. Hand book of Microbial Quality control by Rosamund. M, Baird Norman. A, Hodges and Stephen. P, Denyer. CRC press.
2. The Microbiological Quality of Food, 1st Edition, Editors: Antonio Bevilacqua Maria Rosaria Corbo Milena Sinigaglia eBook ISBN: 9780081005033 Imprint: Wood head Publishing.
3. Guide to Microbiological Control in Pharmaceuticals and Medical Devices, Second Edition, Stephen P. Denyer, Rosamund M. Baird, CRC Press.
4. Cappucino J and Sherman N. (2010). Microbiology: A Laboratory Manual. 9th edition. Pearson Education Limited

**S210E: APPLICATIONS OF BIOTECHNOLOGY IN AGRICULTURE
THEORY**

Total Teaching Hours: 45

No. of Hours per week: 3

(3 Credits)

CObj	Course Objectives
CObj_1	To impart basic knowledge and understanding of scope and concepts in Agriculture Biotechnology.
CObj_2	To detail and weigh the pros and cons of the case studies/practical topics/issues handled in the field of Agriculture Biotechnology.
CObj_3	To make clear understanding about the Bt based products usage and update technologically.

CO	Course outcomes
	After completion of this module, students should be able to
CO1	Understand the scope, significance and importance of plant tissue culture and its techniques related to entrepreneurship.
CO2	Imbibe the fundamental concepts, terminologies and commercial setup with available classical examples on small scale bio enterprises.
CO3	Analyze the pros and cons of the genetically modified crop in the diversified sectors and improvising the decision making ability in terms of safety, acceptance, and perception of GM crops.
CO4	Familiarize with the GM crops and their applications in various industries viz., bio factories, molecular pharming, edible vaccines, plantibodies and nutraceuticals.
CO5	Comment on the Bt based pesticides, applications of antisense RNA technology, utilization of genetic engineering in value addition, and quality improvement traits.

CO-PO Mapping

	PO_1	PO_2	PO_3	PO_4	PO_5	PSO_1	PSO_2	PSO_3	PSO_4	PSO_5
CO_1	X	-	X	X	X	X	-	X	-	X
CO_2	X	X	X	-	-	-	X	X	X	-
CO_3	-	-	X	X	X	-	X	X	X	X
CO_4	X	X	X	X	-	X	X	X	X	-
CO_5	-	X	X	-	X	-	X	X	X	X

Course Content

Sl. No.	Unit/Chapter title	Content	Number of hours	Skills developed
1	Unit: I Agricultural Biotechnology	Concepts and scope of biotechnology in Agriculture. Plant tissue culture, micro propagation, entrepreneurship in commercial plant tissue culture. Banana tissue culture - primary and secondary commercial setups, Small scale bioenterprises: Mushroom cultivation.	11Hrs	Cognitive/ Research/ Analytical Skills 1. EMP 2. SKD 3. EDP
2	Unit: II Transgenic plants	The GM crops – safety, ethics, perception and acceptance of GM crops. GM crops case study: Bt cotton, Bt brinjal, Plants as biofactories for molecular pharming: edible vaccines, plantibodies, and nutraceuticals.	11Hrs	Cognitive/ Research/ Analytical Skills 1. EMP 2. SKD 3. EDP
3	Unit: III Biopesticides	Baculovirus pesticides, Mycopesticides, Post-harvest Protection: Antisense RNA technology for extending shelf life of fruits and shelf life of flowers.	11Hrs	Cognitive/ Research/ Analytical Skills 1. EMP 2. SKD 3. EDP
4	Unit: IV Value addition of food products	Genetic Engineering for quality improvement: Seed storage proteins, Biofortification. Fruit crops: Leveraging the antioxidants – Lycopene – Tomato, watermelon, strawberry. Anthocyanin – Tomato, grape berry. Carotene – Carrot, papaya, Flavours– capsaicin and vanillin.	12Hrs	Cognitive/ Research/ Analytical Skills 1. EMP 2. SKD 3. EDP

Books for Reference:

- Chrispeels M.J.et al. Plants, Genes and Agriculture-Jones and Bartlett Publishers, Boston.1994.
- Gamborg O.L. and Philips G.C.Plant cell, tissue and organ culture (2nd Ed.) Narosa Publishing House. New Delhi.1998
- Hammound J, P McGravey&Yusibov.V. Plant Biotechnology, Springer verlag.2000
- Heldt. Plant Biochemistry and Molecular Biology.Oxford and IBH Publishing Co. Pvt.Ltd. Delhi. 1997
- LydianeKyte and John Kleyn.Plants from test tubes. An introduction to

6. Micropropagation (3 rd. Ed.). Timber Press, Portland. 1996
7. Murray D.R. Advanced methods in plant breeding and biotechnology.Panima Publishing Corporation.1996
8. NickoloffJ.A.Methods in molecular biology, Plant cell electroporation and electrofusion protocols-Humana press incorp, USA. 1995.
9. Sawahel W.A. Plant genetic transformation technology.Daya Publishing House, Delhi.1997
10. Gistou, P and Klu, H.Hand book of Plant Biotechnology (Vol. I & II).John Publication.2004

Web Resources

1. <https://www.coursera.org/courses?query=biotechnology>
2. https://onlinecourses.nptel.ac.in/noc24_ag08/preview

Journals

1. <https://link.springer.com/journal/12892/volumes-and-issues>
2. <https://www.sciencedirect.com/journal/biocatalysis-and-agricultural-biotechnology>

MATRIX AND SYLLABUS

For the Programme B.Sc. BC-BT

SEMESTER III



**M.Sc. BIOTECHNOLOGY: (CBCS) First year
SEMESTER SCHEME:**

Paper No	Title of the paper	Type of paper	Periods /Week	Duration of Exam (Hours)	IA	EA	Max Mark	Credits
I Semester Theory								
MBT-101	Cell Biology	H Core	4	3	30	70	100	4
MBT- 102	Molecular Genetics	H Core	4	3	30	70	100	4
MBT -103	General Microbiology	H Core	4	3	30	70	100	4
MBT- 104	Biochemistry	H Core	4	3	30	70	100	4
MBT -105	Biostatistics	S Core	2	2	15	35	50	2
Practical								
MBT- 106	Cell Biology and Molecular genetics	Pract	4	4	30	70	100	4
MBT- 107	General Microbiology and Biochemistry	Pract	4	4	30	70	100	4
Total marks and Credits							650	26

Paper No	Title of the paper	Type of	Periods /Week	Duration of exam (Hours)	IA	EA	Max Mark	Credits
II Semester Theory								
MBT-201	Biochemical Techniques and Enzymology	H Core	4	3	30	70	100	4
MBT- 202	Molecular biology	H Core	4	3	30	70	100	4
MBT -203	Immunology & Immuno-technology	H Core	4	3	30	70	100	4
MBT- 204	Environmental Biotechnology	H Core	4	3	30	70	100	4
MBT-205	Bioinformatics	S Core	2	2	15	35	50	2
Practical								

MBT- 404	Bioprocess Technology, Medical and Pharmaceutical Biotechnology	Pract	4	4	30	70	100	4
MBT- 405	Project work/ dissertation						100	4
	Project viva						50	2
Total Marks & Credits							550	22
Grand total and credits							2500	100

Guidelines for M.Sc. IV semester Project work

1. Proposed to carry out the project work individually or in group to a maximum of 4 to 5 students.
2. Project shall be allotted at the beginning of the III semester to facilitate students to work during semester break.
3. Students may be allowed to carry out the project work in other research institutes based on the requirement of the work (Instrumentation/ Equipments, conditions etc.)
4. Faculty members of the respective college/department must serve as guides.
5. Co-guides from the other institutions may be allowed.
6. One copy of the dissertation to be submitted to the college.
7. Evaluation of the dissertation has to be done by the two external examiners appointed by the college for 100 marks.
8. The project viva examinations will be held at the department by the BOE for 50 marks.
9. Mark schematics

Project work / dissertation max. marks 100	Viva max. marks 50
Relevance of the work in the present context = 10	Presentation skill = 20
Literature survey = 10	Clarity of the subject = 10
Methodology = 20	Dissertation defence = 10
Execution of the work = 20	Presentation material = 05
Results and discussion = 20	Timeline = 05
Over all presentation of the dissertation = 20	
Total = 100	= 50

I SEMESTER (THEORY)
MBT-101: CELL BIOLOGY

Total Hours: 52

Unit 1

Basic Characteristics of the Cell:

Structure, organization and composition of prokaryotic and eukaryotic cell. Plasma membrane-structure and functions, membrane models. Components of Blood & their functions (Plasma, RBC, WBC, Platelets). Extracellular matrix (collagen, proteoglycans, fibronectin, lamins).

8 Hours

Unit 2

Cytoskeleton:

Nature of cytoskeleton, Actin filaments, actin binding proteins, Intermediate filaments Microtubules, MAPs, Structure and functions of cilia and flagella.

8 Hours

Unit 3

Membrane Transport:

Transport across membrane-passive diffusion, osmosis, active transport, Ion Channels, A B C transporters, Na⁺ and K⁺ pump, Ca⁺ ATPase pump, co-transport, symport, antiport, endocytosis and exocytosis. Membrane vesicular traffic.

8 Hours

Unit 4

Cell Signalling:

Cell to cell interactions, Cell adhesion-integrins, selectins, cadherins. Cell Junction-Tight and gap junctions, Desmosomes, plasmodesmata. General principles of cell signaling, types of signaling-Paracrine, Autocrine and Endocrine, Signaling via G-protein coupled receptors, kinase receptors, Role of secondary messengers.

8 Hours

Unit 5

Cell Cycle:

Molecular events of cell division and cell cycle, regulation of cell cycle events-Cyclins, Cyclin dependent kinases, inhibitors. Apoptosis, necrosis.

6 Hours

Unit 6

Specialized Cells (Muscle & Nerve cells):

Structure & functions of muscles (Straited, nonstraited and cardiac). Molecular basis of muscle contraction. Structure of neuron, neuroglia. Mechanism of nerve transmission-Resting and action potential, electrical and chemical transmission, Neurotransmitters and their receptors.

8 Hours

Unit 7

Antioxidant defence system and Senescence:

Free radicals-ROS, RNS. Effect of free radicals on Proteins, Lipids and Nucleic acids. Mechanism of antioxidant defence system-enzymatic and non-enzymatic. Senescence-theories and concepts of aging.

6 Hours

References:

1. Mathews,C.A.(2003). Cellular physiology of nerve and muscle. 4th edin. Blackwell publishers
2. Alberts, B., Bray, D., Lewis, J., Raf, M., Roberts, K., Watson, J.D. (1994). Molecular Biology of the Cell.
1. Cooper, G.M. (1997).The Cell: A molecular approach, ASM Press, USA.
2. Darnell, J., Lodish, H., Baltimore, D. (1990). Molecular Cell Biology. Scientific American Books Inc. NY. nd
3. Garrett, R.H., Gresham, C.M. (1995). Molecular aspects of Cell Biology, International edition, Saunders College Pub.
4. Holy Ahern (1992). Introduction to Experimental Cell Biology, Wm. C. Brown Publishers.
5. Karp, G. (1996). Cell and Molecular Biology concepts and experiments, John Wiley and Sons Inc. NY.
6. Lodish, H., Baltimore, D., Berk, A., Zipursky, B.L., Mastsydaira, P., Darnell, J. (2004).
7. Molecular Cell Biology, Scientific American Books Inc. NY.
8. Tobin and Morel (1997). Asking about “Cells” Saunders College Publisher.
9. Wolfe, S.L. (1991). Molecular and Cellular Biology, Wordsworth Pub.Co.
10. Kanugo, M.S. (2002) Genes and aging. Cambridge University Press.
11. Hall Wel ,B Gutteridge J.M.C (2002).Free redicles Biology and medicine. Oxford Press.UK
12. Kanugo,M.S.(2002). Genes and aging.Cambridge University Press.

MBT-102: MOLECULAR GENETICS

Total Hours: 52

Unit 1

Physical basis of Heredity:

Introduction, concepts and theories of Mendelian genetics, chromosome theory of inheritance, Nucleus, nucleolus and extra chromosomal inheritance.

6 Hours

Unit 2

Chromosomes and Genes:

Structure and organization of eukaryotic chromosomes: Super coiled loops, domains and scaffolds in eukaryotic chromosome. Difference between interphase chromatin and mitotic chromosomes. Heterochromatin, euchromatin and telomeres. Nucleosomes-Organization of DNA in the nucleosome, histone octamer. Split genes and overlapping genes, gene interaction. Human chromosomal aberrations, karyotype analysis-normal and abnormal karyotype.

10 Hours

Unit 3

Genetic Recombination:

Mechanism of recombination, Holliday, White house and Radding models, Enzymes involved in homologous and site specific recombination. Breakage and reunion of DNA at specific sites. Synapsis of homologous duplexes, role of RecA in recombination. Topological manipulation of DNA

Bacterial Recombination-Transformation, conjugation, transduction, plasmids and episomes-Application in genome mapping of E. coli.

10 Hours

Unit 4

Transposable Genetic Elements:

Transposons – Transposable elements in prokaryotes and eukaryotes – IS elements, Composite transposons, Tn3 elements, Ac and Ds elements, P elements, Retrotransposons and their significance. Transposable elements in human and their genetic and evolutionary significance.

8 Hours

Unit 5

Mutation:

Base pair and frame shift mutation, genetic suppression. Molecular basis of mutation – spontaneous and induced mutation and their role in evolution. Detection of mutation – Ames test, Mutation in – yeast, neurospora and chlamydomonas. Mutation studies in drosophila and human disorders by mitochondrial genome mutation.

10 Hours

Unit 6

Sex Determination and Dosage Compensation: Sex determination in *Drosophila* and mammals. Secondary sex determination in mammals. Dosage compensation in *Drosophila* and mammals.

4 Hours

Unit 7

Population Genetics:

Gene pools, allele frequencies, Hardy Weinberg equation, non random breeding, genetic drift, gene flow, selection, speciation. Protein and DNA sequence polymorphism, molecular basis of evolution in *Homo sapiens*.

4 Hours

References:

1. David Freifelder. (2004). Microbial genetics. 10th edition, Norton publisher, New Delhi.
2. Lodish, H.D., Baltimore, A., Berk, B.L., Zipursky, P., Matsudaira and Darnell, J. (2004). Molecular cell biology. Scientific American Books Inc., NY.
3. Gardner/Simmons/Snustad. (2006). Principles of Genetics. 8th Edn. John Wiley & sons.
4. Klug, W.S., Cummings. (2003). Concepts of genetics, 7th Edn. Pearson Education.
5. Dale, J.W. (1994). Molecular Genetics of bacteria, John Wiley & Sons.
6. Streips and Yasbin. (2001). Modern microbial Genetics. Niley Ltd.
7. John Ringo (2004). Fundamental Genetics. Cambridge University Press.

MBT-103: GENERAL MICROBIOLOGY

Total Hours: 52

Unit 1

Microbial classification:

Three domain system of classification, Phylogenetic Relationships, Code for bacterial nomenclature and taxonomy, Criteria for microbial classification-morphological, staining techniques, biochemical methods, serological techniques, phage typing, fatty acid profiles, Flow cytometry, DNA base composition, DNA fingerprinting, rRNA sequence, Nucleic acid hybridization, Numerical Taxonomy, Chemotaxonomy, Classification of bacteria according to Bergey's Manual of systematic Bacteriology, Dichotomous keys, Cladograms, dendrograms, universal phylogenetic tree.

12 Hours

Unit 2

Prokaryotic Microorganism-General properties, Structure, and Reproduction: Domain Bacteria: Proteobacteria (Alpha, Beta, Gamma, Delta and Epsilon Proteobacteria), Cyanobacteria, Chlorobium, Firmicutes, Actinobacteria, Chlamydiae, Spirochaetes, Bacteroidetes, Fusobacteria. Domain Archaea: Crenarchaeota, Euryarchaeota.

10 Hours

Unit 3

Eukaryotic Microorganisms-General characters, Structure and Reproduction:

Fungi (Saccharomycetes), Algae (Spirulina), Protozoa (Plasmodium), Slime molds (Physarum)

8 Hours

Unit 4

Viruses, Virioids and Prions (Acellular entities)

General characters, Structure, Criteria for classification of Viruses, Viruses that affect humans, animals and plants, Isolation, cultivation and identification of Viruses (Growing in Bacteria, Living Animals, embryonated eggs, Cell Cultures). Viral Multiplication (Lytic and lysogenic life cycle), Virioids and Prions -General properties and diseases caused by virioids and prions.

10 Hours

Unit 5

Microbial Growth and Control

Physical parameters (Temperature, pH, Osmotic Pressure), Chemical parameters (Carbon, Nitrogen, Phosphorous, Sulphur, Trace elements, oxygen), Growth factors, Culture Media, Phases of Growth, Growth Measurements, Microbial growth control -Physical methods (Heat, Pasteurization, Filtration, Radiation, Dessication, Low Temperature, High Pressure, Osmotic Pressure) and Chemical Methods (Phenols, Halogens, Alcohols, quaternary ammonium compounds).

6 Hours

Unit 6

Microbiological methods:

Isolation and cultivation of microorganisms from Water, Soil, Air, Rhizosphere, Phyllosphere and Mycorrhiza, Biogeochemical cycle.

6 Hours

References:

1. Microbiology by MJ Pelczar Jr, ECS Chan, NR Krieg 5 Edition, Pub: Tata Mcgrah-Hill Publishing Co Ltd.
2. Introductory Microbiology by Heritage Pub Heritage
3. General Microbiology by Stainer Pub; Ingraham and Wheeler (McMillan)
4. Alexander M (1977) Introduction to soil microbiology, John Wiley and Sons Inc.N.Y. nd
5. Atlas R.M. (1998) Microbiology, Fundamentals and applications 2 Edition, Milan Publishing Co. th
6. Brock T.D. and Madigan M.T (1992) Biology of Microorganisms 6 Edn. Prentice Hall, Eagle wood cliffs N.j.
7. Holt J.S. Kreig N.R., Sneath P.H.A and Williams S.T (1994) Bergey.s Manual of th Systemic Bacteriology 9 Edn. William and Wilkins, Baltimore.
8. Prescott L.M, Harley T.P and Klein D.A. (1996) Microbiology WMC. Brown publishers

MBT-104 BIOCHEMISTRY

Total Hours: 52

Unit-1

Principles of Bioenergetics: Introduction, Laws of thermodynamics, Gibbs free energy, Relationship of Standard free energy to enthalpy, entropy and equilibrium constant, High energy compounds, ATP as universal currency of free energy, Oxidation-Reduction Reactions, Electromotive force, Half reactions, Redox potentials, Relationship of standard redox potential and standard free energy change. Standard redox potentials of some biologically important Half reactions.

6 Hours

Unit-2

Oxidative phosphorylation: Electron transport chain, Electron transfer reactions in mitochondria, Electron carriers, Ubiquinone, Cytochromes, Iron sulfur centers, Methods to determine sequence of electron carriers, Fractionation of Multi enzyme complexes I, II, III, IV of Mitochondria and their inhibitors, Oxidative phosphorylation, ATP synthesis, Chemiosmotic model, Proton gradient, Structure of ATP synthetase, Mechanism of ATP synthesis, Brown fat, Regulation of Oxidative phosphorylation.

8 Hours

Unit-3

Carbohydrates: Classification, structure and Properties of mono, oligo and polysaccharides. Chirality and optical activity, stereoisomerism, cyclic structure of monosaccharide, (pyranoses and furanoses), structures of glucose. absolute and relative configuration (D & L and R & S nomenclature). Derived sugars-Sugar acids (Aldonic, Aldaric and Saccharic acids), Amino sugars. Disaccharides-structures of Maltose, Lactose, Sucrose, Trehalose, Raffinose. Polysaccharides structure and properties of homo and hetero polysaccharides. Storage polysaccharides. (Starch, Glycogen, cellulose, chitin) Glycosamino glycans and glycoproteins.

Carbohydrate metabolism: Glycogenolysis, Glycogenesis, Coordinated regulation of Glycogen metabolism. Glycolysis-Energetics and Regulation, Fermentation reactions (Lactic acid and alcoholic fermentation), Gluconeogenesis, Reciprocal regulation of Glycolysis and Gluconeogenesis, Citric acid cycle-Energetics and regulation, Glyoxylate cycle. Pentose phosphate pathway.

12 Hours

Unit-4

Amino acids and Proteins: Classification, structure and properties of amino acids, reactions of amino acids, peptide bond. Classification of proteins-Structural organisations of proteins (primary, secondary, tertiary and quaternary), conformational analysis, Ramachandran's plot. Thermodynamic aspects of protein folding. General aspects of amino acid metabolism:

Transamination, Deamination, Decarboxylation, basic glutamine and glutamic acid pathways, urea cycle and its regulation, formation of uric acid.

10 Hours

Unit-5

Lipids: Classification-Structure, properties, reactions and biological functions of lipids. Phospholipids, Sphingo and glyco lipids, Steroids-cholesterol-bile salts, steroid hormones. **Metabolism of Lipids:** Beta oxidation of Fatty acids-activation, transport to mitochondria, Beta oxidation reactions. Oxidation of unsaturated fatty acids. Alpha and omega oxidation. Biosynthesis of saturated and unsaturated fatty acids and cholesterol. **Biological functions of eicosanoids** (prostaglandin, leucotrienes and thromboxane).

10 Hours

Unit-6

Nucleic acids: Structure and properties-Bases, Nucleosides, Nucleotides, Polynucleotides. Nucleic acid metabolism: Biosynthesis of purines and pyrimidines, Denovo and Salvage pathways, **biodegradation of purines and pyrimidines.**

6 Hours

References:

1. Nelson, D.L., Cox, M.M. Lehninger. (2004). Principles of Biochemistry 4 edition Pub WH Freeman Co. rd
2. Elliott, W.H., Elliott, D.C. Biochemistry and Molecular Biology 3 Indian edition, Pub. Oxford. rd
3. Mathews, Van Holde and Ahern, Biochemistry by 3 edition, Pub Pearson education
4. Stryer, L. Biochemistry 4 Edn. W.H. Freeman and Co. NY. nd
5. Kuchel, P.W., Ralston Schaums, G.B. Outlines of Biochemistry 2 edition Pub: Tata. Mac Hill.
6. Voet, D., Voet J.G. (2004). Biochemistry 2 Edn.
7. Devlin, T.M. (1997). Biochemistry with clinical correlations, Wiley-Liss Inc. NY
8. Zubey, G.L. Parson, W.W., Vance, D.E. (1994). Principles of Biochemistry WmC Brown publishers. Oxford. nd
9. Edwards and Hassall. Biochemistry and Physiology of the cell 2 Edn. McGraw Hill Co. UK. Ltd.

MBT-105 BIOSTATISTICS

(Soft core)

Total Hours: 26

Unit 1:

Introduction to Bio-statistics, basic concepts, data types. Need for statistical techniques for biological applications, replicable data, Tabulation of data, construction of graph and graphical representations of data. Different models of data presentations.

Frequency distribution, Arithmetic mean, mode, median and percentiles. Measures of variability: Range, mean deviation. standard deviation and co-efficient of variation.

Properties of the data-Organization of data, Central tendency, dispersion, linear regression and correlation-test of significance, skewness and kurtosis and their various measures, percentiles Simple linear correlation and regression analysis. Analysis of variance.

Population and sample: Random sample, use of table of random numbers, parameter and statistics, sampling distribution of sample means, Standard error; confidence intervals.

14 Hours

Unit 2:

Probability: types of event, sample space, definition, conditional probability, addition and multiplication rules of probability and some simple problems. Probability distributions-Binomial, Poisson and Normal distributions and a few simple problems. Statistical Inference-Estimation, standard error, confidence interval for means and proportion.

Testing of hypothesis: basic concepts and definitions, types of errors. Tests based on Normal, student's t, chi-square and F distributions, interpretation of „p. value.

Statistical package-Features of statistical software, SPSS for various applications in Biostatistical programme.

12 Hours

References:

1. Daniel (1999). Biostatistics (3 edition) Panima Publishing Corporation.
2. Khan (1999). Fundamentals of Biostatistics, Panima Publishing Corporation
3. Swardlaw, A.C. (1985). Practical Statistics for Experimental Biologists, Joh
4. Bazin, M.J. (1983). Mathematics in microbiology Academic press
5. Green, R.H. (1979). Sampling design & Statistical methods for environmental Biologists, Wiley Int. N.Y.
6. Campbell, R.C. (1974). Statistics for Biologists, Cambridge Univ. Press, Cambridge
7. Bliss, C.I.K. (1967). Statistics in Biology, Vol.1 Mc Graw Hill, New York.
8. Wiley and Sons, Inc. NY.

I SEMESTER (PRACTICAL)

MBT-106: CELL BIOLOGY AND MOLECULAR GENETICS

Total Units: 16

1. Mounting of polytene chromosomes
2. Mounting of Barr bodies
3. Study of Karyotyping in onion, humans (normal and abnormal)
4. Study of mutation in E.coli by UV light
5. Demonstration of multiple allele by blood group in humans
6. Mounting of imaginal discs of drosophila
7. Study of Drosophila mutant type
8. Problems on (a) law of segregation (b) Independent assortment (c) Sex linked inheritance (d) population genetics
9. Study of mitosis by using onion root tips
10. Study of meiosis
11. Isolation of nucleus and determination of its purity
12. Isolation of mitochondria and determination of purity
13. Isolation of chloroplast by sucrose density gradient and determination of its purity
14. Determination of the rate of active transport of glucose across the intestinal membrane
15. Determination of muscle ATPase activity
16. Determination of acetylcholine esterase activity in the rat brain

MBT-107: GENERAL MICROBIOLOGY AND BIOCHEMISTRY

Total Units: 16

1. Determination of pI of amino acid by titration method
2. Estimation of glucose by Hagerdon and Jensen method
3. Estimation of total sugar by Anthrone method
4. Estimation of amino acid by Ninhydrin method
5. Estimation of protein by Lowry's method
6. Estimation of inorganic phosphate by Fiske-Subbarow method
7. Determination of (a) Iodine number and (b) Acetyl number of a lipid
8. Separation of amino acids by paper chromatography and TLC
9. Microbes culture in broth and solid media, Colony characteristics and Counting of colony
10. Bacterial growth assessment by turbidometry
11. Staining techniques (a) Simple staining (b) Gram staining (c) Endospore staining (d) Capsule staining (e) AFB staining (f) negative staining
12. Biochemical tests (a) Indole test (b) Methyl red test (c) Voges Proskauer test (d) Citrate utilization test (e) Triple sugar iron agar test (f) Starch hydrolysis test (g) Gelatin hydrolysis test (h) Catalase test (i) Oxidase test
13. Soil Microbiology Isolation microflora of (a) rhizosphere (b) phylloplane (c) actinomycetes (d) Rhizobium from legume of root nodules (e) Sporocarp by sieve method (f) identification of Rhizobium and agrobacterium
14. Air Microbiology Isolation of air microflora (a) exposure plate method (b) rotorod sampler method.
15. Water Microbiology: Testing of quality of water (coliform test), H₂S strip method.
16. Estimation of lactate/ Citrate from bacterial culture media

II SEMESTER (THEORY)

MBT-201: BIOCHEMICAL TECHNIQUES AND ENZYMOLOGY

Total Hours: 52

Unit 1

Physical Techniques:

Principles and applications of Rayleigh scattering, viscometry. Absorption, adsorption, crystallization, x-ray crystallography spectrophotometry, fluorimetry, flame photometry, mass spectroscopy. Distillation, liquid -liquid extraction Centrifugation, differential, gradient, ultra centrifugation, salt fractionation and dialysis.

10 Hours

Unit 2

Chromatographic Techniques

Principles and applications of gel filtration-ion exchange chromatography-thin layer chromatography-affinity chromatography-gas chromatography, high performance liquid chromatography (HPLC).

8 Hours

Unit 3

Electrophoresis

Principles and applications of moving boundary electrophoresis, zone electrophoresis, gel electrophoresis-PAGE and SDS PAGE agarose gel electrophoresis, isoelectric focusing and 2D Gel electrophoresis. Pulsed field electrophoresis.

6 Hours

Unit 4

Enzyme catalysis

Introduction to enzymes; nomenclature and classification of enzymes; chemical nature and properties of enzymes, activation energy, factors affecting enzyme activities, active site, allosteric site, coenzymes and co factors. Types of enzyme specificity, units of enzyme activity. Strategies of purification of enzymes, criteria of purity, molecular weight determination and characterization of enzymes. Enzyme single and multi substrate reactions. Ping-pong mechanism, sequential mechanism (ordered and random), enzyme models -host guest complexation chemistry.

8 Hours

Unit 5

Enzyme Kinetics and Mechanism of Enzyme catalysis

Chemical kinetics, rate of reaction, order of reaction, zero order and first order. Derivation of michaelis-menton equation, km value and its significance, lineweaver-burk plot. Velocity maximum. Mechanism of enzyme action, lock and key model, induced fit hypothesis, substrate strain theory (with lysozyme as a typical example). Mechanism of enzyme catalysis -Acid-Base

catalysis, Covalent catalysis, metal ion catalysis and entropy effect. Enzyme inhibition-reversible and irreversible, competitive, uncompetitive, non competitive. Regulation of enzyme activity – Covalent modulation, Allosteric regulation, ligand interactions, scatchard plot, co-operative interactions, feedback regulation. Isozymes.

12 Hours

Unit 6

Coenzymes

Structure and mechanism of action of some important co-enzymes NAD⁺, FAD, FMN, TPP, pyridoxal phosphate, lipoic acid, CoASH and vitamin B12

8 Hours

References:

1. Nelson, D.L., Cox, M.M. Lehninger. (2004). Principles of Biochemistry, 4 edition Pub WH Freeman Co.
2. Daniel, L, Purich, Melvin, I. Simon, John, N., Abelson. (2000). Contemporary enzyme kinetics and mechanism.
3. Plowman. (1972). Enzyme kinetics. McGraw hill.
4. Jack kite. (1995). Mechanisms in protein chemistry, Garland publishers.
5. Gerhartz, W. (1990). Enzymes in industry: Production and applications. VCH publishers, NY.
6. Chaplin, M.F., Bucke, C. (1990). Enzyme technology. Cambridge university press, Cambridge.
7. Belter, P.A., Cussier, E. (1985) Wiley Bio separations .
8. Asenjo, J. Dekker, M. (1993) Separation processes in biotechnology.
9. Upadhyay and Nath (2003). Biophysical chemistry, principles and techniques, Himalaya publishing house.

MBT-202: MOLECULAR BIOLOGY

Total Hours: 52

Unit 1

Structure and Properties of DNA and RNA:

Information flow in biological systems: Central dogma. Biochemical evidences for DNA as genetic material. Watson and Crick model of DNA, different forms of DNA (A, B, Z, C and D). Properties and types of DNA. UV absorption, Denaturation and renaturation, thermodynamics of melting of the double helix, kinetics of unwinding of the double helix, Interaction with small ions. Structure and functions of different types of RNA.

6 Hours

Unit 2

Replication:

Characteristics and functions of bacterial DNA polymerases, Mechanism of prokaryotic DNA replication, models of replications in prokaryotes. Fidelity of replication, Nearest neighbor frequency analysis. Eukaryotic DNA polymerases and mechanism of replication. Telomere synthesis-telomerases. Replication of viral DNA, rolling circle model. Inhibitors of replication

8 Hours

Unit 3

Transcription:

Characteristics and function of bacterial RNA polymerases, mechanism of transcription and regulation. Eukaryotic RNA polymerases-transcription factors, mechanism of transcription and regulation. Stringent response. Post transcriptional modifications of mRNA (5.CAP formation, poly adenylation, mechanism of splicing, Group I, II and III, splicosome assembly, splicing editing, Group IV splicing), stability. Processing of tRNA and rRNA. Inhibitors of transcription. Ribozyme technology: mechanism of action and applications.

.

8 Hours

Unit 4

Translation:

Genetic code, Wobble hypothesis. Ribosome assembly, mechanism of activation of amino acids. Mechanism of translation in prokaryotes and eukaryotes. Differences between prokaryotic and eukaryotic protein synthesis, codon usage, Inhibitors of protein synthesis. Co and posttranslational modifications of proteins. Control of translation in eukaryotes (Antisense RNA, Heme and interferon).

8 Hours

Unit 5

Regulation of Gene expression:

Gene regulation, Operon model-Inducible and repressible systems, lac, gal, trp, his and arabinose operon; Attenuation, positive and negative regulation, role of cAMP and CRP in the expression of lac genes, catabolite repression, regulation of eukaryotic gene expression, transcriptional control, cis control elements, promoters, enhancers, transacting factors, homeobox in the control of developments in insects and vertebrates. DNA binding motifs of transcription factors, posttranscriptional control.

10 Hours

Unit 6

Protein localization and Targeting:

Export of secretory proteins-signal hypothesis, transport and localization of proteins to mitochondria, chloroplast, peroxysomes and membrane.

5 Hours

Unit 7

DNA damage and Repair:

DNA damage-alkylation, deamination, oxidation, UV radiation. Repair mechanisms-photoreactivation, excision repair, post replication repair, mismatch repair and SOS repair.

5 Hours

Unit 8

Gene Silencing:

Definition, types –transcriptional and post transcriptional gene silencing, RNAi pathway (si RNA and mi RNA).

2 Hours

References:

1. Principles of gene manipulation -An introduction to genetic engineering, Old R.W., Primrose S.B., Blackwell Scientific Publications, 1993.
2. Nelson, D.L., Cox, M.M. Lehninger Principles of Biochemistry (2005). 4 edition Pub WH Freeman Co. rd
3. Elliott, W.H., Elliott, D.C. Biochemistry and Molecular Biology 3 Indian edition, Pub. Oxford. rd
4. Mathews, Van Holde, Ahern, Biochemistry by 3 edition, Pub Pearson education.
5. Alberts, B., Bray, D., Lewis, J., Raf, M., Roberts, K. and Watson, J.D. (1994). Molecular Biology of the Cell.
6. Cooper, G.M. (1997). The Cell: A molecular approach, ASM Press, USA.
7. Darnell, J. Lodish, H., Baltimore, D. (1990). Molecular Cell Biology. Scientific American Books Inc. NY.
8. Garrett, R.H. and Gresham, C.M. (1995). Molecular aspects of Cell Biology, International edition, Saunders College Pub.
9. Karp, G. (1996). Cell and Molecular Biology concepts and experiments, John Wiley and Sons Inc. NY.
10. Lodish, H., Baltimore, D., Berk, A., Zipursky, B.L., Matsudaira, P., Darnell, J. (2004). Molecular Cell Biology, Scientific American Books Inc. NY.

MBT-203: IMMUNOLOGY AND IMMUNOTECHNOLOGY

Total Hours: 52

Unit 1: Immune system and Immune Response: Innate and acquired immunity, structure and functions of immune cells-T cells, B cells, Macrophages, NK cells and dendritic cells, Eosinophils, Neutrophils, Mast cells. Organs of immune system-Primary and secondary lymphoid organs. Primary and secondary immune response, Clonal selection theory.

10 Hours

Unit 2: Antigens and Antibodies: Structure and properties of antigens –Iso and alloantigens-antigen specificity, Haptens and adjuvants-structure and properties. Immunoglobulins-Structure and properties, types and subtypes. Generation of immunological diversity. Complement system-component, properties and functions. Complement pathways and biological significance.

8 Hours

Unit 3: Major Histocompatibility Complex and Transplantation: Structure and functions of MHC and HLA systems. Genetic control of immune response. Tissue transplantation-Tissue typing methods for tissue and organ transplantations. Graft versus host reaction and rejection, xenotransplantation, immunosuppressive therapy.

6 Hours

Unit 4: Hypersensitivity Reactions: Allergy, Hypersensitivity reactions-types (I, II, III, and IV), symptoms, immunodiagnosis. Lymphokines and cytokines : Interleukins and Interferons Production, biological functions and assay methods. Immunological tolerance.

8 Hours

Unit 5: Autoimmunity and Immunomodulation: Autoimmunity-Autoimmune diseases Hashimoto's disease, Systemic lupus erythematosus, Multiple sclerosis, Myasthenia gravis and their treatment. Immunomodulation(immunosuppression & immunostimulation), Immunotherapy, lymphocyte migration, homing and trafficking, antigen-induced lymphocyte proliferation, Granulysin mediated anti-microbial activity of T cells.

8 Hours

Unit 6: Immunological Techniques: Agglutination, precipitation, immune-fluorescence, immunoelectrophoresis, immunoblotting, ELISA, RIA, Flow cytometry. Production and purification of antibodies, determination of antibody titre by RID and EID, production of hybridoma.

T-cell cloning: Mechanism of antigen recognition by T and B -lymphocytes, Importance of antigen and MHC class II molecules in T-cell cloning. Antigen specific and alloreactive T-cell cloning - immunologically relevant antigens and T cell subtypes. [Applications in vaccine development.](#)

8 Hours

Unit 7: Immunization: [Vaccines-conventional, peptide vaccines, subunit, DNA vaccines. Toxoids, antisera, edible vaccines, plantibodies, ISCOMs, recombinant antibodies, Immune stimulatory complexes. Common immunization programmes-BCG, small pox, DPT, polio, measles, Hepatitis-B.](#)

4 Hours

References:

1. Abdul, K., Abbas, Andrew K. L., Jordan, S. P. (1998). Cellular and Molecular Immunology. Sanders College Pub.
2. Benjamine, E., Cocoi., Sunshine. (2000). Immunology 4 th edition-Wiley-Liss. Publ. NY.
3. Borrebacc, C.A.K. (1995). Antibody Engineering, 2 eidtion. Oxford University Press.
4. Dimmock, N.J., Primrose, S.B. (1994). Introduction to Modern Virology, Blackwell Science Ltd.Oxfird. nd
5. Hyde, R.M. (1992). Immunology, 2 edition, Williams and Wilkins, Baltimore. th
6. Kuby, J. (2003). Immunology 5 Edition. WH. Freeman and Company, NY.
7. Klaus D. Elgert (1996). Immunology. ELBS, Blackwell Scientific Publishers, London.
8. Roitt, I.M. (1998). Essential Immunology, ELBS, Blackwell Scientific Publishers, London.
9. Richard A., Goldsby, Thomas, J., Kindt, Barbara, A., Osborne (2000). Kuby th Immunology, 4 edition. W.H. Freeman and Company, NY. th
10. Tizard I.R.(1995). Immunology, 4 edition, Saunder College Pub.
11. William E Paul (1989). Fundamentals in Immunology, Raven Press. NY.

MBT-204: ENVIRONMENTAL BIOTECHNOLOGY

Total Hours: 52

Unit 1

Environment and monitoring: Introduction, renewable and non-renewable sources of energy; Environmental pollution-water pollution, soil pollution and air pollution-sources. Xenobiotic compounds and their sources, Biomagnification, Bioindicators. Biomonitoring: Biosensors and biochips.

8 Hours

Unit 2

Water Management and waste water treatment: Water as a scarce natural resource, water management including rain water harvesting. Waste water characteristics, waste water treatment-physical, chemical, biological processes. Aerobic processes; Activated sludge, oxidation ditches, trickling filter, oxidation ponds; Anaerobic processes; Anaerobic digestion, anaerobic filters, anaerobic sludge, membrane bioreactors. Reverse osmosis and ultra filtration. Treatment of industrial effluents.

12 Hours

Unit 3

Biomining and Biodiesel: Bioleaching of ores to retrieve scarce metals, Bio-mining;. Biodiesel production from Jatropa, Pongamia and Castor.

4 Hours

Unit 4

Bioremediation: Concept and principles, Bioremediation using microbes, In situ and ex situ bioremediation, biosorption and bioaccumulation of heavy metals; Phytoremediation, bioremediation of xenobiotics (heavy metals, pesticides, oil slicks, plastic). Bioremediation of soil and water contaminated with hydrocarbons and surfactants, biofilms.

8 Hours

Unit 5

Biowaste treatment: Microorganisms involved in the degradation of plant fibre, cell wall, lignin, fungal de-lignification and pulping of wood. Pitch problems in pulp and paper processes and solving by enzymes or fungi. Hemicellulases in pulp bleaching. Solving slime problem in the pulp and paper industry. Reduction of organochlorine compounds in bleach plant effluents. Solid wastes: Sources and management, waste as a source of energy. Production of oils and fuels from solid waste, composting, vermiculture, Biogas production, methanol production from organic wastes, byproducts of sugar industries.

12 Hours

Unit 6

Global environmental problems: Global warming, ozone depletion, UV-B, green house effect and acid rain, their impact and management. Biodiversity and its conservation, status of biodiversity, hotspots, Red data book.

8 Hours

References:

1. Allsopp D and K.J Seal., Introduction to Biodeterioration-ELBS/Edward Arnold. 1999
2. Christon, J. Harst Manual of Environment Microbiology, ASM Press, Washington DC.1997.
3. Ericksson Ed., Biotechnology in the pulp and paper industry, Springer –Verleg.1997
4. Hurst CJ et al. eds., Environmental Microbiology, ASM Press, Washington, D.C. 1997
5. Larry Anderson and David A. Tilman., Fuels from waste, Academic Press. 1997.
6. Whitaker J R and S.Philip. Biocatalysis in agricultural Biotechnology, Washington ACS.1989
7. Jordening H J and Josef Winter Environmental biotechnology: concepts and applications nd (2 Ed.) Wiley & Sons Publishers.UK.2005 st
8. Daniel Vallero., Environmental Biotechnology: A Biosystems Approach (1 Ed.) Academic press. New York. 2010 9.
- Wang LK. Handbook of Environmental Engineering (1 Ed.) Springer Publishers.2010
10. Evans G G and Judy Furlong., Environmental Biotechnology: Theory and Application (2 Ed.).Wiley publishers. 2011
11. Wang L.K., Ivanov V., Tay J.H., HungY.T (2010) Handbook of Environmental Engineering (1 Ed.) Springer Publishers
12. Gareth G. Evans, Judy Furlong (2010) Environmental Biotechnology: Theory and Application (2 Ed.).Wiley publishers.

MBT-205 BIOINFORMATICS
(Soft core)

Total Hours: 26

Unit 1

Introduction to Computer: Computer softwares-operating system-Windows, UNIX, Linux, Application software-word processor, spread sheet. Introduction to statistical software (SPSS).

2 Hours

Unit 2

Computer Network and Programming Languages: Structure, architecture, Advantages, types (LAN, MAN & WAN), Network protocols-Internal protocol (TCP/IP), File transfer protocols (FTP), WWW, HTTP, HTML, URL. Network Security-Group policies Fire-walls. C Programming and PERL-Algorithm and flowchart, Structure of C program, Header file, Global declaration, Main function, variable declarations, Control statement-conditional and unconditional -sub functions. Introduction to PERL, Application of Bioperl.

6 Hours

Unit 2

Databases: Introduction -Relational Databases Management (RDMS) -Oracle, SQL, Database generation.

3 Hours

Unit 3

Biological Databases: Datamining and applications, accessing bibliographic databases-Pubmed, Nucleic acid sequence databank – NCBI and EMBL. Protein sequencedatabankNBRF-PIR, SWISSPROT. Structural databases -protein data Bank (PDB). Metabolic pathway data bank (Pub gene), Microbial genomic database (MBGD), Cell line database (ATCC), Virus data bank (UICTVdb). Sequence alignment -Global and Local alignment, scoring matrices. Restriction mapping -NEB CUTTER, Similarity searching (FASTA and BLAST), Pair wise comparison of sequences, Multiple Sequence alignment of sequences, Identification of genes in genomes and Phylogenetic analysis with reference to nucleic acids and protein sequences, Identification of ORFs, Identification of motifs.

10 Hours

Unit 4

Protein Structure and Molecular Interaction: Introduction to protein structure -secondary structure prediction, tertiary structure prediction, protein modelling-principles of homology and comparative modelling. Threading, structure evaluation and validation and ab initio Modelling, Applications -Molecular docking -Autodoc .

5 H

References:

1. Dhananjaya (2002). Introduction to Bioinformatics, www.sd-bio.com series

2. Jan (2001). Nucleic acid research, Genome Database issue
3. Higgins & Taylor (2000). Bioinformatics, OUP.
4. Baxavanis (1998). Bioinformatics.
5. Fry, J.C. (1993). Biological Data Analysis. A practical Approach. IRL Press, Oxford.
6. Swardlaw, A.C. (1985). Practical Statistics for Experimental Biologists

II SEMESTER (PRACTICAL)
MBT-206: ENZYMOLOGY AND IMMUNOLOGY

Total Units: 16

1. Isolation and assay of alpha-amylase activity from saliva
2. Isolation and assay of urease from horse gram or kidney gram
3. Isolation and assay of acid phosphatase from sweet potato
4. Determination of K_m and V_{max}
5. Effect of pH and temperature on enzyme activity
6. Determination of specific activity of an enzyme
7. Molecular weight determination of a protein by gel electrophoresis
8. Immobilization of enzyme (Urease/Amylase)
9. Partial purification of IgG by ammonium sulphate fractionation and Dialysis
10. Purification of IgG by column chromatography
11. Serum separation and serological reactions (a) agglutination (b) precipitation
12. Enzyme linked immunosorbant assay
13. Isolation of lymphocytes from peripheral blood
14. Ouchterlony double diffusion
15. Single radial immunodiffusion
16. Rocket immunoelectrophoresis

MBT-207 MOLECULAR BIOLOGY AND ENVIRONMENTAL BIOTECHNOLOGY

Total Units: 16

1. Estimation of DNA by diphenyl amine method
2. Estimation of RNA by orcinol method
3. Isolation of Genomic DNA and agarose gel electrophoresis
4. Isolation of Plasmid DNA and agarose gel electrophoresis
5. Preparation of competent cells and transformation by calcium chloride method and calculation of transformation efficiency
6. Study of conjugation in E.coli
7. Study of transduction in E.coli
8. Searching bibliographic databases for relevant information. Sequence retrieval from nucleic acid and protein databases
9. Determination of total dissolved solids, BOD and COD of water sample
10. Estimation of Chromium in Industrial effluent by colorimetry
11. Estimation of Calcium in water sample by titration method
12. Isolation of bacteriophages from sewage
13. Sludge analysis (a) Organic matter, (b) Nitrogen (c) Phosphorous (d) Potassium
14. Biodegradation of industrial aromatic compounds
15. Determination of Phosphate and nitrate from sewage samples
16. Microbial analysis of water-MPN

III SEMESTER (THEORY)
MBT 301: PLANT AND AGRICULTURAL BIOTECHNOLOGY

Total Hours 52

Unit 1 10 Hours

Plant Cell and Tissue Culture: Scope of plant tissue culture- Media composition and types, hormones and growth regulators, organogenesis, Micro propagation, somatic embryogenesis. Plant cell culture for the production of useful chemicals and secondary metabolites (Hairy root culture, Biotransformation, Elicitation). Plant tissue culture in crop improvement. Somaclonal variation and cell line selection, production of haploid plants and homozygous cell lines. Protoplast culture and somatic hybridization. Cryopreservation, germplasm collection and conservation, plant tissue culture certification.

Unit 2 08 Hours

Plant Transformation Techniques: Mechanism of DNA transfer - *Agrobacterium* mediated gene transfer, Ti and Ri plasmids as vectors, role of virulence genes; design of expression vectors; Binary (pBin 19) and co-integrative vector. Marker genes for transformant selection, viral vectors. Direct gene transfer methods- particle bombardment, electroporation and microinjection. Transgene stability and gene silencing.

Unit 3 07 Hours

Metabolic Engineering of Plants: Production of pigments, flavonoids, alkaloids; mechanism and manipulation of Shikimate pathway.

Biodegradable plastics and antibiotics using transgenic technology. Modification of plant oils: production of medium chain and long chain fatty acids, PUFA Oil, Golden rice.

Unit 4 05 Hours

Molecular Farming in Plants: Production of plant antibodies, therapeutic proteins, edible vaccines and Industrial enzymes.

Unit 5 06 Hours

Plant Development: Plant growth regulators, auxins, gibberellins, cytokinins, abscisic acid, acetylene. Biological nitrogen fixation- importance and mechanism.

Biofertilizers-types, production. VAM, *Rhizobium*, *Azotobacter*, Mycorrhiza, Actinorhiza. Vermicomposting technology. Biopesticides.

Unit 6 10 Hours

GM Technology: Crop improvement, productivity, performance and fortification of agricultural products-Bt cotton, Bt brinjal. Herbicide resistance, viral resistance, bacterial resistance, fungal resistance crops. Strategies for engineering stress tolerance. transgenic plants; Current status of transgenic plants in India and other countries, Ethical issues associated with GM crops and GM food; labeling of GM plants and products. Importance of integrated pest management and terminator gene technology. Environmental impact of herbicide resistance crops and super weeds.

Unit 7 06 Hours

Post Harvest Technology: RNAi and antisense RNA technology for extending shelf life of fruits and flowers (ACC synthase gene and polygalacturonase); delay of softening and ripening of fleshy fruits (tomato, banana, watermelons). Post-harvest protection of cereals, millets and pulses.

References

1. Adrian Slater A, Nigel W. Scott Mark R. Fowler Plant Biotechnology: The Genetic Manipulation of Plants 2nd Edition. 2010
2. Chawla H.S. Introduction to Plant Biotechnology. Science Publishers. 2004.
3. Chrispeels M.J.et al. Plants, Genes and Agriculture-Jones and Bartlett Publishers, Boston.1994.
4. Christou, P and Klee H. Handbook of Plant Biotechnology (Vol. I & II). John Wiley Publishers. 2004
5. Gamborg O.L. and Philips G. Plant Cell, Tissue and Organ Culture (2nd Ed.) Narosa Publishing House. New Delhi.1998
6. Halford N.G. Plant Biotechnology: Current and future applications of genetically modified crops. John Wiley Publishers. 2006
7. Hammound J, P McGravey and Yusibov.V. Plant Biotechnology, Springer verlag.2000
8. Kirakosyan A and Kaufman P.B. Recent Advances in Plant Biotechnology (1st Ed.).Springer Publishers.2009
9. Lydiane Kyte and John Kleyn. Plants from test tubes. An introduction to Micro propagation (3rd Ed.). Timber Press, Portland. 1996
10. Murray D.R. Advanced Methods in Plant Breeding and Biotechnology. Panima Publishing Corporation.1996
11. Nickoloff J.A. Methods in Molecular Biology, Plant Cell Electroporation and Electrofusion Protocols-Humana press in corp, USA. 1995.
12. Sawahel W.A. Plant Genetic Transformation Technology. Daya Publishing House, New Delhi.1997.

MBT-302: ANIMAL BIOTECHNOLOGY

Total Hours: 52

Unit 1

Animal Cell Culture: Introduction, cell culture laboratory-design, layout and maintenance. Equipment and Instrumentation. Methods of sterilization, types of culture media, composition, preparation and metabolic functions. Role of CO₂, Serum, supplements, growth factors (EGF, PDGF, NGF, Gap-43). Serum and protein free defined media. Culture and maintenance of primary and established cell lines. Biology of cultured cells culture environment, cell adhesion, cell proliferation and differentiation. Characterization of cultured cells, viability, cytotoxicity, growth parameters, cell death and Apoptosis. Expression of culture efficiency.

15 Hours

Unit 2

Stem cells and Tissue Engineering: Scope, embryonic and adult stem cells, properties, identification, stem cells culture, techniques and their applications in modern clinical sciences. Tissue engineering, biomaterials used in tissue engineering, three dimensional culture and transplantation of engineered cells. Tissue engineering -skin, bone and neuronal tissues.

7 Hours

Unit 3

Transgenic Animals and Animal cloning: Methods involved in the production of transgenic animals, importance and applications of transgenic animals. Gene knock out and mice models for tackling human diseases. Animal cloning: methods of cloning and their importance with reference to domestic animals. IVF-technology for live stock and humans.

10 Hours

Unit 4

Applications of Animal Biotechnology: Improvement of biomass (Fish, Cattle and Poultry), disease resistant, recombinant vaccines for poultry, live stock-pharming products. Pharmaceutical products produced by mammalian cells -plasminogen activator, erythropoietin, blood clotting factors, glycoprotein hormones, interleukins, interferons, Cell culture based vaccines.

8 Hours

Unit 5

Bioethics: Bioethics in Biodiversity, ethics of resource management, impact of patenting on biodiversity rich developing countries. Ethical issues associated with consumptions of genetically modified foods. Ethical implication of human genome project, international ethical and legal issues connected with human genome diversity research. Genetic studies of ethnic races. Use of cell cultures as alternative for animal models for research. Testing of drugs on human volunteers, use of animals for research and testing; animal and human cloning-ethical and social issues, organ transplantation and xeno transplantation.

6 Hours

Unit 6

Biosafety: The Cartagena protocol on biosafety. Biosafety management: Key to the environmentally responsible use of biotechnology. Ethical implications of biotechnological products and techniques. Social and ethical implications of biological weapons. Biosafety regulations and national and international guidelines with regard to rDNA technology, transgenic science, GM crops,. [Experimental protocol approvals, levels of containment](#). [Guidelines for research in transgenic plants](#). [Good manufacturing practice and Good lab practices \(GMP and GLP\)](#). [Use of genetically modified organisms \(crippling organisms\) and their release to environment](#).

6 Hours

References:

1. Ballin C.A., Philips J.P and Moo Young M. Animal Biotechnology. Pergamon press, New York. 1989.
2. Watson J.D. et al. Molecular Biology of Gene (6th Ed.) Publisher Benjamin Cummings. 2007.
3. Berger S. L. and A.R. Kimmel. Methods in enzymology guide to molecular cloning techniques (Vol 152). Academic Press Inc. San Diego. 1996
4. Glick, B.R. and Pasternak J.J. Molecular Biotechnology. ASM Press, Washington DC. 2003.
5. Jenni, P., Mather and David Barnes, Methods in Cell Biology (Vol 57) Academic Press. 2001
6. Ratledge, C. and B. Kristiansen, Basic Biotechnology. Cambridge Univ. Press, London. 2001
7. Watson J.D. et al. Molecular Biology of the Gene (6th Ed), The Benjamin Cummings Pub. Co. Inc. USA. 2008
8. Shantharam, D., Jane F Montgomery. Biotechnology, Biosafety & Biodiversity: Scientific & Ethical issues for Sustainable development. 1999
9. Jan Freshney. R. Culture of Animal Cells: A Manual of Basic Technique and Specialized Applications (6th Ed.) Wiley & Sons. 2010
10. John Davis., Animal Cell Culture: Essential Methods (1st Ed.) Wiley-Blackwell and Sons publisher. 2011
11. Ernst-L Winnacker, From Genes to Clones: Introduction to Gene Technology. WILEY-VCH Verlag GmbH, Weinheim, Germany Reprinted by Panima Publishing Corporation, New Delhi. 2003.

MBT-303 GENETIC ENGINEERING

Total Hours: 52

UNIT 1

2 HOURS

Introduction to Genetic Engineering:

Scope and importance of Genetic Engineering.

UNIT 2

14 Hours

Tools of Genetic Engineering: Enzymes; Non-specific endo & exo nucleases, DNase, RNase. Restriction modification; restriction endonucleases- types, nomenclature, recognition sequences and mechanism of action. **Methylation, RNA modification.** Role of Kinases, phosphatases, polynucleotide phosphorylase, polynucleotide kinases. Ligases - types and mechanism of action. Vectors: General characteristics of vectors, Brief account of naturally occurring plasmids. Promoter, MCS, Ori, and marker genes-lac Z. **Construction of pBR 322, pBR325, pUC 18 and 19 vectors and expression vectors. M13 derived vectors, Lambda based vectors, cosmids, phagemids, minichromosomes, BACs, YACs, Shuttle vectors, Ti plasmids, vectors for animals-SV40 and Bovine papilloma virus. E.coli promoters, lac promoter, trp promoter, lambda pL promoter, hybrid tac promoter, ribosome binding site, codon selection. Insertional inactivation,**

UNIT 3

Gene Cloning Strategies and Construction of Gene Libraries:

14 Hours

Cloning from mRNA: Isolation and purification of RNA, synthesis of cDNA, Isolation of plasmids, cloning cDNA in plasmid vectors, cloning cDNA in bacteriophage vectors. cDNA library. Cloning of genomic DNA: Isolation and purification of DNA, preparation of DNA fragments and cloning. Construction of genomic libraries (Using λ gt 10 and 11 vector). *In vitro* packaging of λ phage. Use of adaptors and linkers, homopolymer tailing in cDNA cloning,

Selection, screening and analysis of recombinants: Chromogenic substrates, complementation of defined mutations, nucleic acid hybridization, screening methods for cloned libraries-Direct and Indirect, PCR screening protocols, immunological screening, restriction mapping of cloned gene, DNA sequencing methods. Purification strategies of expressed His- tagged proteins.

UNIT 4

8 Hours

Transformation Techniques: Purification of vector DNA, restriction digestion, end modification, transformation screening, selection, expression and preservation. Transformation and transfection techniques, preparation of competent cells of bacteria, chemical methods calcium phosphate precipitation method, liposome mediated method, physical methods- Electroporation, gene gun method. Transformation and transfection efficiency. Expression of cloned DNA molecules.

UNIT 5

8 Hours

Labelling and Detection Techniques: Labeling of DNA, RNA and Proteins by radioactive isotopes, non-radioactive labeling, in vivo labeling, autoradiography and autofluorography. Agarose gel electrophoresis, PAGE, PFGE. Methods of nucleic acid hybridization; Southern, Northern and Western Blotting techniques.

UNIT 6

6 Hours

Chemical Synthesis of Genes and PCR: Phosphodiester, phosphotriester and Phosphite ester methods, principles and strategies. Oligonucleotide synthesis and application, synthesis of complete gene. PCR, methodology, essential features of PCR, primers, Taq polymerases, reverse transcriptase-PCR, types of PCR-Nested, inverse, RAPD-PCR, RT-PCR (real time PCR), Applications of PCR.

References:

1. Nicholl D.S.T. Introduction to Genetic Engineering Cambridge (3Rd Ed.) University press.UK. 2008
2. Old R.W., Primrose S.B. Principles of gene manipulation - An introduction to genetic engineering (5th Ed.), Blackwell Scientific Publications, UK. 1996.
3. David S L. Genetics to Gene Therapy – the molecular pathology of human disease (1st Ed.) BIOS scientific publishers, 1994.
4. Ernst-L Winnacker, From Genes to Clones: Introduction to Gene Technology. WILEY-VCH Verlag GmbH, Weinheim, Germany Reprinted by Panima Publishing Corporation, New Delhi. 2003
5. Benjamin Lewis, Genes VIII (3rd Ed.) Oxford University & Cell Press,NY.2004
6. Robert Williamson.Genetic Engineering (1st Ed.) Academic Press.1981.USA
7. Rodriguez. R.L (Author), Denhardt D.T. Vectors: A Survey of Molecular Cloning Vectors and Their Uses (1st Ed.) Butterworth-Heinemann publisher.UK. 1987
8. Sambrook J et al. Molecular cloning Volumes I, II and III. Cold Spring Harbor laboratory Press, New York, USA. (1989, 2000)
9. Terence A Brown. Genomes, (2nd Ed.) BioScientific Publishers.UK.2002
10. S. B. Primrose, Richard M. Twyman.Principles of gene manipulation and genomics (7th Ed.) John Wiley & Sons publishers.2006

OPEN ELECTIVE
OPEBT-4: BIOTECHNOLOGY

Total Hours: 52

Unit-1

Bioprocess Engineering

Introduction to biotechnology: Scope of biotechnology, industrial biotechnology, Bioreactors:

Typical structure of Bioreactor and their working mechanism; Fermentation media and Fermentation Process: Natural and synthetic media. Types of fermentation processes- Industrially important products: Ethanol, citric acid, penicillin, riboflavin, amylase, protease, biodegradable plastic: Fermented foods

8 Hours

Unit -2

Plant and Agricultural Biotechnology

Plant tissue culture, micropropagation, transgenic plants, crop improvement, Bt cotton, Bt brinjal, golden rice, production of enzymes, biodegradable plastics, therapeutic proteins, edible vaccines.

8 Hours

Unit-3

Animal Biotechnology

Animal cell culture, stem cells and tissue engineering, transgenic animals, IVF technology for livestock improvement, biofarming, pharmaceutical products, plasminogen activator, blood clotting factors, interleukins, vaccines.

8 Hours

Unit-4

Medical Biotechnology

Microbial diseases of humans: AIDS, Hepatitis B, Rabies, Typhoid, STDs, Tb, plague, malaria, amoebiasis, tumors, treatment of cancer, diabetes, anemia, gene therapy

8 Hours

Unit-5

Environmental Biotechnology

Pollution : Air, water, soil , Bio-indicators, waste water management, treatment, bioremediation, biodegradation, biowaste treatment, global warming, ozone depletion, acid rain

8 Hours

Unit-6

Nanobiotechnology

Introduction, types, DNA, protein based applications, nanobiosensors, drug and gene delivery, risk potential of nano molecules

6 Hours

Unit-7

IPR, patenting of biotech products, examples: turmeric, basmati rice, neem, Bioethics, ethical issues related to consumption of GM crops, ethical implication of Human Genome Project

6 Hours

References:

1. Kuby, J. (2003). Immunology 5th Edition. WH. Freeman and Company, NY.
2. Roitt, I.M. (1998). Essential Immunology, ELBS, Blackwell Scientific Publishers, London.
3. Gistou, P and Klu, H. Hand book of Plant Biotechnology (Vol. I & II). John Publication. 2004
4. Halford N.G. Plant biotechnology: current and future applications of genetically modified crops. John Wiley Publishers. 2006
5. Ballin C.A., Philips J.P and Moo Young M. Animal Biotechnology. Pergamon press, New York. 1989.
6. Watson J.D. et al. Molecular Biology of Gene (6th Ed.) Publisher Benjamin Cummings. 2007.
7. Ratledge, C. and B. Kristiansen, Basic Biotechnology. Cambridge Univ. Press, London. 2001
8. David S L. Genetics to Gene Therapy – the molecular pathology of human disease (1st Ed.) BIOS scientific publishers, 1994.
9. Prescott, Sc and Dunn, C. Industrial Microbiology, McGraw Hill, New York. 1984
10. Santaniello V, Evenson RE, Zilberman D and Carlson GA, Agriculture and Intellectual property rights: Economic, Institutional and Implementation Issues in Biotechnology, University Press. 2003
11. S N Jogdand Medical Biotechnology 2nd Edition Himalaya publishers 2008
12. Niemeyer C.M. and Mirkin C.A, Introduction to Nanobiotechnology, Wiley VCH publishers 2003

III SEMESTER (PRACTICAL)
MBT-304: PLANT, AGRICULTURAL AND ANIMAL BIOTECHNOLOGY

Total Units: 16

1. Preparation of plant tissue culture media and Organ culture (Shoot tip, nodal and leaf culture).
2. Callus culture: Initiation and regeneration.
3. Anther culture for the production of haploids.
4. Isolation, culture and fusion of protoplasts.
5. Isolation of plant genomic DNA from pea shoot tip/ Cauliflower by CTAB method.
6. Agrobacterium culture, selection of transformants.
7. Suspension culture and production, separation and estimation of secondary metabolites β -carotene from carrot and anthocyanin from beetroot.
8. Study of VAM, isolation of spores, arbuscles and vesicles from roots.
9. VAM culture
10. Organic farming and Mushroom Cultivation
11. Study and culture of biocontrol agents (*Trichoderma viridae*, *Trichoderma harzianum*, *Aspergillus awamori*)
12. Animal cell culture: Preparation of (serum and non serum supplemented) media, cell culture, assessment of viability and counting using trypan blue exclusion method
13. Primary culture of fibroblast cells.
14. Determination of GST enzyme activity in cytotoxicity induced cells.
15. Estimation of lipid peroxidase (Malondialdehyde) in cytotoxicity induced cells.
16. MTT assay for cell viability and growth.

MBT-305: GENETIC ENGINEERING AND BIOINFORMATICS

Total Units: 16

1. Isolation of genomic DNA from bacterial source & DNA amplification by PCR.
2. Electrophoresis of restriction digested plasmid DNA, Restriction mapping and determination of molecular weight of digested DNA fragment.
3. Ligation of DNA and analysis by electrophoresis.
4. Preparation of competent cells and transformation by CaCl₂ method and Selection of Transformed colony by X-Gal method.
5. Determination of molecular weight of proteins by SDS PAGE and analysis by Western blotting
6. Analysis of DNA by Southern blotting
7. Labelling of proteins by dinitrofluorobenzene and analysis
8. Isolation of total RNA and analysis by formaldehyde gel electrophoresis
9. Restriction mapping, Sequence (FASTA and BLAST) searches.
10. Pair wise comparison of sequences, multiple alignments of sequences.
11. Evolutionary studies / Phylogenetic analysis.
12. Identification of genes in Genomes and Primer Design
13. Protein databank retrieval and visualization Ros mol
14. Ramachandran plot-secondary structure prediction of proteins.
15. Introduction to Auto doc
16. Calculation of SD, Variance and plotting the graph by using MS Excel

IV SEMESTER (THEORY)

MBT-401: BIOPROCESS TECHNOLOGY

Total Hours: 52

Unit-1: 03 Hours

Introduction: Scope and importance of bioprocess technology, Microbial culture: Screening and selection for fermentation processes; Preservation of industrially important microorganisms. Strain development: general, mutation, selection of mutants, recombination.

Unit-2: 09 Hours

Media formulation and Fermentation Process: Natural media, synthetic media-Strategies. Sources of carbon, nitrogen and vitamins. Role of buffers, precursors, inhibitors, inducers and antifoam agents. Batch culture, continuous culture and fed-batch culture. Kinetics of fermentation process. Submerged fermentation, surface or solid state fermentation. Monitoring of variables-temperature, agitation, pH and pressure. Scale up of fermentation process, scale down methods for fermentation.

Unit-3: 09 Hours

Bioreactors: Typical structure of advanced Bioreactor and its working mechanism; Design features; Heat transfer and Mass transfer; Specialised bioreactors- design and their functions; Airlift bioreactors, Tubular bioreactors, Membrane bioreactors, Tower bioreactors, Fluidized bed bioreactors, Packed bed reactors and Photo bioreactors.

Unit-4: 08 Hours

Downstream processing: Cell disruption, precipitation methods, solid-liquid separation, liquid-liquid extraction, filtration, centrifugation, chromatography, drying devices (Lyophilization and spray dry technology), crystallization, biosensors-construction and applications.

Unit 5: 05 Hours

Immobilization and Biotransformation: Methods of immobilization, adsorption, cross linking, ionic bonding, entrapment, encapsulation; Advantages and industrial applications of Immobilization of enzymes and whole cells.

Biotransformation of antibiotics, steroids and their applications.

Unit 6: 11 Hours

Production of Industrially important products: Alcohol: Ethanol, glycerol, butanol; Acetone; Organic acids: citric, acetic, and gluconic acid; Amino acids: lysine, glutamic acid; Antibiotics: penicillin, streptomycin, tetracycline; Vitamins: riboflavin, Enzymes: amylase, protease, Biodegradable plastic: polyhydroxyalkanoates (butyrate, propionate.); Recombinant protein- Insulin, hepatitis-B vaccine. Single-cell proteins
Fermented foods-sausages, olives, bread, idly and acidophilus milk.

Unit 7: 07 Hours

Intellectual Property Rights (IPRs) and Entrepreneurship: IPRs- implications for India, WTO, WIPO, GATT, TRIPS. Basic principles and general requirements of patent law-Biotechnological inventions and patent law-Legal development-Patentable subjects and protection in biotechnology. Entrepreneurship - Potential entrepreneurship activities in biotechnology, product development, marketing, research and training units. Industrial licensing, venture capital, Biotechnology Industries in India and the potential job opportunities.

References:

1. Cinar A, J Sathish. "Batch Fermentation Modelling: Monitoring and Control" (2003).
2. Crueger CW, "A Textbook of Industrial Microbiology" 2nd Ed. Panima Publishing Corporation, (2000).
3. Mansi EMTEL, Bryle CFA. "Fermentation Microbiology and Biotechnology", (2nd Ed). Taylor & Francis Ltd, UK, (2007).
4. Michael J. Waites, Neil L. Morgan, John S. Rockey, Gary Higton. "Industrial Microbiology: An Introduction". Blackwell Science. (2001).
5. Michael L. Shuler and Fikret Kargi. "Bioprocess Engineering: Basic concepts" (2nd Ed.) Prentice Hall Publishers. (2001).
6. Moser A. Bioprocess Technology- Kinetics and Reactors. 1st Edition. Springer-Verlag (1988).
7. Nduka Okafor. "Modern Industrial Microbiology and Biotechnology". Science Publishers (2007).
8. Patel A.H. "Industrial Microbiology" 2nd Edition. Trinity Press. (2016).
9. Paul A. Belter, E.L. Cussler, Wei-Shou Hu "Bioseparations: Downstream Processing for Biotechnology". Wiley Publishers. (1988).
10. Peter F. Stanbury, Stephen J. Hall and A. Whitaker, "Principles of Fermentation Technology", Elsevier India Pvt Ltd. (2007).
11. Ravindra P. "Advances in Bioprocess Technology". Springer. (2015)
12. Samuel Cate Prescott and Cecil Gordon Dunn. "Industrial Microbiology", McGraw Hill, New York. (1984)
13. Sibi G. "Industrial Microbiology and Biotechnology". Himalaya Publishing House (2018).

MBT-402 MEDICAL AND PHARMACEUTICAL BIOTECHNOLOGY

Total Hours: 52

Unit 1

Microbial Diseases of Humans: mode of infection, symptoms, detection, epidemiology and control measures of disease caused by Viruses (AIDS, Hepatitis-B, Rabies, HSV-1) Bacteria (Typhoid, STD, TB, Plague) Fungi (Aspergillosis, Histoplasmosis, Cryptococcosis) Protozoa (Malaria, Amoebiasis)

8 Hours

Unit 2

Cancer Biology: Tumors, types of tumors, pre-disposing factors, cellular changes involved in tumor formation, genes associated with cancer (oncogenes, tumor suppressive genes etc.), methods of tumor detection, tumor markers, treatment of cancer-chemo therapy, radio therapy, immunotherapy and gene therapy.

6 Hours

Unit 3

Human Diseases: Symptoms and treatment of the Genetically inherited diseases: PKU, Alkaptonuria, Galactosemia, Von Gierke disease, Lesch-Nyhan syndrome, Gout, Sickle cell anemia, Beta Thalassemia and Diabetes

Evaluation of organ functions: liver, kidney, cardiac and gastric function tests. Significance of biochemical markers-amino transferases, creatine kinase, LDH, amylase and α -glutamyl transpeptidase

8 Hours

Unit 4

Nanobiotechnology: introduction, types and synthesis of nanomaterials, protein-based nano structures, DNA-based nano structures, Applications of nanomaterials, nanobiosensors, drug and gene delivery, disease diagnostics and therapy, risk potential of nanomaterials.

6 Hours

Unit-5

Molecular therapeutics: Drugs, drug receptors, Relationship between drug concentration and response, agonists, drug clearance, biological half life, drugs accumulation, basic concepts of toxic effect. Gene therapy, barriers to gene delivery, overview of inherited and acquired diseases for gene therapy; Retro and adeno virus mediated gene transfer; Liposome mediated gene delivery. Cellular therapy; use of stem cells. Recombinant therapy; Erythropoietin; Insulin analogs and its role in diabetes. Streptokinase and urokinase in thrombosis.

10 Hours

Unit 6

Drug discovery: Introduction, conventional drug design approaches, irrational Vs rational, Lipinski's rule of five, ADME, Calculation of LD 50 and ED 50. Acute, subacute and chronic toxicity studies. Irwin profile test, Drug development process (Preclinical, clinical and toxicological studies). Novel Drug Development approaches QSAR (quantitative structure activity relationship), Highthroughput screening.

6 Hours

Unit 7

Clinical Research: Past, Present and future Importance, Mile stones of regulations. FDA, US, Indian clinical research, global scenario of clinical research, Regulatory agency.

Designing clinical trials-History, principles, scheme for conducting clinical trials, planning defining, objectives, variables, study populations, testable hypothesis, prediction of errors and bioselection of appropriate study design, Execution steps.

Ethical Issues in clinical research-Introduction, codes, declaration and guidelines, Informed consent, special issues, Roles and responsibilities of IRBS, issues with ethics review. ICH-GCP- History of ICH, Objectives, ICH structure, Guidelines, Future of ICH.

8 Hours

References:

1. Judit Pongracz and Mary Keen, Medical Biotechnology 1st Edition, Elsevier publications, 2008
2. S N Jogdand Medical Biotechnology 2nd Edition Himalaya publishers 2008
3. Keith Wilson & John Walker, Practical Biochemistry-5th edition, Cambridge University Press, UK 2000
4. Bartram G. Katzung, Basic & Clinical Pharmacology, 9th Edition, Mc Graw Hill Publications 2004
5. Devlin TM, Text book of biochemistry with Clinical Correlations 5th edition 2002
6. Richard B Silverman, Organic Chemistry of Drug design and Drug action Elsevier Science, Academic Press
7. Warren Levinson, Ernest Jawetz, Medical Microbiology and Immunology: Examination and Board Review 7th edn. McGraw Hill Publications 2003
8. Jawetz, Melnuk and Adelgerg, Medical Microbiology, Appleton & Lange pub 1971.

MBT-403 GENOMICS AND PROTEOMICS

Total Hours: 52

UNIT 1

Introduction: Concept of genomics, structural genomics, Functional Genomics, Transcriptomics, RNAmics proteomics, and metabolomics.

4 Hours

UNIT 2

Genomics: Genome sequencing, Fluorescence method, automated sequencing, shot-gun approach. Clone contig method, Genome sequencing projects of E.coli., yeast, and human genome project. Next generation sequencing

Genome sequence data bases, expressed sequenced tags (ESTs), Gene variation and Single Nucleotide Polymorphisms (SNPs), disease association, diagnostic genes and drug targets, genotyping -DNA Chips, diagnostic assays, Genome sequence analysis. Principle, salient features & drawbacks of methods of gene prediction / gene modeling: GRAIL, GENEMARK, GLIMMER. Promoter prediction methods.

10 hours

UNIT 3

Genome Analysis, Genome Organization and Structure: C-Values of genomes, Repetitive and coding sequences, Genetic and physical maps, Methods of physical mapping. Molecular markers, Hybridization based markers restriction fragment length polymorphism (RFLP.s), random amplification of polymorphic DNA (RAPD.s) and amplified fragment length polymorphisms (AFLP). Multiple arbitrary amplicon profiling using short oligonucleotide primers, SCAR, micro satellites and other markers, length polymorphisms in simple sequences repeats (SSR and ISSR). Approaches to mapping, fluorescence in-situ hybridization (FISH) -DNA amplification markers; Telomerase as molecular markers, T-DNA tagging, Transposon tagging, General structural features of Viral and Bacterial genomes. Organization of E.coli genome, Arabidopsis genome, Rice genome, Human genome, Unusual structure of Y chromosome, Chloroplast and Mitochondrial genomes. Commercializing the genomics, polymorphisms.

15 Hours

Unit 4

Functional and Comparative Genomics: Transcriptomes-transcripts of a tissue, use of Northern blot, subtractive and additive library, Rnase protection assay, RT-PCR, Analysis of steady state gene expression by EST tags and cDNA library, Microarray techniques, sequence analysis of gene expression (SAGE). Massively parallel signature sequencing (MPSS), Expression profiling in human diseases. Orthologs, homologs, paralogs, gene evolution, protein evolution by exon shuffling, comparative genomics of closely related bacteria.

5 Hours

UNIT 5

Proteomics: Expression analysis and characterization of proteins-separation of proteins-2D PAGE (2DGE), multiplexed analysis, multidimensional liquid chromatography, high throughput screening by Mass spectrometry, MALDI-TOF, peptide fingerprinting, protein micro array-antibody arrays, antigen arrays, general protein arrays, biochips.

Analysis of protein structures-Sequence analysis by Tandem Mass Spectrometry, structure prediction, X-ray, NMR and CD and Bio-informatic approaches.

Protein-protein interactions-genetic, comparative genomic, biochemical approaches. Large scale analysis of protein intractions-yeast two hybrid interaction screens, post-translational modification analysis, proteomics databases & analysis.

10 Hours

UNIT 6

Metabolomics: Concepts, Levels of metabolite analysis, metabolomics in humans, sample selection and handling, over view of different methods used for analysis of metabolites. Metabolic regulation network at genome level, Basic concept of metabolic engineering.

8 Hours

References:

1. Peter M Gresshoff .Plant Genome Analysis (1 Ed.), CRC Press.UK.1994 st
2. John R S Finchman. Genetic Analysis – Principles, Scope and Objectives (1 Ed.). Blackwell Science. Singapore.1994.
3. Smith D.W. Biocomputing Informatics and the Genome Projects (1st Ed.) AcademicPress.USA.1993. th
4. Benjamin Lewis. Genes VIII (7 Ed.). Oxford University & Cell Press.UK.1999 th
5. Benjamin Lewis. Genes IX (9 Ed.). Jones and Bartlett publishres.USA. 2007 th
6. Blackwell publishers.UK.2007 st
7. Dubitzky W et al. Fundamentals of data mining in genomics and proteomics (1 Ed.) Springer publishres.USA.2007 nd
8. Liebler D C. Introduction to Proteomics-Tools for the New Biology (2 Ed.).John R. Humana Press Totowa. NJ. 2002 nd
9. Terence A. B. Genomes (2 Ed.).Bios Scientific Publishers.UK.2002 th
10. Griffiths AJF. An Introduction to Genetic Analysis (7 Ed.). W. H. Freeman publisher. NY.2000 st
11. Michel Blot. Prokaryotic Genomics (1 Ed.) Springer publishers.2002
12. Josip Lovric Introducing Proteomics: From concepts to sample separation, mass spectrometry and data analysis. Wiley-Blackwell publishers.UK.2011 st
13. Richard Twyman, Principles of Proteomics (1 Ed.).Wiley-Blackwell publishers.UK.2004

IV SEMESTER (PRACTICAL)

MBT-404: BIOPROCESS TECHNOLOGY AND MEDICAL AND PHARMACEUTICAL BIOTECHNOLOGY

Total Units: 16

1. Study of fermentor-Demonstration.
2. Production and isolation of antibiotics (Penicillin and Streptomycin)
3. Production and analysis of Single cell protein (Spirulina and yeast).
4. Production of yoghurt and estimation of lactic acid at different time intervals.
5. Production of wine – estimation of percentage of alcohol, total acidity & volatile acidity in wine.
6. Production and assay of α -amylase from *Aspergillus niger*.
7. Effect of temperature & pH on enzyme activity (Catalase in potato)
8. Kinetics of growth in batch cultivation- estimation of Monod kinetic parameters
9. Purification and assay of alpha amylase by simple precipitation using sodium sulphate and organic solvents.
10. Blood urea analysis by diacetyl monoxyme method
11. Analysis of acid and alkaline phosphatase from serum samples
12. Estimation of serum cholesterol
13. Assay of SGOT & SGPT enzyme activity
14. Blood sugar analysis by Folin -Wu method
15. Estimation of Creatinine from urine samples
16. Visit to industries/Biotech park-report to be submitted along with the record



Department of Life Sciences

Genetics

PEOs	Programme Educational Objectives
PEO1	To prepare graduates who can exhibit quality of excellence, critical thinking, creativity, inventiveness and self-motivation.
PEO2	To produce graduates who are globally acceptable professionals for academic and research organizations along with entrepreneurial skills.
PEO3	To groom graduates who can demonstrate competence and problem solving abilities in the field of Life sciences.
PEO4	To produce graduates who can lead and work as a team with high ethical standards.
PEO5	To enable the graduates pursue multiple professional pursuits and enhance their own achievements while serving the society at large.

PO	Programme Outcomes
PO1	Develop comprehensive knowledge and understanding in the field of Life Sciences.
PO2	Inculcate complex problem solving ability using analytical thinking, reasoning, and creativity along with good communication skills.
PO3	Demonstrate research related skills along with coordinating and collaborating abilities.
PO4	Develop leadership abilities with a knowledge of time management, community engagement and service.
PO5	Demonstrate capability to use advanced digital and technological skills for the benefit of society.

PSOs	Programme Specific Outcomes
PSO1	To analyze how Biotechnology and Genetic concepts address broad societal issues including health and diseases, bioremediation, biofuel production etc.
PSO2	To provide hands on experience in molecular biology and genetic engineering techniques, thus enabling the students to begin their career in industry and research laboratories.
PSO3	To demonstrate various tools and techniques in the field of biotechnology and applied genetics research. Identify the appropriate strategies to solve problems with respect to agriculture, medicine and environment.
PSO4	To imbibe a robust interdisciplinary knowledge base and practical skill sets in molecular diagnostics, recombinant proteins, vaccines, crop improvement and transgenic technology suitable for academia and industry.
PSO5	To equip students with expertise in laboratory, computational and analytical proficiencies indispensable for research and development.



MATRIX AND SYLLABUS

For the Programme B.Sc. (Genetics & Biotechnology)

Genetics

NEP Based Curriculum (2021 onwards)

I Semester

NEP- Curriculum Framework for Approval

B.Sc. (Genetics & Biotechnology) - Matrix for I Semester (w.e.f. 2023-24 onwards)

I Semester							
Code	Course Code	Course	Teaching Hours	Course Components			Credits
				L	T	P	
AECC	S21KN 1.1/ S21HN 1.1/ S21AE 1.1	Language I (Kannada/Hindi/Additional English)	45	3	1	-	3
AECC	S21GE 1.1	Language II (Generic English)	60	3	1	-	3
DSC1	S23GN 1.1	Principles of Genetics (Theory)	60	4	-	-	4
DSC 1	S23GN 1.2	Principles of Genetics (Practical)	60	-	-	4	2
DSC 1	S23BT 1.1	Cell Biology (Theory)	60	4	-	-	4
DSC 1	S23BT 1.2	Cell Biology (Practical)	60	-	-	4	2
OE-1	S23OE/ S21OE	Genes and Diseases/ Biotechnology for Human Welfare	45	2	1	-	3
SEC-SB	21SBC 1.1	Digital Fluency-I	30	1	-	2	2
SEC-VB	21VBC 1.1	Health and Well-being	30	-	-	2	1
SEC-VB	21VBC 1.2	Yoga	30	-	-	2	1
Total							25

Note 1:

AECC- Ability Enhancement Compulsory Course

DSC - Discipline-Specific Course

OE- Open elective (course offered by the department to students of other stream)

DSE – Discipline-Specific Elective

SEC - VB Skill Enhancement Course -Value Based

SEC - SB Skill Enhancement Course -Skill Based

Continuous Internal Assessment – Scheme of Evaluation

For Theory Courses

End Semester Examination: 60%

Continuous Internal Assessment: 40%

Activities (CIA: 40 Marks)	Proposed and Approved Scheme		Total Marks (40)
	IA-1	IA-2	
Session Test Maximum Marks	30	30	
1. Weightage (Marks)	10	10	20
2. Assignment (Marks)	20		20
i. Writing	10		
ii.Quiz / Presentation / Creating diagrams /charts / Classwork / Case study / Viva / Field work etc.	05		
iii. Classroom participation	05		
Total			40

Continuous Internal Assessment
Scheme of Evaluation for Practical Courses
End-Semester Examination: 50%
Continuous Internal Assessment: 50%

CIA (25 marks) + End Semester Exam (25 marks)	
Maximum Marks (Internal Assessment)	25
1. Weightage (Marks)	15
2. Record work (Marks)	05
3. Quiz/Presentation/creating diagrams/ charts/Lab work/	05
Total (Marks)	25

S23 GN 1.1: PRINCIPLES OF GENETICS

THEORY

Total Teaching Hours: 60

No. of Hours per Week: 4

(4 credits)

CObj	Course Objectives
CObj_1	To provide comprehensive understanding of the historical development of Genetics as a scientific discipline and its significance in modern biology and to introduce students to Mendel's laws of inheritance and their applications in understanding genetic patterns and traits in various organisms.
CObj_2	To familiarize with the concept of gene interaction and how multiple genes can influence the expression of a trait.
CObj_3	To understand the structure and organization of chromosomes in prokaryotic and eukaryotic cells and their roles in inheritance and genetic stability and to comprehend the mechanisms and factors involved in sex determination in different organisms.

CO	Course Outcomes
	After completion of this course, students should be able to:
CO1	Explain the historical milestones in the field of genetics, the contributions of key scientists to its development and to apply Mendel's laws to predict and analyze patterns of inheritance for single gene traits in various organisms.
CO2	Describe different types of gene interactions (e.g., dominance, co-dominance, epistasis) and their impact on phenotype and analyze and interpret genetic data involving multiple alleles at a gene locus.
CO3	Compare and contrast the structure of prokaryotic and eukaryotic chromosomes, understanding their differences and functions and describe karyotype and ideogram.
CO4	Elucidate the features of polytene chromosomes, lampbrush chromosomes and B chromosomes.
CO5	Analyze the mechanisms of sex determination in different organisms, including the role of sex chromosomes and environmental factors.

CO-PO Mapping

	PO_1	PO_2	PO_3	PO_4	PO_5	PSO_ 1	PSO_ 2	PSO_3	PSO_4	PSO_ 5
CO_1	X		X		X	X	X	X	X	
CO_2	X	X	X	X				X	X	X
CO_3	X	X		X	X	X	X		X	
CO_4	X			X	X				X	X
CO_5	X				X	X	X		X	X

Course Content

Sl. No.	Unit/chapter title	Content	Number of hours	Skills developed
1	Unit- I	- Definition and scope of Genetics. Pre Mendelian genetic concepts- Moist Vapour theory, Reproductive Blood theory, Preformation theory, theory of Epigenesis, theory of acquired characters, theory of Pangenesis, Germplasm theory. - Heredity and environment, genotype and phenotype, heredity and variation. - Clones, purelines and inbred lines. Norms of reaction and phenocopies. - Biography of Mendel and his experiments. Law of Segregation: Monohybrid cross, Back cross and Test cross, Genetic Problems. Law of Independent Assortment: Dihybrid cross, Back cross and Test cross, Genetic Problems.	15 Hrs	Cognitive/ Transferrable/ Analytical skills
2	Unit- II	Multiple Alleles: Definition, ABO blood groups and Rh factor in Human, Genetic Problems. Gene Interactions: Deviations from Mendelism: Incomplete dominance and co-dominance, Complementary gene interaction (Ex: <i>Lathyrus odoratus</i>- 9:7), Supplementary gene interaction (Ex. Grain color in Maize- 9:3:4), Recessive Epistasis (Ex: Coat color in Mice- 9:3:4) , Dominant Epistasis (Ex: Fruit color in <i>Cucurbita pepo</i>- 12:3:1), Inter allelic Non-Epistasis (Collaborator gene- Comb pattern in fowl – 9:3:3:1).	15 Hrs	Cognitive/ Analytical skills
3	Unit- III	Physical Basis of inheritance: Chromosome theory of inheritance. - Prokaryotic Chromosome: Structure and Organization. Eukaryotic Chromosome: Macromolecular organisation, Primary and Secondary constriction, Sat – bodies, telomeres. - Differences between Prokaryotic and Eukaryotic Chromosomes.	15 Hrs	Cognitive/ Research /Analytical/ Transferrable skills

		• Heterochromatin and Euchromatin and its significance. • Ultra Structure of Chromosome: Nucleosome model and Nucleosome Structure. • Karyotype and Idiogram. • Special types of Chromosome: Polytene chromosome – Salivary gland chromosome in <i>Drosophila</i>. Lampbrush chromosome in amphibian Oocyte. B Chromosome.		
4	Unit- IV	• Sex Determination: Chromosomal theory of sex determination- XX-XY; XX-XO and ZZ-ZW., Genic balance theory of Bridges, role of Y chromosome in <i>Melandrium</i>. • Environmental influence on sex determination. • Hormonal control of sex determination (free martin). • Gynandromorphs. • Sex differentiation and dosage compensation(<i>Drosophila</i> & Man).	15 Hrs	Cognitive/ Research /Analytical/ skills

Books for Reference:

1. Pierce, B. A. (2019). Genetics: a conceptual approach. 7th Edition. W. H. Freeman
2. Brooker, Robert J. (2021). Concepts of Genetics. 4th Edition. McGraw-Hill.
3. Gupta, P.K. (2010). Cytogenetics. Rastogi Publications, Meerut, India.
4. Hartl, Daniel L., and Elizabeth W. Jones. (2017). Genetics: Analysis of genes and genomes. 9th Edition. Jones & Bartlett Learning.
5. Hartwell, L. H., Golberg, M.L and Fischer, J.A. (2014) . McGraw-Hill Education.
6. Lewin, B., Krebs, J., Kilpatrick, S. T., & Goldstein, E. S. (2017). Lewin's genes XII. 12th Edition. Jones & Bartlett Learning.
7. Lewin, B.,. (1997). Genes VI. Oxford University Press.
8. Snustad, D. P., & Simmons, M. J. (2015). Principles of genetics. John Wiley & Sons.
9. Sumner, A.T. (2008). Chromosomes: Organization and Function. Blackwell Publishing, USA.
10. Mark, H. F. L. (2000). Medical Cytogenetics, CRC Press Inc.
11. Hamerton, J. L. Human Cytogenetics. Vols. I &II. Academic Press, N.Y

Web Resources:

1. <https://openoregon.pressbooks.pub/mhccmajorsbio/chapter/introduction-to-genetics-mt-hood-community-college-biology-102/>
2. <https://www.nature.com/scitable/topicpage/gregor-mendel-and-the-principles-of-inheritance-593/>

Journals:

1. Nature Genetics
2. Annual Review of Genetics
3. Genes

S23 GN 1.2: PRINCIPLES OF GENETICS**PRACTICAL****Total Teaching Hours: 60****No. of Hours per Week: 4****(2 credits)**

Sl. No.	Unit/chapter title	Content	Number of hours	Skills developed
1	Module 1	Pre-treating, fixing agents and stains for cytological preparations.	04 Hrs	Research/ Employable skills
2	Module 2	Study of Meiosis using flower buds/grasshopper testes.	12 Hrs	Cognitive/ Research skills
3	Module 3	Culturing and handling of <i>Drosophila</i> .	08 Hrs	Cognitive/ Research skills
4	Module 4	Life cycle of <i>Drosophila melanogaster</i> .	04 Hrs	Research/ Analytical skills
5	Module 5	Mounting of sex comb of <i>Drosophila melanogaster</i>	04 Hrs	Research/ Analytical skills
6	Module 6	Preparation of salivary gland chromosomes in <i>Drosophila</i> larvae.	12 Hrs	Cognitive/ Research skills
7	Module 7	Blood typing in humans for multiple alleles and Rh factor.	04 Hrs	Analytical/ Transferrable skills
8	Module 8	Study of gene interaction: a) Flower colour in <i>Mirabilis</i> and <i>Antirrhinum</i> b) Coat colour in mice c) Comb pattern in fowl	04 Hrs	Cognitive/ Analytical skills
9	Module 9	Genetic Problems: a) Multiple alleles b) Gene interactions	04 Hrs	Analytical/ problem solving skill
10	Module 10	Study of Karyotypes –Normal Karyotypes in Humans	04 Hrs	Cognitive/ Analytical skills

Books for Reference:

1. Worku, M. (2019). Laboratory Manual for Principles of Genetics. LAP Lambert Academic Publishing.
2. Gupta, B.R. (2017). Laboratory Manual for Principles of Animal and Population Genetics. Copal Publishing Group.

S23OE1: GENES AND DISEASES**Total Teaching Hours: 45****No. of Hours per Week: 3****(3 credits)**

CObj	Course Objectives
CObj_1	To understand the basics of genetics and heredity without technical jargon.
CObj_2	To recognize the genetic basis of various common diseases and conditions and make informed decisions regarding their own health and genetic testing.
CObj_3	To appreciate the ethical and societal implications of genetic research and healthcare.

CO	Course Outcomes
	After completion of this course, students should be able to:
CO1	Elucidate the role of genes in determining traits and characteristics.
CO2	Identify genetic factors contributing to common health issues and diseases.
CO3	Discuss the societal and ethical aspects of genetic testing and research.
CO4	Critically evaluate health-related information from a genetic perspective.
CO5	Engage in informed discussions and make well-reasoned decisions about genetic health topics.

CO-PO Mapping

	PO_1	PO_2	PO_3	PO_4	PO_5	PSO_1	PSO_2	PSO_3	PSO_4	PSO_5
CO_1	X	X				X		X		
CO_2			X			X	X	X		
CO_3		X		X				X	X	X
CO_4										
CO_5	X	X			X	X	X			X

Course Content

Sl. No	Unit/chapter title	Content	Number of Hours	Skills Developed
1.	Unit- I Introduction to Genetics	● Genetics and its Relevance: Overview of the course, Genes and importance of genes, Historical perspectives on genetics. Common genetic terminologies. ● Inheritance and Traits: Inheritance of traits are from parents to offspring, Nature vs. nurture.	11 Hrs	Cognitive/ Analytical / Life skills
2.	Unit- II Genetic Diversity and Population	● Genetic Diversity and Populations: Genetic diversity and individual differences, Genetic diversity in human populations, Ancestry and identity through genetics, Phylogenetics. ● Genetic Testing and Personal Health: Different types of genetic tests, Pros and cons of direct-to-consumer genetic testing, Interpretation of genetic health reports- case studies	11 Hrs	Transferrable/ Employable/ Analytical Life skills
3.	Unit- III Fundamental Concepts of Genetic Disorders	● Genetic Diseases: The Basics: Common genetic diseases and conditions, Genetics behind inherited diseases, Genetic testing and diagnosis. ● Genetics and Common Health Issues: The genetic factors in common health problems (e.g., heart disease, diabetes, obesity). ● Lifestyle and environment's role in gene expression. ● Case studies.	11 Hrs	Transferrable/ Employable/ Life skills
4.	Unit- IV Ethical and Societal Implications	● Moral and Social Consequences: Ethical considerations in genetic research and healthcare, Genetic discrimination and privacy concerns, Genetic counseling and patient rights. ● Applying Genetics to Your Life: Recent developments in genetic research and HealthCare, Practical	12 Hrs	Transferrable/ Cognitive/ Analytical skills

		applications of genetic knowledge, Making informed health decisions, Case studies and group discussions.		

Books for Reference:

1. Lewis (2021), Human Genetics, 13th edition. Publisher: McGraw-Hill.
2. Cummings (2016) Human Heredity, 11th edition. Publisher: Cengage.
3. Lodish, H et al.(2016), Molecular Cell Biology. 8th Edition. W.H Freeman
4. Willard and Haga. (2022).The Book of Genes and Genomes. Springer.
5. Strachan, T. and Read, A. P. (2018). Human Molecular Genetics. Garland Science.

Web Resources:

1. <https://www.ncbi.nlm.nih.gov/books/NBK22183/>
2. <https://genomemedicine.biomedcentral.com/articles/10.1186/gm77>

Journals:

- 1.The Journal of Genetic Medicine
2. Journal of Biochemical and Clinical Genetics

MATRIX AND SYLLABUS

For the Programme B.Sc. (Genetics & Biotechnology)

Genetics

NEP Based Curriculum (2021 onwards)

II Semester

NEP- Curriculum Framework for Approval

B.Sc. (Genetics & Biotechnology) - Matrix for II Semester (w.e.f. 2023-24 onwards)

II Semester							
Code	Course Code	Course	Teaching Hours	Course Components			Credits
				L	T	P	
AECC	S21KN 2.1/ S21HN 2.1/ S21AE 2.1	Language I (Kannada/Hindi/Additional English)	45	3	1	-	3
AECC	S21GE 2.1	Language II (Generic English)	60	3	1	-	3
AECC	21SBC 2.1	Environmental Studies	45	2	1	-	3
DSC2	S21GN 2.1	Bioinstrumentation and Animal Cell Culture (Theory)	60	4	-	-	4
DSC2	S21GN 2.2	Bioinstrumentation and Animal Cell Culture (Practical)	60	-	-	4	2
DSC2	S21BT 2.1	Microbiology (Theory)	60	4	-	-	4
DSC2	S21BT 2.2	Microbiology (Practical)	60	-	-	4	2
OE-2	S23OE/ S21OE	Health and Lifestyles / Applications of Biotechnology in Agriculture	45	2	1	-	3
SEC-VB	21VBC 2.1	NCC/NSS/Cultural	30	-	-	2	1
SEC-VB	21VBC 2.2	Sports	30	-	-	2	1
Total							26

Note 1:

AECC- Ability Enhancement Compulsory Course

DSC - Discipline-Specific Course

OE- Open elective (course offered by the department to students of other stream)

SEC - VB Skill Enhancement Course -Value Based

SEC - SB Skill Enhancement Course -Skill Based

Continuous Internal Assessment – Scheme of Evaluation

For Theory Courses

End Semester Examination: 60%

Continuous Internal Assessment: 40%

Activities (CIA: 40 Marks)	Proposed and Approved Scheme		Total Marks (40)
	IA-1	IA-2	
Session Test Maximum Marks	30	30	
1. Weightage (Marks)	10	10	20
2. Assignment (Marks)	20		20
i. Writing	10		
ii.Quiz / Presentation / Creating diagrams /charts / Classwork / Case study / Viva / Field work etc.	05		
iii. Classroom participation	05		
Total			40

Continuous Internal Assessment
Scheme of Evaluation for Practical Courses
End-Semester Examination: 50%
Continuous Internal Assessment: 50%

CIA (25 marks) + End Semester Exam (25 marks)	
Maximum Marks (Internal Assessment)	25
1. Weightage (Marks)	15
2. Record work (Marks)	05
3. Quiz/Presentation/creating diagrams/ charts/Lab work/	05
Total (Marks)	25

S21 GN 2.1: BIOINSTRUMENTATION AND ANIMAL CELL CULTURE

THEORY

Total Teaching Hours: 60

No. of Hours per Week: 4

(4 credits)

CObj	Course Objectives
CObj_1	To provide students with a comprehensive understanding of the principles underlying bioinstrumentation, including the design and application of instruments used in biological research and analysis.
CObj_2	To equip students with the skills and knowledge necessary for successful cultivation and maintenance of animal cells in <i>in vitro</i> .
CObj_3	To foster an interdisciplinary approach by teaching students how to integrate bioinstrumentation techniques with animal cell culture processes, enabling them to design experiments and analyze biological samples using appropriate instruments.

CO	Course Outcomes
	After completion of this course, students should be able to:
CO1	Explain the principles and applications of various bioinstruments used in biological research and industry. Demonstrate proficiency in bioinstrumentation showcasing adeptness in experimental setup and data acquisition.
CO2	Apply cell culture techniques in ensuring the successful cultivation and manipulation of animal cells in a laboratory setting.
CO3	Design and execute experiments that involve the integration of bioinstrumentation and animal cell culture.
CO4	Analyze data obtained from bioinstrumentation and cell culture experiments, demonstrating the ability to interpret results critically.
CO5	Apply critical thinking skills to troubleshoot issues that may arise during bioinstrumentation experiments or cell culture processes.

CO-PO Mapping

	PO_1	PO_2	PO_3	PO_4	PO_5	PSO_1	PSO_2	PSO_3	PSO_4	PSO_5
CO_1	X	X	X	X	X	X	X	X	X	X
CO_2	X	X	X						X	X
CO_3		X	X	X	X		X	X		
CO_4		X			X		X			X
CO_5		X			X			X		X

Course Content

Sl. No.	Unit/chapter title	Content	Number of hours	Skills developed
1	Unit- I	• Microscopy: Introduction and principle • Types of microscopes: Simple and Compound microscopes, Light microscopes, Fluorescence, electron microscopy (transmission and scanning), Phase contrast, Confocal, Stereo microscopy. • Uses of microscopy and biological applications: High resolution imaging, immunohistochemistry, Medical science, Forensic laboratories. • Different types of sterilization methods: Autoclave, steam sterilizers, dry heat sterilizers and ovens and UV chambers.	15 Hrs	Evaluation/ Transferrable/ Cognitive/ Research/ Life skills
2	Unit- II	Analytical Instruments: • pH meter: Principle and components of pH meter. • Thermometer: Principle, types of thermometers-digital, mercury, strip-type, Infrared. • Colorimeter: Principles and applications. • Spectroscopy: Beer-Lambert's Law in spectrometry, UV spectrophotometers, Atomic absorption spectroscopy (AAS), Electron Spin Resonance (ESR), Nuclear Magnetic Resonance (NMR).	15 Hrs	Evaluation/ Transferrable/ Cognitive / Employable skills
3	Unit- III	Instruments used in separation techniques: • Centrifugation: Principle and applications of centrifuge, types of centrifuge- ultra-centrifuge, Refrigerated centrifuge. • Chromatography: Principle and application of Chromatography, types- ion exchange, gel filtration, HPLC, affinity chromatography, GC-MS.	15 Hrs	Employable/ Transferrable/ Analytical/ Research/ Life skills

		• Electrophoresis: Principle and applications of electrophoresis. Types of electrophoresis: vertical and horizontal.		
4	Unit- IV	Animal cell culture: • Principles of cell culture, cell types, cell lines, Primary culture, secondary culture, cryopreservation, contaminations, organotypic culture. Organoid culture, 2D & 3D cultures and co-culture. • Requirements in Animal Cell Culture: Equipment used in Cell culture, Culture vessels, Aseptic techniques. • Cell culture media: Natural and defined, role and components of serum in culture. <i>In vitro</i> transformation of animal cells, Types of cell culture. • Applications of cell culture: Cell culture in biomedical research-karyological studies, amniocentesis, mutagenesis, Cytotoxicity assays.	15 Hrs	Transferrable/ Employable/ Analytical skills

Books for Reference:

1. Alberts, B., Johnson, A., & Lewis, J et al. (2014). Molecular Biology of the Cell. 4th edition, New York: Garland Science.
2. Lodish, H., Berk, A., & Zipursky, S. L., et al (2016). Molecular Cell Biology, 4th Edition. New York: W.H. Freeman.
3. Freshney R., (2015), Culture of Animal Cells-A Manual of Basic Technique and specialized Applications. 7th Edition, Wiley Blackwell.
4. Davis J.M. (2011). Animal Cell Culture: Essential Methods, John Wiley & Sons Ltd.
5. Ninfa, A. J. & Ballou, D. J. (1998). Fundamental Laboratory Approaches for Biochemistry and Biotechnology, 2nd Edition. Wiley.
6. Sambrook, J. & Russell, D. W. (2012), Molecular Cloning: A Laboratory Manual. 4th Edition. Cold Spring Harbor Laboratory Press.
7. Bronzino, J. D., (1986). Biomedical engineering and instrumentation. PWS Publishing Co.
8. Willard, H. H., Merritt, L. L., Dean, J. A., and Settle, F.A. (1986). Instrumental Methods of Analysis. 7th Edition. CBS Publishers & Distributors.
9. Sharma, B. K., (2008). Instrumental Methods of Analysis. Goel Publishing house.
10. Sharma Y.R., (2013). Elementary Organic Spectroscopy, S.Chand & company Ltd. New Delhi.

Web Resources:

1. <https://www.sciencedirect.com/topics/biochemistry-genetics-and-molecular-biology/centrifugation>
2. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7325846/>
3. <https://www.atcc.org/resources/culture-guides/animal-cell-culture-guide>

Journals:

1. Introduction to Biomedical Engineering.
2. Journal of Bioengineering & Biomedical Science
3. Biomedical Instrumentation and Technology.

S21 GN 2.2: BIOINSTRUMENTATION AND ANIMAL CELL CULTURE**PRACTICAL****Total Teaching Hours: 60****No. of Hours per Week: 4****(2 credits)**

Sl. No.	Unit/chapter title	Content	Number of hours	Skills developed
1	Module 1	Demonstration of optical Components of microscope: Eye piece, Eye piece tube, Nose piece, Objective lenses, Coarse and Fine Focus knobs, Stage and stage clips, Aperture, Illuminator, Condenser, Condenser Focus Knob, Iris Diaphragm.	08 Hrs	Cognitive/ Research skills
2	Module 2	Fluorescence Microscopy: viewing cells stained with fluorescent dyes.	08 Hrs	Research/ Transferrable/ Employable skills
3	Module 3	Demonstration of experiments on, laser scanning, Phase contrast, confocal and scanning electron microscopy.	08 Hrs	Employable/ Cognitive/ Analytical/ Research skills
4	Module 4	Preparation of buffers using pH meter.	08 Hrs	Transferrable/ Employable/ Analytical skills
5	Module 5	Temperature recording using Thermometer	08 Hrs	Transferrable/ Employable/ Analytical skills
6	Module 6	Colorimetric estimation of proteins: Protein estimation by Bradford reagent.	04 Hrs	Analytical/ Research skills
7	Module 7	Demonstration of Beer-Lambert's Law in spectrometry.	04 Hrs	Employable/ Analytical skills
8	Module 8	Recording ultraviolet absorption spectra for DNA.	04 Hrs	Employable/ Analytical skills

9	Module 9	Demonstration of UV spectrophotometers, Atomic absorption spectroscopy, Electron Spin Resonance (ESR), Nuclear Magnetic Resonance (NMR) Spectrophotometers, Flame photometer.	04 Hrs	Research/ Transferrable/ Employable skills
10	Module 10	Chromatography: Paper chromatography and TLC, size exclusion	04 Hrs	Research/ Transferrable skills

Books for Reference:

1. Prasad, R. K., Rai, A., & Singh, K. (2021). Instrumental Methods of Analysis (Lab Manual). Book Rix Publishers.
2. Khare, E., & Rastogi, S. R. (2023). Practical Manual of Instrumental Analysis of Methods. Narain Publishers & Distributors
3. ATCC Animal Cell Culture Guide.
4. Capes, A., Davis, R.,. Freshney, I A. (2021). Freshney's Culture of Animal Cells: A Manual of Basic Technique and Specialized Applications, 8th Edition. Wiley-Blackwell.
5. Freshney I A.,(2010). Culture of Animal Cells: A Manual of Basic Technique and Specialized Applications. John Wiley & Sons, Inc.

S23OE-2: HEALTH AND LIFESTYLES

THEORY

Total Teaching Hours: 45

No. of Hours per Week: 3

(3 credits)

CObj	Course Objectives
CObj_1	To build the knowledge on health & lifestyle management and help to better manage their social and psychological dimensions of life.
CObj_2	To evaluate nutrition and meal planning principles in selection, planning, preparation and serving of meals that meet specific nutritional needs and analyses the results of a fitness assessment to create and implement a personal fitness plan
CObj_3	To acquire knowledge and comprehension of topics related to health, nutrition, and various aspects of lifestyle, encompassing mental and emotional well-being, as well as the diseases associated with these areas.

CO	Course Outcomes
	After completion of this course, students should be able to:
CO1	Describe dimensions of health and concepts of wellness and identify the major physical and psychological health concerns.
CO2	Analyze the basic principles of nutrition and ways to obtain and maintain a healthy body composition.
CO3	Evaluate the nutritional habits with lifestyle management and be able to design, implement, and self-assess a personal nutrition and fitness plan.
CO4	Prepare to interconnect the mental, emotional, and physical well-being, and explore strategies for a holistic approach to health.
CO5	Develop an own thinking, opinions and attitudes to global health issues.

CO-PO Mapping

	PO_1	PO_2	PO_3	PO_4	PO_5	PSO_1	PSO_2	PSO_3	PSO_4	PSO_5
CO_1	X	X				X		X		
CO_2	X				X	X			X	
CO_3		X	X	X		X		X		X
CO_4	X			X		X			X	
CO_5		X	X		X		X	X		X

Course Content

Sl. No	Unit/chapter title	Content	Number of Hours	Skills Developed
1.	Unit-I Introduction to Health	● Introduction to Health: Definition and Change in paradigm in health and lifestyles, Components and spectrum of health, Role of lifestyle habits on health. ● Importance of health in adulthood: Stages, Characteristics and changes during adulthood; Nutritional needs; Eating Habits – eating disorders, skipping breakfast, junk food consumption.	11 Hrs	Cognitive/ Research/ Transferrable skills
2.	Unit –II Nutrition Management	● Nutrition Management: The food pyramid, components of nutrition-carbohydrates, fibre, protein, fat and types of fat and label reading. Supplements, eating disorders, anorexia nervosa and bulimia nervosa. ● Food and Nutritional Requirements during adulthood: Fluid intake; nutrition related problems; lifestyle related problems, Role of physical activity; resting pattern and postures, Personal habits – alcoholism, and other tobacco products, electronic addiction. ● case studies	11 Hrs	Evaluation/ Analytical/ Employable skills
3.	Unit-III Weight and Lifestyle Management	● Weight Management: Medical, Physical, Nutritional, Psycho-social and behavioural aspects of health and illness, Importance of Body Mass Index (BMI), skin-fold test, nutritional habits. ● Lifestyle Management: Evolutionary causes of diseases, lifestyle related diseases- Cardiovascular disease, diabetes, obesity, hypertension, cancers, HIV and AIDS working on wellness (WOW) and overview of WOW- dimensions of wellness model.	11 Hrs	Evaluation/ Analytical/ Employable skills
4.	Unit -IV Stress Management And Well-being	● Introduction to Stress: Definition, types of stress and stress management methods. Yoga, Meditation, Music Therapy, Aroma therapy, development of hobbies. Practical examples /case studies. ● Managing Mental Health: The importance of self-concept, self-esteem, self-efficacy, and self-efficiency, Defining sadness and	12 Hrs	Transferrable / Employable/ Analytical/ Life skills

		depression and the effect on behaviour. Positive case studies. ● Ways to Foster Wellness: Definition and pathways to wellness-mindfulness walk & talk - experiencing natural movement to cultivate mindfulness and a wakeful presence. Movement to Music - learning how music can stimulate the body's natural feel good endorphins, providing an outlet to control feelings, Self-Care - learning to manage your own health, actively preserving or improving mental or physical health, Soul Food - identifying the importance of core nutrients to keep the brain and body healthy.		

Books for Reference:

1. Robbins, G., Powers, D., & Burgess, S. (2011). A Wellness Way of Life, 9th edition. McGraw-Hill Education.
2. Barlow, T. W., Rapee, & Perin. (2014), 10 Steps to Mastering Stress: A Lifestyle Approach, USA.
3. Clayton, M., (2011). Brilliant stress management How to manage stress in any situation's 1st Edition. Great Britain Pearson Education.
4. Yoke, M. (2001). A Guide to personal fitness training. Aerobics and fitness association of America.
5. Matheny, K. B. (1992). Stress And Strategies for Lifestyle Management. Georgia State University Business Press.
6. Park, K. (2011). Textbook of Preventive and Social Medicine. Banarsidas Bhanot Publishers.

Web Resources:

1. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4703222/>
2. <https://www.nature.com/articles/s41562-023-01624-7>
3. <https://www.nature.com/articles/s41430-022-01230-2>

Journals:

1. Journal of Health and Social Behavior
2. Journal of Health Science
3. American Journal of Lifestyle Medicine: Sage Journals

NEP Choice Based Curriculum

PEOs	Programme Educational Objectives
PEO1	To prepare graduates who can exhibit quality of excellence, critical thinking, creativity, inventiveness and self motivation.
PEO2	To produce graduates who are globally acceptable professionals for academic and research organisations along with entrepreneurial skills.
PEO3	To groom graduates who can demonstrate competence and problem solving abilities in the field of Life sciences.
PEO4	To produce graduates who can lead and work as a team with high ethical standards.
PEO5	To enable the graduates pursue multiple professional pursuits and enhance their own achievements while serving the society at large.

PO	Programme Outcomes
PO1	Develop comprehensive knowledge and understanding in the field of Life sciences.
PO2	Inculcate complex problem solving ability using analytical thinking, reasoning, creativity along with good communication skills.
PO3	Demonstrate research related skills along with coordinating and collaborating abilities.
PO4	Develop leadership abilities with a knowledge of time management, community engagement and service.
PO5	Demonstrate capability to use advanced digital and technological skills for the benefit of society.

PSOs	Programme Specific Outcomes (B.Sc.)
PSO1	Develop a robust interdisciplinary knowledge base and practical skill set suitable for diverse careers, spanning academia, research, pharmaceuticals, healthcare, biomanufacturing, and the ever-evolving biotechnology landscape.
PSO2	Equip students with the necessary laboratory, computational, and analytical proficiencies indispensable for research, development, and production in the dynamic realms of biochemistry and biotechnology.

AECC	LAN 4.1	Kannada / Functional Kannada	45	2	1	-	3
AECC	LAN 4.2	English / Hindi	45	2	1	-	3
AECC	EVS 4.3	Constitution of India	30	-	2	-	2
DSC4	S21 BC 4.1	Analytical Biochemistry	60	4	-	-	4
DSC4	S21 BC 4.2	Analytical Biochemistry – Practical- 4	60	-	-	2	2
DSC4	S21 BT 4.1	Molecular Biology	60	4	-	-	4
DSC4	S21 BT 4.2	Molecular Biology (Practical)	60	-	-	2	2
OEC	OEBC4.1	Nutraceuticals and functional foods	45	-	2	1	3
SEC-4	VBC 4.1	Sports	15	-	-	1	1
SEC-5	VBC 4.2	NCC/NSS/Cultural	15	-	-	1	1
Total							25

Exit Option with DIPLOMA IN _____ (100 Credits)

AECC- Ability Enhancement Compulsory Courses, DSC- Discipline Specific Course, VBC- Value based Course, SEC- Skill Enhancement Course, DSE- Discipline Specific Elective, OE- Open Elective

**Continuous Internal Assessment – Scheme of Evaluation for
Theory Courses**

End Semester Examination: 60%

Continuous Internal Assessment: 40%

Activities (CIA: 40 Marks)	Proposed and Approved Scheme		Total Marks (40)
	IA-1	IA-2	
Session Test Maximum Marks	30	30	
1. Weightage (Marks)	10	10	20
2. Assignment (Marks)	20		20
i. Writing	10		10
ii.Snap Quiz / Oral Viva Voce (T)/Reflective Essay	05		05
iii. Classroom participation	05		05
Total			40

**Continuous Internal Assessment – Scheme of EvaluationFor
Practical Courses**

End-Semester Examination: 50%

Continuous Internal Assessment: 50%

CIA (25 marks) + End Semester Exam (25 marks)	
Maximum Marks (Internal Assessment)	25
1. Weightage (Marks)	15
2. Record work (Marks)	05
3. Quiz/Presentation/creating diagrams/charts/Lab work/	05
Total (Marks)	25

SEMESTER – III

Course Code: S21 BT 3.1

Course Name: Biomolecules

Total Teaching Hours: 60

No. of Hours / Week: 4

CObj	Course Objectives
CObj_1	To familiarize the students with the principal biomolecules.
CObj_2	To familiarize the students with the basic knowledge about the functioning of specialized molecules like enzymes and hormones.
CObj_3	To provide the students with the basic concept of biophysics and familiarize them with methodologies employed to detect and quantitate different biomolecules.

CO	Course Outcomes
CO1	The students will gain fundamental knowledge about the structure and chemistry of the principal biomolecules like carbohydrates, proteins and lipids as well as the importance of these biomolecules in living organisms.
CO2	Students will develop an understanding regarding the diversity of the biomolecules, and their roles in organisms.
CO3	The students will develop a basic understanding about the diversity, structure, and importance of specialized molecules like enzymes and hormones in living organisms.
CO4	The students will develop fundamental concepts like—pH and chemical bonding— that are crucial for the functioning of the biomolecules.
CO5	The students will become familiar with basic detection and separation techniques like spectroscopy, chromatography, centrifugation etc.

Course content

S. No	Unit title	Course Content	Number of Hours	Skills Developed
1.	Atomic theory, water molecule structure, carbohydrates and proteins.	Atomic theory – Valency - Atomic weight - Molecular weight - Molarity. Structure of Water Molecules - Properties and Ionization of Water. pH and Buffers. Carbohydrates: Classification, Structure and Functions - Physical and Chemical Properties.	15Hrs	Transferable skills

		Proteins: Amino Acids and Peptides - Structure and Classification of Amino Acids - Classification and Organization of Proteins – Primary – Secondary - Tertiary and Quaternary - Biological Significance.		
2.	Lipids, Vitamins, Enzymes, and Nucleic acids	Lipids Classification - Structure and Functions. Triglycerides – Phospholipids - Glycolipids and Lipoproteins - Structure and Function. Vitamins: Types - Structure and Functions. Enzymes: IUB Classification and Nomenclature of Enzymes - Michaelis-Menten Equation - Active Sites - Activators and Inhibitors. Isoenzymes - Allosteric Enzymes. Nucleic Acids: Structure - Properties and Functions of Nucleic Acids – DNA - RNA and their Types.	15Hrs	Transferable skills
3.	Hormones, Metabolism of biomolecules	Hormones Steroid hormones- structure O, E2, P4, Glucocorticoid hormones. Mechanism of steroid hormone action. Metabolism Glycolysis - TCA Cycle - Glycogen Breakdown and Synthesis - Gluconeogenesis - Electron Transport Chain and Oxidative Phosphorylation – Photophosphorylation, Biosynthesis and Degradation of Nucleic Acids (Purines and Pyrimidines).	15Hrs	Cognitive skills

4.	Bioanalytical techniques	Separation techniques Principles and applications of a) Chromatography (Paper, thin – layer, column, GLC and HPLC) b) Centrifugation (RPM and G, Ultra centrifugation) c) Electrophoresis: Horizontal & vertical gel electrophoresis – Types of Electrophoresis and its application. Spectroscopic techniques Principles and applications of UV, Visible spectroscopy, X-ray crystallography/diffraction, NMR, IR, fluorescence & atomic absorption. Isotopes Types, their importance in biological studies, measure of radioactivity, GM counters and Scintillation counting.	15Hrs	Employable Skills

Course Code: S21 BT 3.2

Course Name: Biomolecules

Total Teaching Hours: 60

No. of Hours / Week: 4

1. Preparation of Buffers-Citrate and Phosphate.	2 Units
2. Estimation of reducing sugars (Glucose, Maltose and Lactose) by DNS and Somogyi's Methods	3 Units
3. Estimation of Protein by Biuret method and Lowry's method	3 Units
4. Assay of enzyme activity- Amylase.	2 Units
5. Separation of Sugars by TLC.	2 Units
6. Estimation of Amino acids by ninhydrin method.	2 Units
7. Estimation of inorganic phosphate by Fiske Subba Rao method	1 Unit

Text Books/References

1. Ruess, L., & Müller-Navarra, D.C. (2019). Essential Biomolecules in Food Webs. *Frontiers in Ecology and Evolution*.
2. Laage, D., Elsaesser, T., & Hynes, J.T. (2017). Water Dynamics in the Hydration Shells of Biomolecules. *Chemical Reviews*, 117, 10694 - 10725.
3. Schowen, R.L. (1993). Principles of biochemistry 2nd ed. (Lehninger, Albert L.; Nelson, David L.; Cox, Michael M.). *Journal of Chemical Education*, 70.
4. Vogler, L. (2016). Lehninger Principles Of Biochemistry 5th Edition.
5. Voet, D.H., Pratt, C.W., & Voet, J.G. (2018). Voet's principles of biochemistry.
6. Principles of Biochemistry- Albert Lehninger CBS Publishers & Distributors.
7. Schweitzer, L. (2016). Principles Of Biochemistry With A Human Focus.
8. Dresner, L.M. (2016). Lehninger Principles Of Biochemistry 5th Edition.
9. Garrett, R.H., & Grisham, C.M. (2016). Principles of biochemistry.
10. Daecher, J. (2016). Principles Of Biochemistry.
11. Biochemistry-Lubret Stryer Freeman International Edition.
12. Biochemistry-KeshavTrehana Wiley Eastern Publications
13. Fundamentals of Biochemistry J.L. Jain S. Chand and company
14. Biochemistry, Prasaraanga, Bangalore University
15. Fundamental of Biochemistry-Dr. A.C. Deb
16. Textbook of Organic Chemistry (A Modern approach) P.L. Soni, Sultan Chand and Sons, Publishers.
17. The Biochemistry of Nucleic acid-tenth Edition-Roger L.P. Adams, John T. Knowler and David P. Leader, Chapman and Hall Publications.
18. Narayanan, P (2000) Essentials of Biophysics, New Age Int. Pub. New Delhi.
19. Bliss, C.J.K. (1967) Statistics in Biology, Vol. I McGraw hill. New York.
20. Campbell R.C. (1974) Statistics for Biologists, Cambridge Univ. Press, Cambridge
21. Daniel (1999) Biostatistics (3rd edition) Panima Publishing, Computation
22. Sward law, A. C. (1985) Practical Statistics for Exponents Biologists, John Wiley, and Sons, In
23. Khan (1999) Fundamentals of Biostatistics Publishing Corporation
24. Roy R.N. (1999) A Text-Book of Biophysics New Central Book Agency

SEMESTER – IV

Course Code: S21 BT 4.1

Course Name: Molecular biology

Total Teaching Hours: 60

No. of Hours / Week: 4

CObj	Course Objectives
CObj_1	To have basic knowledge of transmission genetics, hereditary mechanism and mutations.
CObj_2	To know the complex organization of the genetic material of prokaryotes and eukaryotes and gene expression studies.
CObj_3	To understand the significance of central dogma of Molecular Biology.

CO	Course Outcomes
CO1	To have a firm foundation in the fundamentals of Molecular Biology.
CO2	To develop an understanding of the cells, Cell organelles and its various cellular mechanisms.
CO3	To analyze the mechanisms associated with Gene Expression at the level of Transcription and Translation.
CO4	To explore the mechanisms associated with Regulation of Gene Expression in Prokaryotes and Eukaryotes.
CO5	To analyze the genotypic and phenotypic relationship of normal and mutant types.

Course Content

Sl. No	Unit title	Course Content	Number of Hours	Skills Developed
1.	Nucleic acids and Recombination in prokaryotes	Structure and functions of DNA and RNA. Watson and Crick model of DNA and other forms of DNA (A and Z). Cot curves, C value paradox. Functions of DNA and RNA including ribozymes. Molecular basis of life – an introduction RNA and DNA as genetic material, experimental proof of DNA as genetic material. Recombination in prokaryotes, Transformation, Conjugation and Transduction.	15Hrs	Cognitive skills
2.	DNA Replication and DNA repair	DNA Replication - Prokaryotic and Eukaryotic – Enzymes and proteins involved in replication, Theta model and Rolling circle model. DNA Repair- causes and mechanism – photoreactivation, excision repair, mismatch repair, SOS repair. Structure of Prokaryotic and Eukaryotic gene – genetic code, Properties and wobble hypothesis.	15Hrs	Cognitive skills
3.	Transcription and translation in Prokaryotes and Eukaryotes	Transcription in Prokaryotes and Eukaryotes Mechanisms, Promoters and RNA polymerase, transcription factors, Post transcriptional modifications of eukaryotic mRNA. Translation Mechanism of translation in prokaryotes and Eukaryotes, Post translational modification of Proteins.	15Hrs	Employable skills
4.	Gene organization and gene regulation	Regulation of Gene expression in Prokaryotes – Operon concept (Lac, Gal and Tryp). Regulation of Gene expression in Eukaryotes –	15Hrs	Analytical skills

		transcriptional activation, galactose metabolism in yeast. Gene organization and expression in Mitochondria and chloroplasts. Insertional elements and transposons. Transposable elements in Maize and Drosophila. Epigenetic modification.		

DSC-2P, S21 BT4.2, Molecular Biology

Course Code: S21 BT 4.2

Course Name: Molecular biology

Total Teaching Hours: 60

No. of Hours / Week: 4

1. Isolation of DNA from plant sources	2 Units
2. Estimation of DNA by DPA method.	1 Unit
3. Estimation of RNA by Orcinol method	1 Unit
4. Column chromatography – gel filtration (Demo)	2 Units
5. Extraction and partial purification of protein from plant source by Ammonium sulphate precipitation.	3 Units
6. Extraction and partial purification of protein from animal source by organic solvents.	3 Units
7. Protein separation by Polyacrylamide Gel Electrophoresis (PAGE)	2 Units
8. Charts on –Conjugation, Transformation and Transduction.	1 Unit

Text books/References

1. Glick, B.R and Pasternak J.J (1998) Molecular biotechnology, Principles and application of recombinant DNA, Washington D.C. ASM press.
2. Howe. C. (1995) Gene cloning and manipulation, Cambridge University Press, USA
3. Lewin, B., Gene VI New York, Oxford University Press.
4. Rigby, P.W.J. (1987) Genetic Engineering Academic Press Inc. Florida, USA.
5. Sambrook et al (2000) Molecular cloning Volumes I, II & III, Cold spring Harbor Laboratory Press New York, USA
6. Walker J. M. and Ging old, E.B. (1983) Molecular Biology & Biotechnology (Indian Edition) Royal Society of Chemistry U.K.
7. Karp. G (2002) Cell & Molecular Biology, 3rd Edition, John Wiley & Sons.



Department of Life Sciences

Genetics

PEOs	Programme Educational Objectives
PEO1	To prepare graduates who can exhibit quality of excellence, critical thinking, creativity, inventiveness and self-motivation.
PEO2	To produce graduates who are globally acceptable professionals for academic and research organizations along with entrepreneurial skills.
PEO3	To groom graduates who can demonstrate competence and problem solving abilities in the field of Life sciences.
PEO4	To produce graduates who can lead and work as a team with high ethical standards.
PEO5	To enable the graduates pursue multiple professional pursuits and enhance their own achievements while serving the society at large.

PO	Programme Outcomes
PO1	Develop comprehensive knowledge and understanding in the field of Life Sciences.
PO2	Inculcate complex problem solving ability using analytical thinking, reasoning, and creativity along with good communication skills.
PO3	Demonstrate research related skills along with coordinating and collaborating abilities.
PO4	Develop leadership abilities with a knowledge of time management, community engagement and service.
PO5	Demonstrate capability to use advanced digital and technological skills for the benefit of society.

PSOs	Programme Specific Outcomes
PSO1	To analyze how Biotechnology and Genetic concepts address broad societal issues including health and diseases, bioremediation, biofuel production etc.
PSO2	To provide hands on experience in molecular biology and genetic engineering techniques, thus enabling the students to begin their career in industry and research laboratories.
PSO3	To demonstrate various tools and techniques in the field of biotechnology and applied genetics research. Identify the appropriate strategies to solve problems with respect to agriculture, medicine and environment.
PSO4	To imbibe a robust interdisciplinary knowledge base and practical skill sets in molecular diagnostics, recombinant proteins, vaccines, crop improvement and transgenic technology suitable for academia and industry.
PSO5	To equip students with expertise in laboratory, computational and analytical proficiencies indispensable for research and development.



MATRIX AND SYLLABUS

For the Programme B.Sc. (Genetics & Biotechnology)

Genetics

NEP Based Curriculum (2021 onwards)

I Semester

NEP- Curriculum Framework for Approval

B.Sc. (Genetics & Biotechnology) - Matrix for I Semester (w.e.f. 2023-24 onwards)

I Semester							
Code	Course Code	Course	Teaching Hours	Course Components			Credits
				L	T	P	
AECC	S21KN 1.1/ S21HN 1.1/ S21AE 1.1	Language I (Kannada/Hindi/Additional English)	45	3	1	-	3
AECC	S21GE 1.1	Language II (Generic English)	60	3	1	-	3
DSC1	S23GN 1.1	Principles of Genetics (Theory)	60	4	-	-	4
DSC 1	S23GN 1.2	Principles of Genetics (Practical)	60	-	-	4	2
DSC 1	S23BT 1.1	Cell Biology (Theory)	60	4	-	-	4
DSC 1	S23BT 1.2	Cell Biology (Practical)	60	-	-	4	2
OE-1	S23OE/ S21OE	Genes and Diseases/ Biotechnology for Human Welfare	45	2	1	-	3
SEC-SB	21SBC 1.1	Digital Fluency-I	30	1	-	2	2
SEC-VB	21VBC 1.1	Health and Well-being	30	-	-	2	1
SEC-VB	21VBC 1.2	Yoga	30	-	-	2	1
Total							25

Note 1:

AECC- Ability Enhancement Compulsory Course

DSC - Discipline-Specific Course

OE- Open elective (course offered by the department to students of other stream)

DSE – Discipline-Specific Elective

SEC - VB Skill Enhancement Course -Value Based

SEC - SB Skill Enhancement Course -Skill Based

Continuous Internal Assessment – Scheme of Evaluation

For Theory Courses

End Semester Examination: 60%

Continuous Internal Assessment: 40%

Activities (CIA: 40 Marks)	Proposed and Approved Scheme		Total Marks (40)
	IA-1	IA-2	
Session Test Maximum Marks	30	30	
1. Weightage (Marks)	10	10	20
2. Assignment (Marks)	20		20
i. Writing	10		
ii.Quiz / Presentation / Creating diagrams /charts / Classwork / Case study / Viva / Field work etc.	05		
iii. Classroom participation	05		
Total			40

Continuous Internal Assessment
Scheme of Evaluation for Practical Courses
End-Semester Examination: 50%
Continuous Internal Assessment: 50%

CIA (25 marks) + End Semester Exam (25 marks)	
Maximum Marks (Internal Assessment)	25
1. Weightage (Marks)	15
2. Record work (Marks)	05
3. Quiz/Presentation/creating diagrams/ charts/Lab work/	05
Total (Marks)	25

S23 GN 1.1: PRINCIPLES OF GENETICS

THEORY

Total Teaching Hours: 60

No. of Hours per Week: 4

(4 credits)

CObj	Course Objectives
CObj_1	To provide comprehensive understanding of the historical development of Genetics as a scientific discipline and its significance in modern biology and to introduce students to Mendel's laws of inheritance and their applications in understanding genetic patterns and traits in various organisms.
CObj_2	To familiarize with the concept of gene interaction and how multiple genes can influence the expression of a trait.
CObj_3	To understand the structure and organization of chromosomes in prokaryotic and eukaryotic cells and their roles in inheritance and genetic stability and to comprehend the mechanisms and factors involved in sex determination in different organisms.

CO	Course Outcomes
	After completion of this course, students should be able to:
CO1	Explain the historical milestones in the field of genetics, the contributions of key scientists to its development and to apply Mendel's laws to predict and analyze patterns of inheritance for single gene traits in various organisms.
CO2	Describe different types of gene interactions (e.g., dominance, co-dominance, epistasis) and their impact on phenotype and analyze and interpret genetic data involving multiple alleles at a gene locus.
CO3	Compare and contrast the structure of prokaryotic and eukaryotic chromosomes, understanding their differences and functions and describe karyotype and ideogram.
CO4	Elucidate the features of polytene chromosomes, lampbrush chromosomes and B chromosomes.
CO5	Analyze the mechanisms of sex determination in different organisms, including the role of sex chromosomes and environmental factors.

CO-PO Mapping

	PO_1	PO_2	PO_3	PO_4	PO_5	PSO_ 1	PSO_ 2	PSO_3	PSO_4	PSO_ 5
CO_1	X		X		X	X	X	X	X	
CO_2	X	X	X	X				X	X	X
CO_3	X	X		X	X	X	X		X	
CO_4	X			X	X				X	X
CO_5	X				X	X	X		X	X

Course Content

Sl. No.	Unit/chapter title	Content	Number of hours	Skills developed
1	Unit- I	- Definition and scope of Genetics. Pre Mendelian genetic concepts- Moist Vapour theory, Reproductive Blood theory, Preformation theory, theory of Epigenesis, theory of acquired characters, theory of Pangenesis, Germplasm theory. - Heredity and environment, genotype and phenotype, heredity and variation. - Clones, purelines and inbred lines. Norms of reaction and phenocopies. - Biography of Mendel and his experiments. Law of Segregation: Monohybrid cross, Back cross and Test cross, Genetic Problems. Law of Independent Assortment: Dihybrid cross, Back cross and Test cross, Genetic Problems.	15 Hrs	Cognitive/ Transferrable/ Analytical skills
2	Unit- II	Multiple Alleles: Definition, ABO blood groups and Rh factor in Human, Genetic Problems. Gene Interactions: Deviations from Mendelism: Incomplete dominance and co-dominance, Complementary gene interaction (Ex: <i>Lathyrus odoratus</i>- 9:7), Supplementary gene interaction (Ex. Grain color in Maize- 9:3:4), Recessive Epistasis (Ex: Coat color in Mice- 9:3:4) , Dominant Epistasis (Ex: Fruit color in <i>Cucurbita pepo</i>- 12:3:1), Inter allelic Non-Epistasis (Collaborator gene- Comb pattern in fowl – 9:3:3:1).	15 Hrs	Cognitive/ Analytical skills
3	Unit- III	Physical Basis of inheritance: Chromosome theory of inheritance. - Prokaryotic Chromosome: Structure and Organization. Eukaryotic Chromosome: Macromolecular organisation, Primary and Secondary constriction, Sat – bodies, telomeres. - Differences between Prokaryotic and Eukaryotic Chromosomes.	15 Hrs	Cognitive/ Research /Analytical/ Transferrable skills

		• Heterochromatin and Euchromatin and its significance. • Ultra Structure of Chromosome: Nucleosome model and Nucleosome Structure. • Karyotype and Idiogram. • Special types of Chromosome: Polytene chromosome – Salivary gland chromosome in <i>Drosophila</i>. Lampbrush chromosome in amphibian Oocyte. B Chromosome.		
4	Unit- IV	• Sex Determination: Chromosomal theory of sex determination- XX-XY; XX-XO and ZZ-ZW., Genic balance theory of Bridges, role of Y chromosome in <i>Melandrium</i>. • Environmental influence on sex determination. • Hormonal control of sex determination (free martin). • Gynandromorphs. • Sex differentiation and dosage compensation(<i>Drosophila</i> & Man).	15 Hrs	Cognitive/ Research /Analytical/ skills

Books for Reference:

1. Pierce, B. A. (2019). Genetics: a conceptual approach. 7th Edition. W. H. Freeman
2. Brooker, Robert J. (2021). Concepts of Genetics. 4th Edition. McGraw-Hill.
3. Gupta, P.K. (2010). Cytogenetics. Rastogi Publications, Meerut, India.
4. Hartl, Daniel L., and Elizabeth W. Jones. (2017). Genetics: Analysis of genes and genomes. 9th Edition. Jones & Bartlett Learning.
5. Hartwell, L. H., Golberg, M.L and Fischer, J.A. (2014) . McGraw-Hill Education.
6. Lewin, B., Krebs, J., Kilpatrick, S. T., & Goldstein, E. S. (2017). Lewin's genes XII. 12th Edition. Jones & Bartlett Learning.
7. Lewin, B.,. (1997). Genes VI. Oxford University Press.
8. Snustad, D. P., & Simmons, M. J. (2015). Principles of genetics. John Wiley & Sons.
9. Sumner, A.T. (2008). Chromosomes: Organization and Function. Blackwell Publishing, USA.
10. Mark, H. F. L. (2000). Medical Cytogenetics, CRC Press Inc.
11. Hamerton, J. L. Human Cytogenetics. Vols. I &II. Academic Press, N.Y

Web Resources:

1. <https://openoregon.pressbooks.pub/mhccmajorsbio/chapter/introduction-to-genetics-mt-hood-community-college-biology-102/>
2. <https://www.nature.com/scitable/topicpage/gregor-mendel-and-the-principles-of-inheritance-593/>

Journals:

1. Nature Genetics
2. Annual Review of Genetics
3. Genes

S23 GN 1.2: PRINCIPLES OF GENETICS**PRACTICAL****Total Teaching Hours: 60****No. of Hours per Week: 4****(2 credits)**

Sl. No.	Unit/chapter title	Content	Number of hours	Skills developed
1	Module 1	Pre-treating, fixing agents and stains for cytological preparations.	04 Hrs	Research/ Employable skills
2	Module 2	Study of Meiosis using flower buds/grasshopper testes.	12 Hrs	Cognitive/ Research skills
3	Module 3	Culturing and handling of <i>Drosophila</i> .	08 Hrs	Cognitive/ Research skills
4	Module 4	Life cycle of <i>Drosophila melanogaster</i> .	04 Hrs	Research/ Analytical skills
5	Module 5	Mounting of sex comb of <i>Drosophila melanogaster</i>	04 Hrs	Research/ Analytical skills
6	Module 6	Preparation of salivary gland chromosomes in <i>Drosophila</i> larvae.	12 Hrs	Cognitive/ Research skills
7	Module 7	Blood typing in humans for multiple alleles and Rh factor.	04 Hrs	Analytical/ Transferrable skills
8	Module 8	Study of gene interaction: a) Flower colour in <i>Mirabilis</i> and <i>Antirrhinum</i> b) Coat colour in mice c) Comb pattern in fowl	04 Hrs	Cognitive/ Analytical skills
9	Module 9	Genetic Problems: a) Multiple alleles b) Gene interactions	04 Hrs	Analytical/ problem solving skill
10	Module 10	Study of Karyotypes –Normal Karyotypes in Humans	04 Hrs	Cognitive/ Analytical skills

Books for Reference:

1. Worku, M. (2019). Laboratory Manual for Principles of Genetics. LAP Lambert Academic Publishing.
2. Gupta, B.R. (2017). Laboratory Manual for Principles of Animal and Population Genetics. Copal Publishing Group.

S23OE1: GENES AND DISEASES**Total Teaching Hours: 45****No. of Hours per Week: 3****(3 credits)**

CObj	Course Objectives
CObj_1	To understand the basics of genetics and heredity without technical jargon.
CObj_2	To recognize the genetic basis of various common diseases and conditions and make informed decisions regarding their own health and genetic testing.
CObj_3	To appreciate the ethical and societal implications of genetic research and healthcare.

CO	Course Outcomes
	After completion of this course, students should be able to:
CO1	Elucidate the role of genes in determining traits and characteristics.
CO2	Identify genetic factors contributing to common health issues and diseases.
CO3	Discuss the societal and ethical aspects of genetic testing and research.
CO4	Critically evaluate health-related information from a genetic perspective.
CO5	Engage in informed discussions and make well-reasoned decisions about genetic health topics.

CO-PO Mapping

	PO_1	PO_2	PO_3	PO_4	PO_5	PSO_1	PSO_2	PSO_3	PSO_4	PSO_5
CO_1	X	X				X		X		
CO_2			X			X	X	X		
CO_3		X		X				X	X	X
CO_4										
CO_5	X	X			X	X	X			X

Course Content

Sl. No	Unit/chapter title	Content	Number of Hours	Skills Developed
1.	Unit- I Introduction to Genetics	● Genetics and its Relevance: Overview of the course, Genes and importance of genes, Historical perspectives on genetics. Common genetic terminologies. ● Inheritance and Traits: Inheritance of traits are from parents to offspring, Nature vs. nurture.	11 Hrs	Cognitive/ Analytical / Life skills
2.	Unit- II Genetic Diversity and Population	● Genetic Diversity and Populations: Genetic diversity and individual differences, Genetic diversity in human populations, Ancestry and identity through genetics, Phylogenetics. ● Genetic Testing and Personal Health: Different types of genetic tests, Pros and cons of direct-to-consumer genetic testing, Interpretation of genetic health reports- case studies	11 Hrs	Transferrable/ Employable/ Analytical Life skills
3.	Unit- III Fundamental Concepts of Genetic Disorders	● Genetic Diseases: The Basics: Common genetic diseases and conditions, Genetics behind inherited diseases, Genetic testing and diagnosis. ● Genetics and Common Health Issues: The genetic factors in common health problems (e.g., heart disease, diabetes, obesity). ● Lifestyle and environment's role in gene expression. ● Case studies.	11 Hrs	Transferrable/ Employable/ Life skills
4.	Unit- IV Ethical and Societal Implications	● Moral and Social Consequences: Ethical considerations in genetic research and healthcare, Genetic discrimination and privacy concerns, Genetic counseling and patient rights. ● Applying Genetics to Your Life: Recent developments in genetic research and HealthCare, Practical	12 Hrs	Transferrable/ Cognitive/ Analytical skills

		applications of genetic knowledge, Making informed health decisions, Case studies and group discussions.		

Books for Reference:

1. Lewis (2021), Human Genetics, 13th edition. Publisher: McGraw-Hill.
2. Cummings (2016) Human Heredity, 11th edition. Publisher: Cengage.
3. Lodish, H et al.(2016), Molecular Cell Biology. 8th Edition. W.H Freeman
4. Willard and Haga. (2022).The Book of Genes and Genomes. Springer.
5. Strachan, T. and Read, A. P. (2018). Human Molecular Genetics. Garland Science.

Web Resources:

1. <https://www.ncbi.nlm.nih.gov/books/NBK22183/>
2. <https://genomemedicine.biomedcentral.com/articles/10.1186/gm77>

Journals:

- 1.The Journal of Genetic Medicine
2. Journal of Biochemical and Clinical Genetics

MATRIX AND SYLLABUS

For the Programme B.Sc. (Genetics & Biotechnology)

Genetics

NEP Based Curriculum (2021 onwards)

II Semester

NEP- Curriculum Framework for Approval

B.Sc. (Genetics & Biotechnology) - Matrix for II Semester (w.e.f. 2023-24 onwards)

II Semester							
Code	Course Code	Course	Teaching Hours	Course Components			Credits
				L	T	P	
AECC	S21KN 2.1/ S21HN 2.1/ S21AE 2.1	Language I (Kannada/Hindi/Additional English)	45	3	1	-	3
AECC	S21GE 2.1	Language II (Generic English)	60	3	1	-	3
AECC	21SBC 2.1	Environmental Studies	45	2	1	-	3
DSC2	S21GN 2.1	Bioinstrumentation and Animal Cell Culture (Theory)	60	4	-	-	4
DSC2	S21GN 2.2	Bioinstrumentation and Animal Cell Culture (Practical)	60	-	-	4	2
DSC2	S21BT 2.1	Microbiology (Theory)	60	4	-	-	4
DSC2	S21BT 2.2	Microbiology (Practical)	60	-	-	4	2
OE-2	S23OE/ S21OE	Health and Lifestyles / Applications of Biotechnology in Agriculture	45	2	1	-	3
SEC-VB	21VBC 2.1	NCC/NSS/Cultural	30	-	-	2	1
SEC-VB	21VBC 2.2	Sports	30	-	-	2	1
Total							26

Note 1:

AECC- Ability Enhancement Compulsory Course

DSC - Discipline-Specific Course

OE- Open elective (course offered by the department to students of other stream)

SEC - VB Skill Enhancement Course -Value Based

SEC - SB Skill Enhancement Course -Skill Based

Continuous Internal Assessment – Scheme of Evaluation

For Theory Courses

End Semester Examination: 60%

Continuous Internal Assessment: 40%

Activities (CIA: 40 Marks)	Proposed and Approved Scheme		Total Marks (40)
	IA-1	IA-2	
Session Test Maximum Marks	30	30	
1. Weightage (Marks)	10	10	20
2. Assignment (Marks)	20		20
i. Writing	10		
ii.Quiz / Presentation / Creating diagrams /charts / Classwork / Case study / Viva / Field work etc.	05		
iii. Classroom participation	05		
Total			40

Continuous Internal Assessment
Scheme of Evaluation for Practical Courses
End-Semester Examination: 50%
Continuous Internal Assessment: 50%

CIA (25 marks) + End Semester Exam (25 marks)	
Maximum Marks (Internal Assessment)	25
1. Weightage (Marks)	15
2. Record work (Marks)	05
3. Quiz/Presentation/creating diagrams/ charts/Lab work/	05
Total (Marks)	25

S21 GN 2.1: BIOINSTRUMENTATION AND ANIMAL CELL CULTURE

THEORY

Total Teaching Hours: 60

No. of Hours per Week: 4

(4 credits)

CObj	Course Objectives
CObj_1	To provide students with a comprehensive understanding of the principles underlying bioinstrumentation, including the design and application of instruments used in biological research and analysis.
CObj_2	To equip students with the skills and knowledge necessary for successful cultivation and maintenance of animal cells in <i>in vitro</i> .
CObj_3	To foster an interdisciplinary approach by teaching students how to integrate bioinstrumentation techniques with animal cell culture processes, enabling them to design experiments and analyze biological samples using appropriate instruments.

CO	Course Outcomes
	After completion of this course, students should be able to:
CO1	Explain the principles and applications of various bioinstruments used in biological research and industry. Demonstrate proficiency in bioinstrumentation showcasing adeptness in experimental setup and data acquisition.
CO2	Apply cell culture techniques in ensuring the successful cultivation and manipulation of animal cells in a laboratory setting.
CO3	Design and execute experiments that involve the integration of bioinstrumentation and animal cell culture.
CO4	Analyze data obtained from bioinstrumentation and cell culture experiments, demonstrating the ability to interpret results critically.
CO5	Apply critical thinking skills to troubleshoot issues that may arise during bioinstrumentation experiments or cell culture processes.

CO-PO Mapping

	PO_1	PO_2	PO_3	PO_4	PO_5	PSO_1	PSO_2	PSO_3	PSO_4	PSO_5
CO_1	X	X	X	X	X	X	X	X	X	X
CO_2	X	X	X						X	X
CO_3		X	X	X	X		X	X		
CO_4		X			X		X			X
CO_5		X			X			X		X

Course Content

Sl. No.	Unit/chapter title	Content	Number of hours	Skills developed
1	Unit- I	• Microscopy: Introduction and principle • Types of microscopes: Simple and Compound microscopes, Light microscopes, Fluorescence, electron microscopy (transmission and scanning), Phase contrast, Confocal, Stereo microscopy. • Uses of microscopy and biological applications: High resolution imaging, immunohistochemistry, Medical science, Forensic laboratories. • Different types of sterilization methods: Autoclave, steam sterilizers, dry heat sterilizers and ovens and UV chambers.	15 Hrs	Evaluation/ Transferrable/ Cognitive/ Research/ Life skills
2	Unit- II	Analytical Instruments: • pH meter: Principle and components of pH meter. • Thermometer: Principle, types of thermometers-digital, mercury, strip-type, Infrared. • Colorimeter: Principles and applications. • Spectroscopy: Beer-Lambert's Law in spectrometry, UV spectrophotometers, Atomic absorption spectroscopy (AAS), Electron Spin Resonance (ESR), Nuclear Magnetic Resonance (NMR).	15 Hrs	Evaluation/ Transferrable/ Cognitive / Employable skills
3	Unit- III	Instruments used in separation techniques: • Centrifugation: Principle and applications of centrifuge, types of centrifuge- ultra-centrifuge, Refrigerated centrifuge. • Chromatography: Principle and application of Chromatography, types- ion exchange, gel filtration, HPLC, affinity chromatography, GC-MS.	15 Hrs	Employable/ Transferrable/ Analytical/ Research/ Life skills

		• Electrophoresis: Principle and applications of electrophoresis. Types of electrophoresis: vertical and horizontal.		
4	Unit- IV	Animal cell culture: • Principles of cell culture, cell types, cell lines, Primary culture, secondary culture, cryopreservation, contaminations, organotypic culture. Organoid culture, 2D & 3D cultures and co-culture. • Requirements in Animal Cell Culture: Equipment used in Cell culture, Culture vessels, Aseptic techniques. • Cell culture media: Natural and defined, role and components of serum in culture. <i>In vitro</i> transformation of animal cells, Types of cell culture. • Applications of cell culture: Cell culture in biomedical research-karyological studies, amniocentesis, mutagenesis, Cytotoxicity assays.	15 Hrs	Transferrable/ Employable/ Analytical skills

Books for Reference:

1. Alberts, B., Johnson, A., & Lewis, J et al. (2014). Molecular Biology of the Cell. 4th edition, New York: Garland Science.
2. Lodish, H., Berk, A., & Zipursky, S. L., et al (2016). Molecular Cell Biology, 4th Edition. New York: W.H. Freeman.
3. Freshney R., (2015), Culture of Animal Cells-A Manual of Basic Technique and specialized Applications. 7th Edition, Wiley Blackwell.
4. Davis J.M. (2011). Animal Cell Culture: Essential Methods, John Wiley & Sons Ltd.
5. Ninfa, A. J. & Ballou, D. J. (1998). Fundamental Laboratory Approaches for Biochemistry and Biotechnology, 2nd Edition. Wiley.
6. Sambrook, J. & Russell, D. W. (2012), Molecular Cloning: A Laboratory Manual. 4th Edition. Cold Spring Harbor Laboratory Press.
7. Bronzino, J. D., (1986). Biomedical engineering and instrumentation. PWS Publishing Co.
8. Willard, H. H., Merritt, L. L., Dean, J. A., and Settle, F.A. (1986). Instrumental Methods of Analysis. 7th Edition. CBS Publishers & Distributors.
9. Sharma, B. K., (2008). Instrumental Methods of Analysis. Goel Publishing house.
10. Sharma Y.R., (2013). Elementary Organic Spectroscopy, S.Chand & company Ltd. New Delhi.

Web Resources:

1. <https://www.sciencedirect.com/topics/biochemistry-genetics-and-molecular-biology/centrifugation>
2. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7325846/>
3. <https://www.atcc.org/resources/culture-guides/animal-cell-culture-guide>

Journals:

1. Introduction to Biomedical Engineering.
2. Journal of Bioengineering & Biomedical Science
3. Biomedical Instrumentation and Technology.

S21 GN 2.2: BIOINSTRUMENTATION AND ANIMAL CELL CULTURE**PRACTICAL****Total Teaching Hours: 60****No. of Hours per Week: 4****(2 credits)**

Sl. No.	Unit/chapter title	Content	Number of hours	Skills developed
1	Module 1	Demonstration of optical Components of microscope: Eye piece, Eye piece tube, Nose piece, Objective lenses, Coarse and Fine Focus knobs, Stage and stage clips, Aperture, Illuminator, Condenser, Condenser Focus Knob, Iris Diaphragm.	08 Hrs	Cognitive/ Research skills
2	Module 2	Fluorescence Microscopy: viewing cells stained with fluorescent dyes.	08 Hrs	Research/ Transferrable/ Employable skills
3	Module 3	Demonstration of experiments on, laser scanning, Phase contrast, confocal and scanning electron microscopy.	08 Hrs	Employable/ Cognitive/ Analytical/ Research skills
4	Module 4	Preparation of buffers using pH meter.	08 Hrs	Transferrable/ Employable/ Analytical skills
5	Module 5	Temperature recording using Thermometer	08 Hrs	Transferrable/ Employable/ Analytical skills
6	Module 6	Colorimetric estimation of proteins: Protein estimation by Bradford reagent.	04 Hrs	Analytical/ Research skills
7	Module 7	Demonstration of Beer-Lambert's Law in spectrometry.	04 Hrs	Employable/ Analytical skills
8	Module 8	Recording ultraviolet absorption spectra for DNA.	04 Hrs	Employable/ Analytical skills

9	Module 9	Demonstration of UV spectrophotometers, Atomic absorption spectroscopy, Electron Spin Resonance (ESR), Nuclear Magnetic Resonance (NMR) Spectrophotometers, Flame photometer.	04 Hrs	Research/ Transferrable/ Employable skills
10	Module 10	Chromatography: Paper chromatography and TLC, size exclusion	04 Hrs	Research/ Transferrable skills

Books for Reference:

1. Prasad, R. K., Rai, A., & Singh, K. (2021). Instrumental Methods of Analysis (Lab Manual). Book Rix Publishers.
2. Khare, E., & Rastogi, S. R. (2023). Practical Manual of Instrumental Analysis of Methods. Narain Publishers & Distributors
3. ATCC Animal Cell Culture Guide.
4. Capes, A., Davis, R.,. Freshney, I A. (2021). Freshney's Culture of Animal Cells: A Manual of Basic Technique and Specialized Applications, 8th Edition. Wiley-Blackwell.
5. Freshney I A.,(2010). Culture of Animal Cells: A Manual of Basic Technique and Specialized Applications. John Wiley & Sons, Inc.

S23OE-2: HEALTH AND LIFESTYLES

THEORY

Total Teaching Hours: 45

No. of Hours per Week: 3

(3 credits)

CObj	Course Objectives
CObj_1	To build the knowledge on health & lifestyle management and help to better manage their social and psychological dimensions of life.
CObj_2	To evaluate nutrition and meal planning principles in selection, planning, preparation and serving of meals that meet specific nutritional needs and analyses the results of a fitness assessment to create and implement a personal fitness plan
CObj_3	To acquire knowledge and comprehension of topics related to health, nutrition, and various aspects of lifestyle, encompassing mental and emotional well-being, as well as the diseases associated with these areas.

CO	Course Outcomes
	After completion of this course, students should be able to:
CO1	Describe dimensions of health and concepts of wellness and identify the major physical and psychological health concerns.
CO2	Analyze the basic principles of nutrition and ways to obtain and maintain a healthy body composition.
CO3	Evaluate the nutritional habits with lifestyle management and be able to design, implement, and self-assess a personal nutrition and fitness plan.
CO4	Prepare to interconnect the mental, emotional, and physical well-being, and explore strategies for a holistic approach to health.
CO5	Develop an own thinking, opinions and attitudes to global health issues.

CO-PO Mapping

	PO_1	PO_2	PO_3	PO_4	PO_5	PSO_1	PSO_2	PSO_3	PSO_4	PSO_5
CO_1	X	X				X		X		
CO_2	X				X	X			X	
CO_3		X	X	X		X		X		X
CO_4	X			X		X			X	
CO_5		X	X		X		X	X		X

Course Content

Sl. No	Unit/chapter title	Content	Number of Hours	Skills Developed
1.	Unit-I Introduction to Health	● Introduction to Health: Definition and Change in paradigm in health and lifestyles, Components and spectrum of health, Role of lifestyle habits on health. ● Importance of health in adulthood: Stages, Characteristics and changes during adulthood; Nutritional needs; Eating Habits – eating disorders, skipping breakfast, junk food consumption.	11 Hrs	Cognitive/ Research/ Transferrable skills
2.	Unit –II Nutrition Management	● Nutrition Management: The food pyramid, components of nutrition-carbohydrates, fibre, protein, fat and types of fat and label reading. Supplements, eating disorders, anorexia nervosa and bulimia nervosa. ● Food and Nutritional Requirements during adulthood: Fluid intake; nutrition related problems; lifestyle related problems, Role of physical activity; resting pattern and postures, Personal habits – alcoholism, and other tobacco products, electronic addiction. ● case studies	11 Hrs	Evaluation/ Analytical/ Employable skills
3.	Unit-III Weight and Lifestyle Management	● Weight Management: Medical, Physical, Nutritional, Psycho-social and behavioural aspects of health and illness, Importance of Body Mass Index (BMI), skin-fold test, nutritional habits. ● Lifestyle Management: Evolutionary causes of diseases, lifestyle related diseases- Cardiovascular disease, diabetes, obesity, hypertension, cancers, HIV and AIDS working on wellness (WOW) and overview of WOW- dimensions of wellness model.	11 Hrs	Evaluation/ Analytical/ Employable skills
4.	Unit -IV Stress Management And Well-being	● Introduction to Stress: Definition, types of stress and stress management methods. Yoga, Meditation, Music Therapy, Aroma therapy, development of hobbies. Practical examples /case studies. ● Managing Mental Health: The importance of self-concept, self-esteem, self-efficacy, and self-efficiency, Defining sadness and	12 Hrs	Transferrable / Employable/ Analytical/ Life skills

		depression and the effect on behaviour. Positive case studies. ● Ways to Foster Wellness: Definition and pathways to wellness-mindfulness walk & talk - experiencing natural movement to cultivate mindfulness and a wakeful presence. Movement to Music - learning how music can stimulate the body's natural feel good endorphins, providing an outlet to control feelings, Self-Care - learning to manage your own health, actively preserving or improving mental or physical health, Soul Food - identifying the importance of core nutrients to keep the brain and body healthy.		

Books for Reference:

1. Robbins, G., Powers, D., & Burgess, S. (2011). A Wellness Way of Life, 9th edition. McGraw-Hill Education.
2. Barlow, T. W., Rapee, & Perin. (2014), 10 Steps to Mastering Stress: A Lifestyle Approach, USA.
3. Clayton, M., (2011). Brilliant stress management How to manage stress in any situation's 1st Edition. Great Britain Pearson Education.
4. Yoke, M. (2001). A Guide to personal fitness training. Aerobics and fitness association of America.
5. Matheny, K. B. (1992). Stress And Strategies for Lifestyle Management. Georgia State University Business Press.
6. Park, K. (2011). Textbook of Preventive and Social Medicine. Banarsidas Bhanot Publishers.

Web Resources:

1. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4703222/>
2. <https://www.nature.com/articles/s41562-023-01624-7>
3. <https://www.nature.com/articles/s41430-022-01230-2>

Journals:

1. Journal of Health and Social Behavior
2. Journal of Health Science
3. American Journal of Lifestyle Medicine: Sage Journals

MATRIX AND SYLLABUS

For the Programme B.Sc. (GBc/GBt)

Genetics

NEP Based Curriculum (2021 onwards)

V Semester

NEP- Curriculum Framework for Approval

B.Sc.- Matrix for V Semester (w.e.f. 2021-22 onwards)

V SEMESTER							
Code	Course Code	Course	Teaching hours	Course Components			Credits
				L	T	P	
DSC5	S21 GN 5.1	Genetic Engineering (Theory)	60	4	-	-	4
DSC5	S21 GN 5.2	Genetic Engineering (Practical)	60	-	-	2	2
DSC6	S21 GN 6.1	Advanced Plant and Animal Tissue culture Technology (Theory)	60	4	-	-	4
DSC6	S21 GN 6.2	Advanced Plant and Animal Tissue culture Technology (Practical)	60	-	-	2	2
DSC5	S21 BC 5.1	Biochemistry of Macromolecules(Theory)	60	4	-	-	4
DSC5	S21 BC 5.2	Biochemistry Practical macromolecules Lab	60	-	-	2	2
DSC6	S21 BC 5.3	Human Physiology and Cell Biology(Theory)	60	4	-	-	4
DSC6	S21 BC 5.4	Biochemistry Practical Physiology and Cell Biology Lab	60	-	-	2	2
SEC		R-Programming-A Practical Approach	30	1	-	2	2
Total							26

Note 1:

DSC - Discipline-Specific Course

DSE – Discipline-Specific Elective

SEC - VB Skill Enhancement Course -Value Based

SEC - SB Skill Enhancement Course -Skill Based

Note 2:

The DSE and Vocational courses are programme specific and may vary depending on programmes offered.

Continuous Internal Assessment – Scheme of Evaluation

For Theory Courses

End Semester Examination: 60%

Continuous Internal Assessment: 40%

Activities (CIA: 40 Marks)	Proposed and Approved Scheme		Total Marks (40)
	IA-1	IA-2	
Session Test Maximum Marks	30	30	
1. Weightage (Marks)	10	10	20
2. Assignment (Marks)	20		20
i. Writing	10		
ii.Quiz / Presentation / Creating diagrams /charts / Classwork / Case study / Viva / Field work etc.	05		
iii. Classroom participation	05		
Total			40

S21 GN 5.1: GENETIC ENGINEERING

THEORY

Total Teaching Hours: 60

No. of Hours per Week: 4

(4 credits)

CObj	Course Objectives
CObj_1	To provide adequate knowledge on salient features and applications of tools used in RDT.
CObj_2	To enable students to understand the methodology involved and the various techniques used in construction of recombinant DNA.
CObj_3	To enable students to comprehend the various applications of RDT.

CO	Course Outcomes
	After completion of this module, students should be able to:
CO1	Elucidate the features of various tools used in genetic engineering.
CO2	Understand the steps involved in recombinant DNA technology.
CO3	Analyze and implement the PCR and DNA sequencing techniques in molecular biology and recombinant DNA technology.
CO4	Understand the applications of recombinant DNA technology.
CO5	Execute laboratory experiments using the standard methods and techniques in molecular biology, with the appropriate analysis and interpretation of results obtained.

CO-PO Mapping

	PO _1	PO _2	PO _3	PO _4	PO _5	PSO _1	PSO _2	PSO _3	PSO _4	PSO _5
CO _1	X	X				X	X			
CO _2	X	X		X	X			X	X	
CO _3	X	X	X	X	X			X	X	
CO _4			X	X	X		X	X	X	X
CO _5		X	X	X	X			X	X	

Course Content

Sl. No.	Unit/chapter title	Content	Number of hours	Skills developed
1	Unit- I	Genetic Engineering and Tools of Genetic Engineering: Introduction, scope and importance. a. Enzymes: Restriction endonucleases: Nomenclature, types and characteristic features, Modification of cut ends; DNA ligases; Other enzymes: Alkaline phosphatase, Polynucleotide kinase, Terminal nucleotidyl transferase, Exonuclease III, DNase I, DNA polymerase and Klenow fragment, RNA dependent DNA Polymerase, S1 nuclease. Enzyme kinetics in RDT. b. Vectors: Properties of an ideal vector; Types : Cloning and expression vectors; i) Cloning vectors: Prokaryotic vectors: Plasmids- pBR 322; pUC 18; Bacteriophages- Lambda phage, Cosmids. Eukaryotic vectors: YAC vectors; Shuttle vectors- Yeast and <i>E. coli</i> ; For higher plants: Integrative DNA transfer- Agrobacterium vectors-Ti plasmid-Binary and Cointegrated vectors; Non integrative DNA transfer: DNA transfer- Plant viral	20 Hrs	Cognitive/ Research/ Analytical skills

		vectors (CaMV); For animals: Animal viral vectors- SV 40 (3 types) ii) Expression vectors in Prokaryotes and Eukaryotes		
2	Unit- II	a. Gene amplification techniques: Genomic library, cDNA library, Organo-chemical synthesis, Amplification through PCR b. Gene transfer methods for bacterial , plant and animal cells: Chemical methods (Calcium chloride mediated transfer and Calcium phosphate co-precipitation method), Lipofection, Electroporation, Microinjection, Ballistic method (Particle shot gun method), Agrobacterium mediated gene transfer. c. Selection and screening of recombinants: Direct methods- Insertional inactivation, Visual screening method, Indirect methods- Colony hybridization, Immunochemical detection, Use of selectable and scorable genes: i) Selectable genes: Plants- NPT ; Animals-TK ii) Scorable genes: Plants- GUS; Animals-lux and luc	20 Hrs	Cognitive/ Analytical / Research/ Creative thinking skills

3	Unit- III	a. Technique for RDT: i) Gel electrophoresis: AGE and SDS PAGE ii) Hybridization: Southern; Northern; Western; Dot blots iii) Autoradiography iv) DNA sequencing: Sanger's Dideoxy method v) Molecular probes; labelling of probes: Nick translation and random primer labeling, nucleotide labelling by isotopic and non- isotopic methods vi) DNA Microarrays (DNA chip technology) vii) CRISPR-Cas9 for genome engineering b. Applications of Genetic Engineering: Transgenic animals: Mouse (Knock out) Transgenic Plants: Resistance to diseases insects (Bt gene transfer); Fertilizer management- Nif gene transfer. Case Studies on RDT in treating Human diseases.	20 Hrs	Logical/ Research /Analytical/ Employable skills

Books for Reference:

- 1) Sandhya Mitra Genetic engineering: Principles and practice; MacMillan India Ltd. 2nd Ed, 2017.
- 2) Old. R. W and Primrose. S.B. 2016. Principles of Gene Manipulation: An Introduction to Genetic Engineering. University of California Press.
- 3) Brown, T. A. 1995. Gene Cloning: An introduction. Chapman and Hall, London.
- 4) Glick, B. R. and Pasternak, J. J. 1994. Molecular Biotechnology: Principles and applications of recombinant DNA. ASM Press, Washington D.C.
- 5) Kreuzer, H. and A. Massey. 2001. Recombinant DNA and Biotechnology. ASM Press, Washington D.C.

Krevzer. H. 1996. Recombinant DNA & Biotechnology Asm Press.

6) Watson . J. D. 2002. Recombinant DNA Technology. Scientific American.

7) Moody. S.A. 2007. Principles of Developmental Genetics. Elsevier Academic Press.

Journal

a. Journal of Genetic Engineering and Biotechnology

b. Nature Journal

c. Journal of Genetics and Genetic Engineering.

S21 GN 5.2: GENETIC ENGINEERING**PRACTICAL****Total Teaching Hours: 60****No. of Hours per Week: 4****(2 credits)**

Sl. No.	Unit/chapter title	Content	Number of hours	Skills developed
1	Module 1	Quantification of DNA by DPA method.	12 Hrs	Research/ Analytical/ Employable skills
2	Module 2	Quantification of RNA by Orcinol method.	12 Hrs	Analytical / Research/ Employable skills
3	Module 3	Isolation of Plasmid DNA.	08 Hrs	Cognitive/ Research/ Analytical skills
4	Module 4	Restriction enzyme digestion and analysis by agarose gel electrophoresis.	08 Hrs	Research/ Analytical/ Creative thinking skills
5	Module 5	Ligation of DNA fragment and analysis by agarose gel electrophoresis.	08 Hrs	Research/ Analytical skills
6	Module 6	Demonstration of Transformation- α complementation.	04 Hrs	Research/ Analytical skills
7	Module 7	Vectors: a) pBR 322 b) Cosmid c) YAC d) Ti plasmid e) SV 40	04 Hrs	Cognitive/ Research skills

8	Module 8	Transgenic plant- Bt cotton. Transgenic animal- Knockout mouse.	04 Hrs	Cognitive/ Research skills

Books for Reference:

1. Sambrook, J. and Russell, D.W. 1989. Molecular Cloning a Laboratory Manual. 4th Edition. Cold Spring Harbor Laboratory Press,U.S.
2. Vennison, S.J. 2009. Laboratory Manual for Genetic Engineering. Prentice-Hall of India Pvt. Limited.
3. Kurnaz, I. A. 2015. Techniques in Genetic Engineering. CRC Press.

S21 GN 6.1 ADVANCED PLANT AND ANIMAL TISSUE CULTURE**TECHNOLOGY THEORY****Total Teaching Hours: 60****No. of Hours per Week: 4
(4 credits)**

CObj	Course Objectives
CObj_1	To enable students to demonstrate a sound knowledge of the fundamentals principles of plant and animal tissue culture.
CObj_2	To widen the knowledge of classical and modern plant and animal biotechnology processes, including breeding of healthy breeds, breeds with improved characteristics and breeds for biomolecule production.
COb_3	To facilitate the students to obtain skills on biotechnological processes such as cell tissue and organ culture, gene transfer with its applicative value in agriculture, pharmaceutical and food industry, and in ecology.

	Course Outcomes
CO1	Comprehend and describe various protocols of plant and animal cell, tissue, and organ culture as well as the scientific principles underlying the protocols.
CO2	To apply tissue culture technology for clonal propagation, assisting plant breeding and improvement, recovering cellines from transformed cells, and production of valuable biochemical molecules.
CO3	To Initiate, analyze and identify concepts and strategies for molecular plant secondary metabolite engineering.
CO4	Acquired awareness of regulations and laws pertaining to ethical concerns using animals for genetic testing.
CO5	Apply knowledge acquired to explore the various applications of organ culture in biomedical research.

CO-PO MAPPING

	PO _1	PO _2	PO _3	PO _4	PO _5	PSO _1	PSO _2	PSO _3	PSO _4	PSO _5
CO _1	X			X		X		X		
CO _2		X	X		X	X		X	X	
CO _3			X			X		X		X
CO _4	X	X			X		X			X
CO _5			X		X			X	X	X

Course Content

Sl. No	Unit/chapter title	Content	Number of Hours	Skills Developed
1.	Unit-I Introduction to Cell and Tissue Culture	1.Introduction to Plant tissue culture: Plant tissue culture media. Plant growth regulators in tissue culture, Selection and preparation of explant. 2.Micropropagation: Direct regeneration, Indirect regeneration – callus culture and organogenesis, Shoot and root meristem culture Somatic embryogenesis; Protoplast isolation and culture, somatic hybridization; 3.Haploid production: Androgenic haploids (anther, pollen culture) and Gynogenic haploids (ovary, ovule culture); Somaclonal variation and its significance. 4. Methods of conservation, Acclimatisation, Germplasm utilization: Gene sanctuaries, Gene,meristem banks for germplasm conservation. Cryopreservation, Gene banks for germplasm conservation.	15 Hrs	Understanding/ logical/Cognitive

2.	Unit- II Plant metabolic engineering (PME)	1. Introduction on plant metabolic engineering (PME) Principles of PME. Biosynthesis metabolic pathway. Methods for identification and analyze plant secondary metabolites and bioactive properties 2. Molecular (Protein) farming Biopolymer,bioenergy from plant Biosynthesis pathway of some secondary metabolites in plant Terpenoids,alkaloids,flavonoid	15 Hrs	Analytical/ Understanding/ Research skills
3.	Unit-III Animal Tissue Culture	1. Biology and Characterization of animal cultured cells : Contamination Testing of Culture, Viability measurement and cytotoxicity Measurement of growth parameters Cell cycle analysis and Synchronization of cultures Organoid culture, 2D & 3D cultures and co-culture. 2. Animal ethics and associated laws and issues: Ethical Guidelines for the Use of Animals in Research.The Prevention of Cruelty Act, 1960. Committee on Animal Research and Ethics	15 Hrs	Analytical/ Employable/ Research skills

		(CARE),Animal Research: reporting of in vivo experiments (ARRIVE Guidelines).		
4.	Unit- IV Applications of Tissue Engineering	1.Application of plant tissue culture Crop improvement, herbicide resistance, insect resistance, virus resistance. Genetic modification – transgenic plants for pest resistant (Bt-cotton); herbicide resistance (Round Up Ready soybean); Improved agronomic traits - flavrSavr tomato, Golden rice); Improved horticultural varieties (Moon dust carnations). 2. Commercial application of animal tissue culture – Uses of animal cells in vaccine production, Cell cultures in the production of medically important compounds – pharmaceuticals, enzymes, hormones, interleukins, interferon's.	15 Hrs	Analytical/ Employable/ Research skills

Books for Reference:

1. Pullaiah. T. and M.V.Subba Rao. 2009. Plant Tissue culture. Scientific Publishers, New Delhi.
2. Bhojwani, S.S. and Razdan, M.K., (1996). Plant Tissue Culture: Theory and Practice. Elsevier Science Amsterdam. The Netherlands.
3. Plant Biotechnology & Genetics: Principles, Techniques and Applications. John Wiley & Sons Inc. U.S.A.

4. Christina Smolke. The Metabolic Pathway Engineering Handbook: Fundamentals. 5. Spier R. E. and Griffith's J.B. Animal cell biotechnology, Volume1- 7 Series, Academic Press, London. 6. Davis John. M. . Animal Cell Culture Essential Methods, Wiley-Blackwell, Sussex, UK. 7. Jenkins, N., . Animal Cell Biotechnology, Humana Press.

Web Resources:

1. <https://link.springer.com/article/10.1007/s11627-019-09983-5>
2. <https://pubmed.ncbi.nlm.nih.gov/16673901/>

Journals:

1. Journal of General Plant Pathology
2. Journal of Plant Growth Regulation
3. Journal of Plant Research
4. Journal of Animal Science and Biotechnology
5. Single Cell Biology

**S21 GN6.2 ADVANCED PLANT & ANIMAL TISSUE CULTURE
TECHNOLOGY PRACTICAL**

Total Teaching Hours: 60

No. of Hours per Week: 4hrs

(2 credits)

S.No	Module title	Module Content	No. of Hours	Skills Developed
1.	Module 1	Requirements for Tissue Culture Laboratory.	4hrs	Analytical
2.	Module 2	Demonstration of Indigenous Systems of Medicine, Floras, Medicinal and Aromatic Plants.	8hrs	Analytical
3.	Module 3	Anther, Embryo and Endosperm culture.	8hrs	Analytical/ Research
4.	Module 4	Callus induction and Plant Regeneration.	4hrs	Analytical/ Research
5.	Module 5	Synthetic seed production.	8hrs	Analytical/Em plo yable/ Research
6.	Module 6	Isolation & Culturing of protoplast.	4hrs	Analytical/ Research
7.	Module 7	Primary explant culture of mouse pup/adult/ chick embryo organs.	4hrs	Analytical/ Research

8.	Module 8	Trypan blue dye exclusion test for cell viability.	8hrs	Analytical
9.	Module 9	Separation of peripheral blood mononuclear cells (PBMCs) - Histopaque method.	8hrs	Analytical/ Research
10	Module 10	Contamination Testing of Culture.	4hrs	Analytical/ Research

Books for Reference:

1. In vitro culture in higher plants R.L.M. Pierik, 1987..MartinusNijhoff Publishers, Boston.
2. Plant propagation by tissue culture: vol 1. The background.George E.F. Springer, 2007.
3. An Introduction to Plant Tissue Culture. Kalyanakumar De. 1997., New Central Book Agency, Calcutta
4. Plant Physiology (Taiz, L and Zeiger, E.) 1991; Biotechnology in Agriculture (Bajaj series, (Vol 1-20) 1990-1999
5. Plant Biotechnology: The genetic manipulation of plants. 1st edition. Slater A and others, Oxford University Press, New York, 2004
6. Freshney, R.I. (Ed.) Animal cell culture, A practical approach II edition, IRL press,Oxford
7. Freshney R. I. Culture of animal cells: A manual of basic technique, IV&V Edition, Alan R. Liss, Inc. New York

Web Resources:

1. <https://labassociates.com/7-methods-of-plant-tissue-culture>
2. <https://www.plantcelltechnology.com/blogtypes-of-tissue-culture-techniques-and-their-uses/>
3. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6716531/?report=reader>

Journals:

1. Journal of plant biochemistry and physiology.
2. Journal of Plant Biochemistry and Biotechnology.
3. Journal of Plant Physiology
4. Journal of Animal Science and Biotechnology
5. Journal of Cell and Animal Biology



MATRIX AND SYLLABUS

For the Programme B.Sc. (GBc/GBt)

Genetics

NEP Based Curriculum (2021 onwards)

VI Semester

NEP- Curriculum Framework for Approval

B.Sc.- Matrix for VI Semester (w.e.f. 2021-22 onwards)

VI SEMESTER

Code	Course Code	Course	Teaching hours	Course Components			Credits
				L	T	P	
DSC7	S21 GN 7.1	Developmental Genetics & Pharmacogenetics (Theory)	60	4	-	-	4
DSC7	S21 GN 7.2	Developmental Genetics & Pharmacogenetics (Practical)	60	-	-	2	2
DSC8	S21 GN 8.1	Population and Evolutionary Genetics(Theory)	60	4	-	-	4
DSC8	S21 GN 8.2	Population and Evolutionary Genetics(Practical)	60	-	-	2	2
DSC7	S21 BC 6.1	Enzymology (Theory)	60	4	-	-	4
DSC7	S21 BC 6.2	Biochemistry Practical VII Enzymology Lab	60	-	-	2	2
DSC8	S21 BC 6.3	Intermediary Metabolism (Theory)	60	4	-	-	4
DSC8	S21 BC 6.4	Biochemistry Practical VIII Bioenergetics & Metabolism Lab	60	-	-	2	2
SEC		Professional & Business Communication	45	2	-	1	2
TOTAL							26

**S21 GN 7.1: DEVELOPMENTAL GENETICS &
PHARMACOGENETICS THEORY**

Total Teaching Hours: 60

No. of Hours per Week: 4

(4 credits)

CObj	COURSE OBJECTIVES
CObj_1	To provide the fundamental understanding of the process that controls embryonic development, analyze Cell fate and pattern formation, molecular analysis of basic body plan.
CObj_2	To enable students to comprehend how basic pharmacokinetic processes are defined, expressed and affected; how pharmacokinetics together with pharmacodynamics determine the effect intensity and effect duration of a drug.
CObj_3	To familiarize students with the basic concepts of toxicology and pharmacogenetics, applications of pharmacogenetics and the process of drug development.

CO	COURSE OUTCOMES
	After completion of this module, students should be able to:
CO1	Provide an in-depth account of molecular events of fertilization and genetics of multicellularity cleavage in early development.
CO2	Give an account of early vertebrate development and morphogenetic and cell movement, analyze cell fate and pattern formation in different organisms and illustrate the role of environment in development.
CO3	Understand and correlate the relationship between pharmacokinetics and pharmacodynamics, and also comprehend toxicology to prevent adverse medication implications in patients and to relate the concepts with the best and advanced clinical practice to augment drug delivery care.

CO4	Understand the basic principles underlying pharmacogenetics and evaluate how genetic variations in drug-metabolizing enzymes, drug transporters, and drug targets can influence individual responses to medications.
CO5	Outline the process of drug development and account for critical factors and decision points in drug development process.

CO-PO Mapping

	P O_ 1	P O_ 2	P O_ 3	PO _4	PO _5	PSO _1	PSO _2	PSO _3	PSO _4	PSO _5
CO_ 1	X		X		X	X			X	
CO_ 2	X		X	X	X	X		X	X	
CO_ 3		X	X	X	X			X		X
CO_ 4	X		X	X	X	X			X	
CO_ 5			X	X	X		X		X	

Course Content

Sl. No.	Unit/chapter title	Content	Number of hours	Skills developed
1	Unit- I	a. Early development: Fertilization, types of cleavage; Genetics of multicellularity cleavage; Gastrulation: Cell movement and formation of germ layers in frog, chick and mouse; Concept of determination, competence and differentiation. b. Development of vertebrate nervous system: Formation of neural tube, formation of brain regions, tissue architecture of the central nervous system.	15 Hrs	Cognitive/ Research/ Transferable skills
2	Unit- II	Genetics of pattern formation i) <i>Caenorhabditis</i>: Vulva formation ii) <i>Drosophila</i>: Maternal genes and formation of body axes; Segmentation genes; Homeotic genes function; Imaginal disc development. iii) Vertebrates: Axes formation and HOX genes Epigenetic regulation in development: DNA methylation in development, histone modifications and chromatin remodelers during development. Epigenetics & MicroRNA.	15 Hrs	Cognitive/ Analytical / Research skills

3	Unit- III	Pharmacokinetics & Pharmacodynamics a. Pharmacokinetics: Absorption, Distribution, Metabolism and Excretion of drug. Pharmacodynamics: Drug receptors and administration, relationship between drug concentration and response. b. Toxicology: Concepts in toxicology, acute, subacute and chronic toxicity studies, Calculation of LD50 and ED50, biological half-life, physicochemical principles, drug accumulation; Molecular mechanisms of drug action.	15 Hrs	Transferable/ Research/ Analytical skills
4	Unit- IV	a. Pharmacogenetics: Introduction to pharmacogenetics; Genetic variation and its impact on drug response; Drug metabolism and pharmacogenetic variations; Pharmacogenetics of drug transporters; Pharmacogenetics of drug targets and receptors; Clinical applications of pharmacogenetics. b. Drug Discovery: Introduction, conventional drug design approaches, irrational vs rational, Lipinski's rule of five, Drug development process (Preclinical, clinical and toxicological evaluation); Novel Drug Development approaches – QSAR (quantitative structure activity relationship).	15 Hrs	Transferable/ Research/ Analytical skills

Books for Reference:

1. Alberts *et al.* 2007. Molecular Biology of The Cell. Garland
2. Gilbert 2006. Developmental Biology. Sinauer
3. Kalthoff .1996. Analysis of Biological Development. McGraw Hill
4. Lewin *et al.* 2009. Lewin's Genes X. Jones & Bartlett Learning, 2009
5. Monk. 1987. Mammalian Development – A Practical Approach. IRL
6. Wolpert.2007. Principles of Development. Oxford
7. Balinsky. 1975. Text Book of Embryology, Holt Saunders Company Ltd.
8. Thompson. 2008. Genetics in Medicine. Saunders.
9. J. Licinio and M -L. Wong . 2002. Pharmacogenomics: The Search for Individualized Therapies
10. John Dickenson *et.al.* 2012. Molecular Pharmacology: From DNA to Drug Discovery
11. Karen E. Stine, Thomas M. Brown. 2015. Principles of toxicology

Journal

- 1) Genesis: The Journal of Genetics and Development.
- 2) Genes and Development
- 3) Current opinion and Genetics and Development.

**S21 GN 7.2: DEVELOPMENTAL GENETICS &
PHARMACOGENETICS PRACTICAL**

Total Teaching Hours: 60

No. of Hours per Week: 4

(2 credits)

Sl. No.	Unit/chapter title	Content	Number of hours	Skills developed
1	Module 1	Study of imaginal discs in <i>Drosophila</i> .	12 Hrs	Cognitive/ Research/ Analytical skills
2	Module 2	Study of the early development of frog/chick.	12 Hrs	Cognitive/ Analytical / Research skills
3	Module 3	Mounting of chick embryos.	12 Hrs	Cognitive/ Research/ Analytical skills
4	Module 4	Frog: induction, spawning and early embryogenesis.	12 Hrs	Cognitive/ Research/ Analytical skills
5	Module 5	Genetics of development in <i>Drosophila</i> - Anterior and posterior polarity/Maternal genes/ Segmentation genes/Homeotic genes/ dorso ventral polarity.	12 Hrs	Cognitive/ Research/ Analytical skills

Books for Reference:

1. Keller, L.R., Evans, J.H. and Keller, T.C.S. 1999. Experimental Developmental Biology: Laboratory Manual. Academic Press, London.
2. Gibbs, M.A. 2003. A Practical Guide to Developmental Biology. Oxford University Press.
3. Mari-Beffa and Knight J. 2011. Key Experiments in Practical Developmental Biology. Cambridge University Press.

**S21 GN 8.1 POPULATION AND EVOLUTIONARY
GENETICS THEORY**

Total Teaching Hours: 60

No. of Hours per Week: 4

(4 credits)

CObj	COURSE OBJECTIVES
CObj_1	To provide a comprehensive overview of the concept of Evolution.
CObj_2	To explain the origin of life and explore salient features of various theories and mechanisms of evolution and speciation.
CObj_3	To impart detailed key concepts of population Genetics in terms of Hardy Weinberg law.

CO	COURSE OUTCOMES
	After completion of this module, students should be able to
CO1	Obtain an academic specialty besides evolutionary trends.
CO2	Acquire in-depth understanding on theories of evolution.
CO3	Gain a glimpse of phylogenetic trees and highlight their construction along with interpretation.
CO4	Earn knowledge on mechanism of speciation.
CO5	Receive adequate information on concepts of population Genetics.

CO-PO Mapping

	PO _1	PO _2	PO _3	PO _4	PO _5	PSO _1	PSO _2	PSO _3	PSO _4	PSO _5
CO _1	X					X			X	
CO _2				X	X			X		X
CO _3		X			X		X		X	
CO _4			X	X	X	X			X	
CO _5	X		X		X		X		X	X

Course Content

Sl. No.	Unit/chapter title	Content	Number of hours	Skills developed
1	UNIT I: Concepts and Evolutionary theories:	Concept of Evolution, Origin of Life, Origin of Prokaryotes and Eukaryotes, Evidences of Evolution – Analogy and Homology, Embryological evidences of evolution, Paleontological evidences, Study of phylogenetic tree, Molecular phylogeny, Molecular Evolution- Gene evolution, Evolution of gene families, Assessment of molecular variation.	10 Hrs	Evaluation skills/ creative thinking/
2	UNIT I: Theories of evolution	Theories of evolution – Darwinism, Neo-Darwinism, Mendelian and Biometrician controversy, Lamarckism and its limitations. Case studies on Evolutionary genetics.	10 Hrs	Analytical skills/creative thinking skills/ Research skills
3	UNIT II: Driving forces of Evolution and Population Genetics	Mendelian population, Gene pool, allele frequencies and genotype frequencies, Hardy-Weinberg genetic equilibrium and its applications, Factors affecting Hardy Weinberg equilibrium, Fitness, Selection, Migration-Emigration and Immigration, Mutation, random drift in small population, Selection-Stabilizing selection, Directional selection, Disruptive selection, Balancing selection, Frequency	20 Hrs	Cognitive skills/ Logical skills/analytical skills

		dependent selection, Density dependent selection. Group and kin selection, selection coefficient, molecular clock, neutral theory of evolution, evolution random walk, Genetic drift, Nonrandom mating.		
4	UNIT III: Species concepts and Isolating mechanisms	Different types - Modes of speciation (Allopatric, Peripatric, Parapatric and Sympatric speciation). Isolating Mechanisms: Classification, Geographical isolation, Reproductive isolation, Premating isolation, Climatic, Seasonal, Habitat, Ethological, Post-mating isolation: Gametic mortality isolation, Muller's view, Dobzhansky view.	10 Hrs	Analytical skills/ Cognitive skills/ Research skills
5	UNIT III: Molecular phylogenetic and Human population Genetics	Construction of phylogenetic tree, phylogenetic inferences: Distance method, Parsimony, maximum likelihood method, Molecular phylogenetics of Homosapiens and related issues, Hominid evolution. Basic attributes of polymorphic structures in human protein coding genes. Mitochondrial DNA polymorphism, Y-Chromosome polymorphism and Single nucleotide polymorphism (SNP).	10 Hrs	Cognitive skills/ Communication skills/ Employable skills

Books for Reference:

1. Batschelet, E. (1975) Introduction to Mathematics for Life Scientists, 2nd edition, Springer-Verlag, Berlin Heidelberg-New York
2. Koto, M. (2000) The Biology of biodiversity, 1st edition, Springer, Japan.
3. Murry J.D. (1993) Mathematical Biology, 2nd edition, Springer-Verlag, New York/Berlin.
4. Simpson, G.G. (1961) Principle of animal taxonomy, Columbia University Press, New York.
5. Snedcor, G.W. and Cochran W.G. (1989) Statistical Methods, Affiliated-East-West Press, New Delhi.
6. Sokal, R.R. and Rohlf F. J. (1995) Biometry the principles and practice of statistics in biological research, 3rd edition, New York W.H. Freeman.
7. Wilson, E.O. (1988) Biodiversity, National Academy Press, Washington, D.C
8. T. A. Brown, 1999. Genomes, John Wiley & Sons (Asia) PTE Ltd.
9. Scott Freeman & Jon C. Herron, 2001. Evolutionary Analysis (2nd Edition), Prentice Hall.
10. Falconer & Mackay, 1996. Introduction to Quantitative Genetics (IV Edition), Longman.
11. David P. Mindell, 1997. Avian Molecular Evolution & Systematics, Academic Press.
12. Derek A. Roff, 1997. Evolutionary Quantitative Genetics, Chapman & Hall.
13. R.S. Singh & C. Krimbas, 2000. Evolutionary Genetics- From Molecules to Morphology, Cambridge University Press.
14. Peter Donnelly & Simon Tavaré, 1997. Progress in Population Genetics & Human Evolution (Vol. 87), Springer.
15. William S. Klug & Michael R. Cummings, 2000. Concepts of Genetics (Sixth Edition), Prentice Hall.
16. Monre W. Strickberger, 1985. Genetics (Third Edition), Prentice Hall of India.
17. Strickberger. Evolution. Prentice Hall. (2002).

Web Resources:

[BIOL 694--Population Genetics--Takebayashi--200503.pdf \(uaf.edu\)](#)

[HUGEN_2022.pdf \(pitt.edu\)](#) [983505.pdf \(ucsd.edu\)](#)

Journals:

1. European Society for Evolutionary Biology.
2. Journal of Evolutionary Genetics
3. Journal of Evolutionary Evolutionary and Population Genetics
4. Journal of Evolutionary Population Genetics

S21 GN 8.2 POPULATION AND EVOLUTIONARY GENETICS**PRACTICAL****Total Teaching Hours: 60****No. of Hours per Week: 4****(2 credits)**

Sl. No.	Module title	Module Content	Number of hours	Skills developed
1	Module 1	Quantitative characters in <i>Drosophila</i> : Sternoplurals and Acrostichals, Mean and standard error.	12 Hrs	Cognitive skills/ Problem solving skills/ Research skills
2	Module 2	Calculation of change in gene frequencies.	8 Hrs	Analytical skills/Problem solving skills.
3	Module 3	Applications of Hardy-Weinberg principles and genetic problems.	8 Hrs	Cognitive skills/ Logical skills/analytical skills
4	Module 4	Experiments on Genetic Drift: a) Population size b) Sampling Error.	12 Hrs	Employable skills/ analytical skills/ Research skills
5	Module 5	Studies on Homology and Analogy.	8 Hrs	Cognitive skills/ Evaluation skills
6	Module 6	Connecting links: <i>Peripatus</i> and <i>Archaeopteryx</i> .	4 Hrs	Transferable skills/ analytical skills
7	Module 7	Living fossil: <i>Nautilus</i> , Study of models of fossil man.	8 Hrs	Cognitive skills/ Analytical skills /Research skills.

Books for Reference:

1. A.P. Jha - Genes and Evolution, Mac Millan India Ltd., 1993.
2. B. Lewin (Ed) - Genes, VII Edition, John Wiley and Sons, New York, 1996.
3. Dobzhansky, Ayala, Stebbins & Valentine – Evolution, W.H. Freeman & Company, 1977.
4. Gardner - Principles of Genetics, John Wiley & Sons Inc., New York, 1991.
5. Klug & Cummings – Essentials of Genetics, Prentice Hall College, 1995.
6. M. Sudhakar Rao, N.A. Madhyastha - Cytology, Genetics and Evolution, Geetha Book House, 1982.
7. N. Gurumani - An Introduction to Biostatistics, MJP publishers, Chennai, 2004.
8. Norman T. J. Bailey - Statistical Methods in Biology, 3rd edition, Cambridge University Press, 1994.
9. P.K. Gupta - Cell Biology, Genetics and Evolution, Rastogi Publications, 2013.
10. P.S. Verma and Agarwal- Cell Biology, Genetics, Molecular Biology, Evolution and Ecology, S. Chand & Co., 2004.
11. Robert H. Tamarin - Principles of Genetics, PWS Publishers, 1982.
12. Sinnott, Dunn, Dobzhansky - Principles of Genetics, Mc Graw Hill, 1958.
13. Strickberger - Genetics, III Edition, Prentice Hall of India Pvt. Ltd., 1995.
14. Suzuki, Griffiths, Miller & Lewontin – An Introduction to Genetic Analysis, W.H. Freeman & Company, New York, 1986.
15. T.H. Hassard - Understanding Biostatistics, Mosby year Book St. Louis, 1991.



DEPARTMENT OF GENETICS

Syllabus of

M.Sc., APPLIED GENETICS

(Program Code: IAMOS01)

Academic Year: 2020-21 onwards

Batch: 2020 - 2022

DEPARTMENT OF GENETICS
M.Sc APPLIED GENETICS (Program Code: IAMOS01)

REGULATIONS PERTAINING TO M.Sc APPLIED GENETICS (CBCS)DEGREE

SEMESTER SCHEME 2020-21 Onwards

1. AIMS AND OBJECTIVES :

1. Understand the steps involved in Recombinant DNA technology and applications of Genetic engineering
2. To impart knowledge on Human Genetics as Genes are the common factor of the qualities of most human-inherited traits. Study of human genetics can answer questions about human nature, can help understand diseases and the development of effective treatment and help us to understand the genetics of human life.
3. To instill practical and theoretical skills in the branches of Applied Genetics
4. Demonstrate knowledge in the applications of biomedical genetics.

I a. Programme Educational Objectives (PEOs) and Programme Outcomes (POs)

PEOs	Programme Educational Objectives (PEOs):		Programme Outcomes(POs)
PEO1	To promote a profound and integrated comprehension of branches of Genetics and their implication towards the advancement of health and biological sciences.	PO1	Able to identify and solve problems associated with the different types of human, animal and plant diseases.
PEO2	To understand how genetic concepts affect broad societal issues including health and disease, food and natural resources, environmental sustainability, etc.	PO2	Develop an in-depth understanding of the principles of genetics, cytogenetics, developmental genetics, molecular mechanisms of cellular physiology, plant and microbial genetics, bioinformatics, human genetics etc., to obtain a sound knowledge of various fields of genetic study
PEO3	To develop insight into the mathematical, statistical, and computational basis of genetic analyses that use genome-scale data sets in systems biology settings	PO3	Enable to think analytically and creatively to solve problems, judge arguments and make decisions in scientific and other contexts.

PEO4	To enable comprehensive and detailed understanding of genetic methodology and how quantification of heritable traits in families and populations provides insight into cellular and molecular mechanisms.	PO4	Develop a commitment to life-long learning and career pursuits within the life sciences disciplines.
PEO5	To facilitate the students to acquire the skills required in starting their own ventures and generating self-employment making them successful entrepreneurs also to develop skills in diagnostic testing, haematology, Invitro fertilization techniques etc. used in clinical and research laboratories will provide them opportunity to work in diagnostic or research laboratory	PO5	Develop ability to integrate the basic knowledge in genetics with other related disciplines

I b. Mapping of PEOs with POs:

PEOs	Programme Outcomes(POs)
PEO1	PO1, PO3, PO5
PEO2	PO1, PO5
PEO3	PO1, PO2, PO3, PO5
PEO4	PO1, PO2, PO3, PO4
PEO5	PO4, PO5, PO3

2. DURATION OF THE COURSE: 2 YEARS (4 Semesters)

3. ELIGIBILITY FOR THE COURSE:

a) B.Sc. graduates with any Life Science subject securing at least 50% marks in aggregate of all optional subjects are eligible. B.Sc. graduates in Biotechnology and B.Sc. (Hons.) graduates in Genetics / Biotechnology / Biology / Botany / Microbiology / Zoology are also eligible provided they have secured 50% marks in the aggregate of all the optional subjects.

b) In the absence of candidates in (a), Graduates in Agricultural Science, Dairy Sciences, Horticulture, Forestry, Fisheries, Pharmacy, Engineering (Biotechnology), Medicine / Dental or Agricultural Engineering, with 50% marks in the aggregate are eligible.

4. MEDIUM OF INSTRUCTION: English

5. ATTENDANCE:

- a) Theory: 75%
- b) Practical: 75%

6. TEACHING METHODS (PEDAGOGY):

1. LECTURES –a) ICT based b) Chalk and board method, both helps the teacher to maintain eye contact with students and to engage in healthy interaction during lecture, important concept of papers.
2. SEMINARS - Students undertake meticulous search for data and citations and are encouraged to present in individual/group on any area from the pertaining curriculum.
3. PRACTICAL LEARNING - These sessions aim to give students an insight into the working environment, knowledge of experimental methods, instrumentation and techniques and an even understanding of the academic material taught on the practical course.
4. FIELD TRIPS - Fieldwork helps the students to put their theoretical knowledge into practice and allow to explore specific areas or learn particular techniques.
5. PROJECTS - It helps enhance student's critical thinking skills, their abilities to analyze, interpret, and evaluate information; derive a hypothesis to solve problems and apply course material to achieve a specific outcome and effectively communicate during viva.
6. E-LEARNING – Students indulge into e-resources like JGATE, INFLIBNET, NPTEL, COURSERA, Bioinformatics is part of their curriculum as a soft core paper.
7. CO-CURRICULAR ACTIVITIES – Student involvement in co- curricular activities is another way for students to build upon the knowledge and skills. Pictionary, Pick and speak, model making, collage, quiz are the most common co-curricular activities in which students are involved.
8. Rewarding excellence -Recognize and reward excellent student performance.

7. EVALUATION:

Post Graduate Program

1. CIA: Seminars, Assignments, Internal exams (Mid-term & End-Term) – 10 Marks each. Total of 30 marks / paper. Soft core Paper of 15 marks with similar criteria.
2. Theory Examination: Total marks -70 marks/ paper (Section – A: 15 marks, Section B: 25 marks, Section C: 30 marks), soft core – 35 marks / paper (Section – A: 10 marks, Section B: 10 marks, Section C: 15 marks).
3. Practical exam: Major experiments. Minor Experiments and Viva – voce – 35 Marks. CIA- 15 Marks.

DEPARTMENT OF LIFE SCIENCES- GENETICS

M.Sc. APPLIED GENETICS – COURSE MATRIX

SEMESTER I

Paper code	Title of the Paper	Total hrs	Hrs/ week	Marks			Credits	Paper code	Total hrs	Hrs/ week	Marks			Credits	Total marks	Total Credits
				IA	Exam	Total					IA	Exam	Total			
MGE 101	Cell Biology	52	4	30	70	100	4	MGE 106	60	4	15	35	50	2	150	6
MGE 102	Basic Genetics	52	4	30	70	100	4	MGE 107	60	4	15	35	50	2	150	6
MGE 103	Essentials of cytogenetics	52	4	30	70	100	4	MGE 108	60	4	15	35	50	2	150	6
MGE 104	Biological chemistry	52	4	30	70	100	4	MGE 109	60	4	15	35	50	2	150	6
MGE 105	Cellular physiology	40	3	30	70	100	2	-	-	-	-	-	-	-	100	2
	Total	248	19	150	350	500	18		240	16	60	140	200		700	26

SEMESTER II

THEORY								PRACTICALS							Total marks	Total credits
Paper code	Title of the Paper	Total hrs	Hrs/ week	Marks			Credits	Paper code	Total hrs	Hrs/ week	Marks			Credits		
				IA	Exam	Total					IA	Exam	Total			
MGE 201	Molecular Biology	52	4	30	70	100	4	MGE 206	60	4	15	35	50	2	150	6
MGE 202	Genetics of development	52	4	30	70	100	4	MGE 207	60	4	15	35	50	2	150	6
MGE 203	Mutation & Cancer biology	52	4	30	70	100	4	MGE 208	60	4	15	35	50	2	150	6
MGE 204	Evolutionary genetics	52	4	30	70	100	4	MGE 209	60	4	15	35	50	2	150	6
MGE 205	Bioinformatics & Biostatistics	40	3	30	70	100	2	-	-	-	-	-	-	-	100	2
	Total	248	19	150	350	500	18		240	16	60	140	200	8	700	26

SEMESTER III

THEORY								PRACTICALS							Total marks	Total credits
Paper code	Title of the Paper	Total hrs	Hrs/ week	Marks			Credits	Paper code	Total hrs	Hrs/ week	Marks			Credits		
				IA	Exam	Total					IA	Exam	Total			
MGE 301	Genetic engineering	52	4	30	70	100	4	MGE 306	60	4	15	35	50	2	150	6
MGE 302	Microbial & plant genetics	52	4	30	70	100	4	MGE 307	60	4	15	35	50	2	150	6
MGE 303	Human genetics	52	4	30	70	100	4	MGE 308	60	4	15	35	50	2	150	6
MGE 304	Cell physiology practicals	-	-	-	-	-	-	MGE 304	60	4	15	35	50	2	50	2
OE 305	Open elective	52	4	30	70	100	4	-	-	-	-	-	-	-	100	4
	Total	208	16	120	280	400	16		240	16	60	140	200	8	600	24

SEMESTER IV

THEORY								PRACTICALS							Total marks	Total credits
Paper code	Title of the Paper	Total hrs	Hrs/ week	Marks			Credits	Paper code	Total hrs	Hrs/ week	Marks			Credits		
				IA	Exam	Total					IA	Exam	Total			
MGE 401	Genomics & Proteomics	52	4	30	70	100	4	MGE 406 & MGE 407	60	4	15	35	50	2	250	10
MGE 402	Immunology & Haematology	52	4	30	70	100	4									
MGE 403	Biomedical genetics	52	4	30	70	100	4	MGE 408 & MGE 409	60	4	15	35	50	2	250	10
MGE 404	Plant & Animal biotechnology	52	4	30	70	100	4									
PR 405	Project			30	70	100	4	-	-	-	-	-	-	-	100	4
	Total	208	16	150	350	500	20		120	8	30	70	100	4	600	24

RESULT:

- Minimum for pass – Theory - 25 marks, Practical paper –25 marks, Internal marks –Minimum 13 marks (Both theory and practical)
- Grading System SGPA

Final Result/Grade Description

Semester/Program% Of marks	Semester GPA/Program CGPA	Grade Alpha Sign	Result / Class Description
90.1 - 100	9.01 – 10.00	O	Outstanding
80.1 – 90.0	8.01 – 9.00	A+	First Class Exemplary
70.1 – 80.0	7.01 – 8.00	A	First Class Distinction
60.1 – 70.0	6.01 – 7.00	B+	First Class
55.1 – 60.0	5.51 – 6.00	B	High Second Class
50.1 – 55.0	5.01 – 5.50	C	Second Class
40.0 – 50.0	4.00 – 5.00	P	Pass Class
Below 40	Below 4.0	F	Re-Appear

c). CGPA

Table of Conversion of % Marks to Grade Point

% Marks	Grade Point
96 - 100	10
91 - 95	9.5
86 – 90	9.0
81 – 85	8.5
76 – 80	8.0
71 – 75	7.5
66 – 70	7.0
61 – 65	6.5
56 - 60	6.0
51 – 55	5.5
46 – 50	5.0
41 – 45	4.5
40	4

LEARNING OUTCOME:

1. Comprehend principles of genetics and relate it to human genome and genomes of other model organisms.
2. Identify and solve problems associated with the different types of human, animal and plant diseases.
3. Analyze and apply the broad areas of advanced field of study like biomedical genetics, Immunology, Bioinformatics and Nano biotechnology in modern day biotechnological research.
4. Provides an in-depth understanding of the principles of genetics, cytogenetics, developmental genetics, molecular mechanisms of cellular physiology, plant and microbial genetics, bioinformatics, human genetics etc., to obtain a sound knowledge of various fields of genetic study.
5. Apply and transfer an in-depth understanding of the principles of genetics to obtain a sound knowledge of various fields of Science, involve in Research activities and also pursue Ph.D

I SEMESTER THEORY SYLLABUS
MGE-101: CELL BIOLOGY

52Hrs

Course Objectives:

1. To enable students to comprehend the structure and functions of various organelles and that extracellular matrix.
2. To acquire knowledge on the cytoskeletal elements and the mechanism of various signaling pathways.
3. To acquaint with various techniques used in cell and molecular biology and their applications in resolving scientific biological problems.

Course Outcomes (COs):

1. Comprehend and relate the structure and functional aspects of various cell organelles.
2. Cognize and contrast the interaction of a cell with extracellular proteins and other cells.
3. Describe and demonstrate the familiarity with the components of cytoskeletal elements.
4. Understand the basic principles of signal transduction mechanisms and infer the role of different extracellular signals and receptors in cellular communication.
5. Elucidate the principles of various techniques in cell and molecular biology.

MGE-101: CELL BIOLOGY

52 Hrs

Unit I

Overview of cells:

03 hrs

Structure, types and kinds of cells, Differences between prokaryotic and eukaryotic cells.

Membrane systems:

15 hrs

a) **Plasma membrane:** Structure and chemical composition: Fluid-mosaic model, Membrane lipids, carbohydrates and proteins, Transport across membranes: Diffusion, active transport, co-transport and bulk transport, Membrane potentials – resting potential and types of propagation of action potentials, liposomes.

b) Organelle membrane:

Endoplasmic reticulum: The smooth and rough endoplasmic reticulum and their functions.

Golgi complex: Types and mechanisms of vesicular transport within the Golgi complex and their functions.

Lysosomes: Lysosomal membranes and their functions.

Mitochondria: Ultrastructure, oxidative metabolism, proton gradients, ATP synthesis, importing of mitochondrial proteins.

Chloroplasts: Ultrastructure, overview of photosynthesis, photophosphorylation, fixation of carbon dioxide and the synthesis of carbohydrates, importing of chloroplast proteins.

Nucleus: Structural organization and functions of nuclear membrane.

Unit II

Cellular interactions and their environment:

08 hrs

a) Interaction of cells with non cellular substrates The extra cellular space, the extracellular matrix, collagens, proteoglycans, fibronectin, laminin and other proteins, Integrins, focal adhesions and hemidesmosomes.

b) Interactions of cells with other cells Selectin, immunoglobulin super family and integrin super family, cadherins, Junctions: tight junctions, gap junctions and desmosomes, Plasmodesmata.

Unit II

Cytoskeleton and cell motility:

08 hrs

Microtubules-structure and function, dynamic property; Molecular motors, Cilia and flagella- structure and function, Intermediate filaments, microfilaments, muscle contractility, non-muscle motility.

Cell signaling:

08 hrs

Communication between cells and their environment, basic characteristics, second messengers and G protein-complex-coupled receptors, role of calcium as a second messenger, receptor tyrosine kinases, MAP kinase cascade, other signaling pathways- NO, IP3 pathways in plants.

Unit IV

Techniques in cell and molecular biology:

10 hrs

Microscopy: Bright-field, phase-contrast, polarization, fluorescence, confocal, microphotography, video processing and image processing, cell culturing, Ultracentrifugation, Isolation, purification and fractionation of proteins and nucleic acids, Autoradiography, Flow cytometry.

References:

1. Alberts, B., Bray, D., Lewis, J., Raff, M., Roberts, K. & Watson, J.D.
2. Molecular Biology of Cell, II Ed., Garland Pub. Inc. N.Y.
3. Lodish, H., Berk, A., Zipuosky, L.S., Matsudaira, P., Baltimore, D. & Darnell, J. Molecular Cell Biology – IV Ed., W.H. Freeman & Company.
4. Gilbert, S.F. Developmental Biology, Sinauer Associates Inc.
5. Wilson, E.B. Cell in Development and Inheritance, Mac Millan, N.Y.
6. Celis, J.E (Ed.),. Cell Biology: A Laboratory Hand Book – Vol. I & II,
7. Academic Press.
8. Darnell, J. H. Lodish & D. Baltimore. Molecular Cell Biology, Scientific
9. American Books, Inc., USA.
10. Cooper, G.M.. The Cell: A Molecular Approach, Sinauer Associates Inc.
11. Lewin B. Genes VIII, Oxford University Press, Oxford, N.Y. & Tokyo.
12. Garrett & Grisha.. Molecular Aspects of Cell Biology, Sounders, N.Y.
13. Karp G. Cell and Molecular Biology, II Ed., John Wiley & Sons, N.Y.

I SEMESTER THEORY SYLLABUS

MGE 102 Basic Genetics

52 hrs

Course Objectives:

1. To obtain an in-depth knowledge of various patterns of inheritance and the experimental and practical basis of those concepts
2. To understand cell-cell hybridization techniques, linkage, crossing over and principle of construction of linkage maps
3. To apply statistical and biometric methods of analysis in genetics research by using Chi-Square test, Students' t test, probability, Anova etc.,

Course Outcomes:

1. Students gained knowledge of various patterns of inheritance in unicellular and multicellular organisms.
2. Acquire knowledge on hybridization techniques, crossing over, linkage and linkage and chromosome mapping.
3. Analyse and apply various non-mendelian inheritance patterns in the form of gene interactions, extranuclear inheritance of traits of various organisms.
4. Apply statistical and biometric methods of analysis like Chi square test in genetics research
5. Derive an understanding of various mechanisms of sex determination

MGE-102: BASIC GENETICS

52Hrs

UNIT I

13 hrs

Introduction to Science of Inheritance: Model genetic organisms. Life history and Inheritance pattern in bacteriophage (T4), Fungi (Neurospora), Algae (Chlamydomonas), Bacteria (E. coli), Plant (Arabidopsis), Caenorhabditis, Drosophila and Mouse.

Mendelian principles: Mendel and his laws, Applications of laws and probability tests. Chi-square test and its application in the analysis of Genetic data. Pattern of inheritance in haploid (Neurospora) and dipliod (Drosophila). Extension of Mendelism- alleles, allelic variation and genetic factor dominant relationship, basis of dominant and recessive inheritance. Multiple alleles and allelic series, lethal alleles, penetrance and expressivity, pleiotropy.

UNIT II

13 hrs

Chromosomal basis of inheritance: Concepts and evidences, sex chromosomes, Sex determination, molecular mechanism of sex determination in *Drosophila* and man. Sex linked inheritance in *Drosophila* and man. Multiple sex chromosomes, sex- limited and sex influenced traits.

Linkage and crossing over: Concept, Genetic recombination and constructions of genetic map. Genetic and linkage map in *Drosophila*, *Neurospora*, Algae and plants (Maize). Interference and coincidence. Mitotic recombination.

UNIT III

13hrs

Non-Mendelian inheritance/ Extranuclear genes: Maternal inheritance, Extra nuclear inheritance in *Neurospora*, *Chlamydomonas*, *Paramecium*, Yeast, *Drosophila* and Man, Mitochondrial and Chloroplast genes.

Somatic cell genetics: Cell-cell hybridization, cell hybrids, mapping of genes by cell hybridization methods and in-situ hybridization.

UNIT IV

13hrs

Transposable genetic elements :

Discovery and definition of transposons, simple transposons (IS elements), composite transposons (Tn3, Tn5), Ac/Ds elements in maize, P elements in *Drosophila*, Retrotransposons, mechanisms of transposition. Transposition - Transposable genetic elements in prokaryotes and eukaryotes; Mechanisms of transposition; Role of transposons in mutation.

REFERENCES

1. Atherly A. G., Girton, J. R. & McDonald, J. F., 1999. The Science of Genetics, Saunders College Publishing, Harcourt Brace College Publishers.
2. Brookers R. J., Benjamin/Cummings, 1999. Genetics: Analysis and Principles, Longman Inc.
3. Garner E. J., Simmons, M. J. & Snustad, D. P., 1991. Principles of Genetics, John Wiley & Sons Inc., N.Y.
4. Griffiths, A. J. F., Miller, J. H., Suzuki, D. T., Lewontin, R. C. & Gelbart, 1996. An Introduction to Genetic Analysis, W H. Freeman and Company, N.Y.
5. Monroe W. Strickberger. 1996. Genetics, 3rd Ed., M. W. Mac Millan Publishing Co., N.Y.
6. Watson, J.D., Hopkins, N. H., Roberts, J. W. Steitz & Weiner, A. M., 1987. Molecular Biology of the Genes, The Benjamin/Cummings Publishing Company Inc., Tokyo.

7. William S. Klug & Michael R. Cummings, 1996. Essentials of Genetics, 2nd Ed., Prentice Hall Internationals.
8. Daniel L. Hartl & Elizabeth W. Jones, 1999. Essential Genetics, 2nd Ed., Jones & Bartlett Publishers
9. Tom Strachan & Andrew P. Read, 2004. Human Molecular Genetics 3, 3rd Ed., Garland Science, N.Y.
10. Robert H. Tamarin, 2002. Principles of Genetics, 7th Ed., TaTa McGraw-Hill Edition, New Delhi, India.
11. Griffiths, A.J.G., Willian M. Gelbart, Richard C. Lewontin & Jeffrey H. Miller, 2003. Modern Genetic Analysis: Integrating Genes and Genomes, 2nd Ed., W. H. Freeman and Company, N.Y.

I SEMESTER THEORY SYLLABUS

MGE-103: ESSENTIALS OF CYTOGENETICS

52hrs

Course Objectives:

1. To gain an in-depth knowledge of concepts and essentials of cytogenetics
2. To obtain an in-depth knowledge of polytene chromosomes, lampbrush chromosomes and B chromosomes and understand their evolutionary significance and their role in development
3. To carry out a detailed analysis of Evolution of sex chromosomes and evolution of new karyotypes

Course Outcomes:

1. Students are able to build an elaborate knowledge of various concepts in Cytogenetics.
2. Students gain an in-depth knowledge of various special types of chromosomes and understand their evolutionary significance and their role in development.
3. Students are able to perform a detailed analysis of Evolution of X and Y chromosomes and the chromosomal mechanics in the evolution of new karyotypes. Students are able to perform a detailed analysis of Evolution of X and Y chromosomes and the chromosomal mechanics in the evolution of new karyotypes.
4. Students obtain a sound knowledge of chromosome organization and structure, Explain and identify the differences between types of chromatin and the evolutionary significance of heterochromatin and the chromatin modification mechanisms in heterochromatin.
5. Students are able to provide experimental evidence for the chromosome theory of inheritance and Chromosomal mechanics in speciation processes.

PAPER – MGE-103: ESSENTIALS OF CYTOGENETICS

52hrs

UNIT I

13hrs

Nucleus and Chromosome structure: Chromosomal theory of inheritance, Interphase nucleus, nuclear membrane, nuclear matrix and other structures, Molecular organization of prokaryotic and eukaryotic chromosomes, Nucleosome structure, Chromosomal protein, Higher order of eukaryotic chromosomes, DNA scaffolds and loops, structure of eukaryotic chromosomes, Chromomere, Kinetochore, Centromeres and Telomeres, Heterochromatin and Euchromatin.

UNIT II

Cell division: Mitotic and meiotic transmission of chromosomes, Specialized Chromosomes; Lampbrush chromosomes: Types, occurrence, specialized organization and biological significance. Polytene chromosomes: Occurrence, structural organization and their functional role. Supernumerary chromosomes: Occurrence, role during meiosis and mitosis and their evolutionary significance. **13hrs**

Chromosome aberrations: Changes in chromosome structure, Origins of changes in chromosome structure. Deletions, duplications, inversions and translocations. Genetic significance of Robertsonian and non-Robertsonian translocations.

UNIT III

Changes in chromosome number: Anueploidy (monosomy, trisomy, double trisomy, tetrasomy, nullisomy): Causes and consequences. Polyploidy (haploids, triploids, tetraploids, allotetraploids): Occurrence, types and genetic significance **13hrs**

Role of chromosomes during evolution: Chromosomal changes and species differentiation, Chromosomal mechanics in speciation processes (Rodents, Insects). Role of heterochromatin in species evolution and karyotypic differentiation(Drosophila and mammals).

UNIT IV

Evolution of sex chromosomes: Types of Sex chromosomes, simple and multiple sex chromosome. Evolution of X and Y chromosome. Chromosome imprinting phenomena. **13 hrs**

Chromosomes in evolution: Evolution of new Karyotypes (Ex. *Drosophila virilis* group), Practical applications of rearrangements: Balancers, Ring chromosomes, Attached X- chromosome in *Drosophila*.

REFERENCES

1. Goodenough Ursula, 1984. Genetics. 3rd Ed., CBS College Publishing.
2. Hamerton, J. L., 1984. Human Cytogenetics. Vols. I &II. Academic Press, N.Y.
3. White, M.J.D., 1973. Animal Cytology and Evolution, Cambridge University Press.
4. White, M.J.D. Modes of Speciation, W.H. Freeman & Co.
5. Gardner, Simmons, & Snustad, 1997. Principles of Genetics 8th Ed., John Wiley and Sons.
6. Lewin, B., 1996. Genes VI, John Wiley and Sons.
7. Mark H. F. L., 2000. Medical Cytogenetics, Marcel Dekker Inc, N.Y.
8. Sambamurthy, A.V.S., 1999. Genetics, Narosa Publishing House, New Delhi.
9. Sumner, A.T. 2003. Chromosomes: Organization and Function, Blackwell Publishing, USA

I SEMESTER THEORY SYLLABUS

MGE-104: BIOLOGICAL CHEMISTRY

52hrs

Course Objectives:

1. To enable to understand and apply the biochemical aspects in biological systems like physiological and metabolic events.
2. To enhance knowledge in the quantitative and qualitative estimation of biomolecules.
3. To instill knowledge in various biochemical concepts and their applications in biological research perspective.

Course Outcomes:

1. Students developed ability to apply basic principles of chemistry to biological systems and molecular biology.
2. Able to relate and experiment various interrelated physiological and metabolic events.
3. Understand and experiment the fundamental concepts of biology, chemistry and biochemistry
4. Acquire knowledge in the quantitative and qualitative estimation of biomolecules and critically analyze the inheritance pattern in the offsprings.
5. Students obtained knowledge about the influence and role of structure in reactivity of biomolecules and research the application of the same.

MGE-104: BIOLOGICAL CHEMISTRY

52hrs

UNIT I

13hrs

Biomolecules:

Carbohydrates - Classification, structure and properties of different classes, chemical reactions, derived sugars.

Amino acids and Proteins – Structure, classification and properties of amino acids and proteins, non-protein amino acids, essential amino acids, amphoteric properties of amino acids, dissociation, chemical reactions. Classes and properties of proteins. Structural Organization of proteins (Primary, Secondary, Tertiary and quaternary structure).

Lipids – Classification, structure of lipids, fatty acids, phospholipids, sphingolipids, glycolipids and steroids, chemical reactions.

Nucleic acids – Structure and properties of different types of RNA, Structure of DNA. Watson – Crick model of DNA, Polymorphism in DNA Structure.

UNIT II

13hrs

Enzymes: History, classification and nomenclature, specificity of enzyme; Kinetics of enzyme catalyzed reaction - Chemical kinetics, Michaelis – Menten equation, Transformation of M-M equation, L-B Plot, quantitative assay of enzyme activity, factors affecting enzyme activity, Mechanism of enzyme action – hypothesis, catalytic mechanism, acid-base and covalent catalysis – activation and inhibition of enzymes,

allosteric modulation, coenzymes and isoenzymes.

UNIT III

13hrs

Bioenergetics: Laws of thermodynamics and their application to biological process, basic concepts of metabolic energy, capture and transfer, biochemical energetics – free energy concept, high energy phosphate compounds (ATP and others)

Biological Oxidation: Oxidation–reduction reactions, biological redox potential, mitochondrial electron transport chain, oxidative phosphorylation, chemical and chemiosmotic hypothesis.

UNIT IV

13hrs

Metabolism:

Carbohydrates: Glycogenolysis, glycogenesis, regulation of glycogen metabolism, glycolysis, gluconeogenesis, fermentation reactions, TCA cycle, glyoxylate cycle, pentose phosphate pathway.

Proteins and amino acid metabolism: Enzymatic and chemical hydrolysis of protein, general metabolism of amino acids – transamination, deamination, decarboxylation, urea cycle, uric acid biosynthesis.

Lipids: Biosynthesis of fatty acids – Regulation of fatty acid synthesis. Oxidation of fatty acids – scheme of β -oxidation, energetics of β -oxidation, other pathways.

Nucleic acids - Biosynthesis of purines and pyrimidines.

REFERENCES

1. Basic Concepts of Biochemistry, Gilbert, H.F., McGraw Hill professional, New York, 2002
2. Biochemistry. Down, M.B., Lipincott Willam & Wilkins, Landon, 1999
3. Biochemistry. Campbell, M., AND Farrell, D., 4th ed. Thomson Brooks/Cole, 2005
4. Biochemistry. Stryer, L., 4th ed, W.H. Freeman and Company, New york 1999
5. An Introduction to Practical Biochemistry, 3rd ed., Tata McGraw Hill, New Delhi, 2001
6. Biochemistry. Power & Chatwal, Himalaya publishing House, New Delhi, 2000
7. Biochemistry. Mathew, Sand Van Holde., 2nd. Benjamin/Cumming publishing Comp. London, 1995
8. Biochemistry – Lehninger
9. Biochemistry – Voet & Voet

I SEMESTER THEORY SYLLABUS
MGE-105: CELLULAR PHYSIOLOGY

40 Hrs

Course Objectives:

1. To give a detailed description of the cell environment, buffering systems, water, gases and blood pressure regulation. A thorough knowledge of radiations in the cell environment and their effects on cells.
2. To obtain insight into ion channels and carriers and movement of solvent and solutes across cell membrane.
3. To obtain an in-depth knowledge of excitability and contractility of cells, synaptic transmission of action potentials, salutatory conduction and an analysis of effects of various factors on action potential of nerve cells.

Course Outcomes:

1. Students gain insight into the cell microenvironment, buffering systems, and the homeostasis of water, gases and blood pressure and knowledge of radiation effects on cells.
2. Students can illustrate the structure of Plasma membrane and permeability to water and solutes, partition coefficient and permeability.
3. Students perform a detailed study of Measuring membrane potential, resting membrane potential and action potential, voltage clamping use of Nernst equilibrium potential and Goldman Constant Field equations.
4. Students demonstrate an in-depth knowledge of ion channels and carriers and movement of solvent and solutes across cell membrane.
5. Students demonstrate an in-depth knowledge of ion channels and carriers and movement of solvent and solutes across cell membrane.

MGE-105: CELLULAR PHYSIOLOGY

40 Hrs

UNIT I

13hrs

THE CELL ENVIRONMENT

Components of the cellular environment, Water, gases and pressure for survival of cells. Buffers and buffering systems- resistance of cells to pH changes, halophilic organisms.

Radiations in the cell environment – natural radiations, different kinds of ionizing radiations and their effect on cells.

Temperature-Thermoregulation, and thermal resistance, Thermal resistance of dormant cells, temperature effects on rate of diffusion and conductivity. Vant Hoff equation for Q10

UNIT II

BIOMEMBRANES

14hrs

Cell Homeostasis and Transport: Membrane permeability to water and solutes, partition coefficient and permeability, volume and distribution of water and electrolytes, normal balance. Effect of narcotics and anesthetics upon permeability

Membrane potentials: Measuring membrane potential, separation of charge, generation of resting potential and propagation of action potential. Factors controlling ion movements, Nernst equilibrium potential, Goldman Constant Field equations for movement of solvent and solutes across cell membrane.

Channels: Voltage sensitive sodium channels and voltage clamping. Extracellular recordings- compound action potential and cardiac action potential. Patch clamp techniques for single channel and whole cell recording.

UNIT III

13 hrs

EXCITABILITY and CONTRACTILITY

Action potentials of cells- rate and conduction of nerve impulses, saltatory conduction, heat production and nerve activity, synaptic transmission of action potentials, effects of various factors on action potential of nerve cells. Action potentials in muscle fibers

Contractility- contraction of smooth muscle cells, cardiac cells and skeletal muscle fibers. Molecular orientation in muscle fibers, structural proteins, calcium conductance and source of energy for contraction, mechanisms of muscle contraction, work and heat generation in muscle contraction

REFERENCES

1. Arthur C. Giese. Cell Physiology (W B Saunders Co)
2. David J. Aidl. The Physiology of Excitable Cells (Cambridge University Press)
3. David Landowne. Cellular Physiology (Tata –McGrwa Hill CompaniesInc).
4. Gary G Mathews. Cellular Physiology of Nerve and Muscle(Wiley)
5. James Keener and James Sneyd. Mathematical Physiology: I. Cellular Physiology (Springer)
6. James Kew and Ceri Davies. Ion Channels: From Structure to Function (Oxford UniversityPress)
7. Mordecai P. Blaustein, Joseph P. Y. Kao and Donald R. Matteson.. Cellular Physiology and Neurophysiology (Mosby) Second edition
8. Mordecai P Blaustein , Joseph P.Y Kao, and Donald R Matteson. Cellular Physiology (Elsevier/Mosby)
9. Nicholas Sperelakis. Cell Physiology Source Book (Elsevier Inc) Third edition
10. Terence Allen and Graham J. Cowling The Cell: A very short introduction (Oxford University Press)

I SEMESTER – PRACTICAL SYLLABUS

MGE-106 CELL BIOLOGY

Total : 60 hrs

Course Objectives:

1. To inspire interest in microscopic analysis of tissues and enable students to identify various stages in cell division.
2. To study vital staining and other staining techniques.
3. To perform the isolation of various organelles like chloroplast, mitochondria and nucleus.

Course Outcomes:

1. The students are able to perform vital staining to observe mitochondria in actively dividing yeast cells.
2. The course enables the students to identify the stages of mitotic cell division.
3. The students are able to distinguish between and identify the various stages and sub-stages of meiotic cell division in grasshopper testis tissue.
4. The students study the structure of X-chromatin in humans.
5. The students gain an insight into the various techniques used for organelle isolation.

MGE-106 CELL BIOLOGY

Total : 60 hrs

1. **Vital staining of Mitochondria**
2. **Study of Mitosis in Onion root tips**
3. **Identification of meiotic stages using permanent slides**
4. **Preparation of temporary/permanent slides of meiotic stages grasshopper testis (Poecilocera/Oxyasps).**
5. **Study of X-chromatin in human (Buccal smear)**
6. **Cell fractionation (demonstration)**
7. **Isolation of chloroplast (spinach leaves)**
8. **Isolation of mitochondria (spinach leaves)**
9. **Isolation of nucleus (sheep liver)**
10. **Culturing of microorganisms (Paramecium, Euglena) to observe cell motility**

I SEMESTER – PRACTICAL SYLLABUS

MGE -107- BASIC GENETICS

Total : 60 hrs

Course Objectives:

1. To make the students to understand the Life Cycle of *Drosophila melanogaster*
2. To apply the inheritance of traits from generation to generation
3. To acquaint in mounting the various parts of *Drosophila*

Course Outcomes:

1. Students are able to understand the Life cycle of *Drosophila*
2. Apply Mendel's Laws of inheritance
3. Able to prepare culture media of *Drosophila melanogaster*
4. Understand the basic concepts of mounting of Sex comb in *Drosophila*
5. Distinguish abnormalities in sperm shape of mouse

MGE -107- BASIC GENETICS

Total : 60 hrs

1. Study of *Drosophila* life cycle and its external morphology.
2. *Drosophila* culture: media preparation and handling of flies
3. Study of *Drosophila* mutants
4. Mounting of sex comb of *Drosophila melanogaster*.
5. Mounting of genital plate of *Drosophila melanogaster*.
6. Mounting and study of forewings of *Drosophila melanogaster*.
7. Study of venation patterns in different *Drosophila species*.
8. Study of Law of segregation and Law of independent assortment in fruit flies.
9. Study of sperm shape abnormalities in mouse.

I SEMESTER – PRACTICAL SYLLABUS

MGE-108 ESSENTIALS OF CYTOGENETICS

Total : 60hrs

Course Objectives:

1. To study the process of meiotic cell division.
2. To provide an insight into chromosomal aberrations and study various modes of inducing them.
3. To deduce the structure of special types of chromosomes like polytene chromosomes.

Course Outcomes:

1. The students are able to dissect and prepare meiotic tissues in *Laccotrephis* and *Sphaerodema* and study various stages of meiosis.
2. Students are adept in the preparation of salivary gland tissue for the visualization of polytene chromosomes.
3. The Students gain exposure in the handling of model organisms like rats and in the preparation of metaphase plate from rat bone marrow.
4. By the end of the course the students are able to successfully culture and propagate paramecia and stain them for the observation of nucleic acid.
5. The students observe the induction of polyploidy in onion root tips

MGE-108 ESSENTIALS OF CYTOGENETICS

Total : 60 hrs

1. Study of meiosis in *Laccotrephis* and *Sphaerodema*.
2. Study of inversion polymorphism in *Chironomous*/mosquito polytene chromosomes.
3. Study of chromosomal aberrations induced by chemicals and X-rays (Rat). (Institutional visit)
4. Preparation of metaphase plate from rat bone marrow(Institutional visit)
5. Induction of Polyploidy in onion root tips
6. Feulgen staining of DNA in protozoa (*Paramecium*)

I SEMESTER – PRACTICAL SYLLABUS

MGE-109 BIOLOGICAL CHEMSITRY

Total : 60 hrs

Course Objectives:

1. To study the process of ATPase activity
2. To provide an insight into esterase activity
3. To deduce optimum blood glucose and serum cholesterol

Course Outcomes:

1. Understand the process of ATPase activity
2. Acquisition of knowledge about esterase activity
3. Able to estimate proteins and amino acids in Biological samples
4. Gain knowledge in the estimation of blood glucose and cholesterol
5. Able to prepare phosphate from egg yolk

MGE-109 BIOLOGICAL CHEMSITRY

Total : 60 hrs

1. Study of sodium-potassium ATPase activity in animal tissues (sheep).
2. Estimation of acetylcholine esterase activity by Hestrin's method (sheep).
3. Preparation of phosphatides from egg yolk.
4. Estimation of proteins in liver/mouse by Lowry's/Bradford's method.
5. Estimation of amino acids by Sorenson's method.
6. Determination of blood glucose and serum cholesterol in clinical samples.

II SEMESTER THEORY SYLLABUS

MGE-201: MOLECULAR BIOLOGY

52Hrs

Course Objectives:

1. To provide comprehensive understanding of salient features and structure of nucleic acids.
2. To impart elaborate understanding of the key events of prokaryotic and eukaryotic replication, transcription and translation.
3. To gain in-depth knowledge on the mechanism of gene regulation and expression.

Course Outcomes (COs):

1. Compare the genome structure and function of eukaryotic cells with that of simpler prokaryotic cells.
2. Illustrate the structural organization of genes and the control of gene expression.
3. Distinguish between positive and negative control of gene expression.
4. Apply the knowledge of various operons in formulating and executing experiments involving gene expression studies to address biological problems.
5. Apply the knowledge and link rapid advances in molecular biology to comprehend the mechanisms involved in various genetic diseases

MGE-201: MOLECULAR BIOLOGY

52Hrs

UNIT I

13Hrs

Structure and Properties of DNA, RNA and Replication:

Information flow in biological systems: Central dogma. Biochemical evidences for DNA as genetic material. Watson and Crick model of DNA, Supercoiling- twist, writhe and linking number, different forms of DNA (A, B, Z). Structure and functions of different types of RNA. Characteristics and functions of bacterial DNA polymerases, Mechanism of prokaryotic DNA replication, models of replications in prokaryotes. Fidelity of replication, Nearest neighbor frequency analysis. Eukaryotic DNA polymerases and mechanism of replication. Telomere synthesis-telomerases. Replication of viral DNA, rolling circle model. Inhibitors of replicatio

UNIT II

13Hrs

Transcription

Characteristics and function of bacterial RNA polymerases, mechanism of transcription and regulation. Eukaryotic RNA polymerases- transcription factors, mechanism of transcription and regulation. Stringent response. Post transcriptional modifications of mRNA (5'cap formation, poly adenylation, spliciosome assembly, splicing editing), stability. Processing of tRNA and rRNA. Inhibitors of transcription. Ribozyme technology: mechanism of action and applications.

UNIT III

13Hrs

Translation and protein targeting:

Genetic code, Wobble hypothesis. Ribosome assembly, mechanism of activation of amino acids. Mechanism of translation in prokaryotes and eukaryotes. Differences between prokaryotic and eukaryotic protein synthesis, codon usage, Inhibitors of protein synthesis. Co and post-translational modifications of proteins. Control of translation in eukaryotes.

Signal hypothesis, Export of secretory proteins- transport and localization of proteins.

UNIT IV**13 Hrs****Regulation of Gene expression:**

Gene regulation, Operon model-Inducible and repressible systems, lac, gal, trp, his and arabinose operon; Attenuation, positive and negative regulation, role of cAMP and CRP in the expression of lac genes, catabolite repression, regulation of eukaryotic gene expression, transcriptional control, cis control elements, promoters, enhancers, transacting factors, homeobox in the control of developments in insects and vertebrates. DNA binding motifs of transcription factors, posttranscriptional control.

Gene Silencing: transcriptional and post transcriptional gene silencing, RNAi pathway (si RNA and mi RNA).

REFERENCES:

1. Principles of gene manipulation - An introduction to genetic engineering, Old R.W., Primrose S.B., Blackwell Scientific Publications,.
2. Nelson, D.L., Cox, M.M. Lehninger Principles of Biochemistry Pub WH Freeman Co.
3. Elliott, W.H., Elliott, D.C. Biochemistry and Molecular Biology , Pub. Oxford.
4. Mathews, Van Holde, Ahern, Biochemistry by, Pub Pearson education.
5. Alberts, B., Bray, D., Lewis, J., Raf, M., Roberts, K. and Watson, J.D. Molecular Biology of the Cell.
6. Cooper, G.M. The Cell: A molecular approach, ASM Press, USA.
7. Garrett, R.H. and Gresham, C.M.. Molecular aspects of Cell Biology, International edition, Saunders College Pub.
8. Karp, G. Cell and Molecular Biology concepts and experiments, John Wiley and Sons Inc. NY.
9. Lodish, H., Baltimore, D., Berk, A., Zipursky, B.L., Mastysdaira, P., Darnell, J. Molecular Cell Biology, Scientific American Books Inc. NY.

THEORY SYLLABUS- II SEMESTER

MGE-202: GENETICS OF DEVELOPMENT

52hrs

Course Objectives:

1. To perform a detailed analysis of molecular events of Oogenesis and spermatogenesis.
2. To analyze cell fate and pattern formation, molecular analysis of basic body plan and understand the genetics of axis specification in *Drosophila*.
3. To give an account on Stem cells, Embryonic stem cells and therapeutic cloning, transgenic stem cells and Regeneration Therapy and to describe Cellular aging and death.

Course Outcomes:

1. Students perform a detailed analysis of molecular events of Oogenesis and spermatogenesis and Hormonal regulations
2. Students are able to provide an in-depth account of Molecular events of fertilization and genetics of multicellularity cleavage in early development
3. Students can account of Early vertebrate development and Morphogenetic and cell movement.
4. Students give an account on Stem cells, Embryonic stem cells and therapeutic cloning, transgenic stem cells and Regeneration Therapy. A description of Cellular aging and death, Caspases, Cellular death receptors, Apoptosis and mechanism of Apoptosis.
5. Students perform a detailed analysis of Cell fate and pattern formation, molecular analysis of basic body plan, Genetics of axis specification in *Drosophila*, *C. elegans*, Amphibians and mammals

MGE-202: GENETICS OF DEVELOPMENT

52hrs

UNIT I

13hrs

Gametogenesis and differentiation: Oogenesis and spermatogenesis, Hormonal regulations.

Fertilization and development: Molecular events of fertilization, activation of sperm motility, gamete fusion, Role of calcium during egg activation; Genetics of multicellularity: cleavage and molecular events.

UNIT II

13 hrs

Early vertebrate development: An introduction to early developmental process-

Development of epidermis and neural tissue, formation of embryonic mesoderm and endoderm.

Morphogenetic and cell movement: Gastrulation in vertebrates, regulation of tissue separation in the amphibian embryo, role of basement membrane in cell migration, epithelial morphogenesis, branching morphogenesis of mammalian epithelia.

UNIT III

13 hrs

Pattern formation: Cell fate and pattern formation, mutational and molecular analysis of basic body plan, Communication between and among cells, Genetics of axis specification in *Drosophila*, *C. elegans*, Amphibians and mammals.

Metamorphosis: Molecular mechanisms of: Ecdysone action, Signalling during larval organ differentiation, Hormone response during metamorphosis, Genetics of eversion and differentiation of imaginal disc cells; Regeneration: Cellular processes, Formation of blastomeres, Neuronal innervation, Transdifferentiation.

UNIT IV

13 hrs

Stem cells: Embryonic stem cells – therapeutic cloning, Multipotent adult stem cells, transgenic stem cells. Regeneration Therapy – neural diseases, cancer. Directed differentiation of stem cells.

Cellular aging: Concepts of aging, Cellular change during aging, theories.

Cell death: Apoptosis and mechanism of Apoptosis; Caspases, pro-apoptotic and anti-apoptotic proteins, Cellular death receptors, Signals for cell survival.

REFERENCES

1. Balinsky. Text Book of Embryology, Holt Saunders Company Ltd.
2. Berryl & Karp. Text Book of Developmental Biology, Tata Mac Graw Hill.
3. Browder, Erison, Jeffery, Developmental Biology, Saunders College Publishing Co., Inc. USA.
4. De Robertis, E.D.P., Essentials of Cell and Molecular Biology, Academic Press.
5. Gerald Karp,. Cell and Molecular Biology, John Wiley and Sons, Inc. Canada.
6. Gilbert, S.F., Developmental Biology-VI Ed, Sinauer Associates Inc. Publishers, Massachusetts.
7. Knobil, E. & Neil, J.D. (Eds.),. The Physiology of Reproduction-II ED, Vol-I&II, Raven Press Ltd.
8. Meyerowitz, E.,. Principles of Development, Oxford University Press.
9. Wolpert, et al.,. Principles of Development, Oxford University Press.
10. Davis. J.M., Basic Cell Culture.

THEORY SYLLABUS- II SEMESTER

MGE-203: MUTATION AND CANCER BIOLOGY 52Hrs

Course Objectives:

1. To give a description of basic concepts of mutation, mutagenesis and mutagenic agents and their effects.
2. To give a detailed analysis of DNA damage and repair mechanisms and DNA repair diseases.
3. To gain an in-depth view of cancer cytogenetics and cancer genetics.

Course Outcomes:

1. Students gain knowledge of Basic concepts of mutation, mutagenesis and mutagenic agents and their effects, effects of physical and chemical mutagens
2. Students perform a detailed analysis of DNA damage and repair mechanisms and an account of DNA repair defects in Human diseases
3. Students perform an in-depth analysis of Cancer cytogenetics and cancer genes- oncogenes, tumor suppressors, role of P53 in cancer induction
4. Students gain an understanding of tumor immunology, Mechanism of immune response to cancer, cancer diagnostics & therapy, Biochemical, histological and radiological methods for cancer diagnosis. An analysis of Chemotherapy and radiotherapy strategies for cancer treatment, Immunotherapy of cancer
5. Students are introduced to Cancer biology, mechanism of Carcinogenesis, types of cancers, characteristics of cancer cells.

MGE-203: MUTATION AND CANCER BIOLOGY 52Hrs

UNIT I

13 Hrs

Basic concepts of mutation and mutagenesis : Introduction, historical perspective; Types of mutations: microlesions - substitution, frameshift, non-frameshift, insertion, deletion; Macrolesions; spontaneous and induced mutations.

Mutagenic agents and their effects: Ionizing – alpha, beta, gamma and X radiations; Non-ionizing radiations - Ultraviolet and electromagnetic radiations; radiation dosimetry.

Mutagenic and clastogenic effects of radiations - Radiation effects on DNA; single strand breaks, double strand breaks, base damages, cross links, dimerisation. Chromosome and chromatid aberrations, breaks, exchanges, dicentrics, translocations, achromatic lesions, aneuploidy.

Chemical mutagens and their mechanisms – Agents which induce alkylation, deamination, base substitution, intercalation. Clastogenic effects of chemicals.

UNIT II

13 Hrs

DNA damage and repair mechanisms : Introduction, DNA damage, types of DNA repair and their mechanisms – Direct repair, Base excision repair, Nucleotide excision repair, mismatch repair, recombinational repair, Photoreactivation, SOS repair; DNA repair genes, role of P53 gene in DNA repair and apoptosis. DNA repair defects in Human diseases – Ataxia Telangiectasia, Xeroderma Pigmentosum, Bloom's syndrome, Fanconi anemia, Cockayne syndrome, hereditary breast cancer

Cancer biology and carcinogenic agents: Introduction, neoplasia, anaplasia, metaplasia and hyperplasia, types of cancer- benign, malignant, metastatic cancers. Carcinomas, sarcomas, adenomas, haemopoietic cancers. Characteristics of cancer cells - changes in cell membrane structure and functions, tumor angiogenesis.

Carcinogenic agents – Physical, chemical and biological agents in carcinogenesis. Historical highlights, types of chemical carcinogens; direct acting, pro-carcinogens, co-carcinogens, mechanism of their action. Viral carcinogenesis – Role of viruses in causation of human cancer; Tobacco and diet related cancers

UNIT III

13 Hrs

Cancer cytogenetics and cancer genes: Somatic mutation theory of cancer, Cytogenetic and karyotype nomenclature, Various types of chromosomal aberrations in cancers, Philadelphia chromosome, Role of mismatch repair in cancer.

Oncogenes : Historical aspects, provirus, provirus and oncogene hypothesis. Functional class of oncogenes (proto-oncogenes) Mechanism of carcinogenic transformation by oncogenes, viral oncogenes. Tumor suppressor genes- properties and mechanism of tumor suppression with special reference to p53 gene. Inherited cancers

UNIT IV

13 Hrs

Tumor immunology and cancer diagnostics & therapy: Tumor immunology – Introduction, Mechanism of immune response to cancer, natural killer cells and cell mediated cytotoxicity. Biochemical, histological and radiological methods for cancer diagnosis.

Chemotherapy and radiotherapy strategies for cancer treatment. Cancer chemotherapeutic drugs.

Types of radiation therapy.

Immunotherapy of cancer – Rationale of immunotherapy, Tumor necrosis factor, interleukins, cytokines, interferons, vaccines, monoclonal antibodies.

REFERENCES:

1. Heim S, Mitelman F Cancer Cytogenetics, Alan R. Liss, Inc., New York.
2. Raymond W. R Cancer Biology, Oxford University Press, New York.
3. Becker F. F (Ed) Cancer, Vol.1-3, Plenum Press, New York.
4. Souhani R Cancer and its management, Blackwell Publishers,Oxford.
5. Alberts B, Bray D, Lewis J, Raff M, Roberts K. and Watson J.D. Molecular Biology of the Cell, Garland Publishing Company Ltd. New York and London

6. Kleinsmith L. J. and Valeri M. K. Principles of Cell and Molecular biology, Harper Collins College publishers
7. Darnell J. H, Lodish and D. Baltimore Molecular Cell Biology, Scientific American Books, New York.
8. Lewin B. (Ed Genes, John Wiley and Sons, New York.
9. Umadevi P, Nagaratnam A and Satish Rao B.S Introduction to Radiation Biology, B.I. Churchill Livinstone Pvt. Ltd. New Delhi

THEORY SYLLABUS- II SEMESTER

MGE- 204: EVOLUTIONARY GENETICS

52hrs

Course Objectives:

1. To make the Students to understand Biochemical and Genetic basis of formation of new species and inheritance of characteristics.
2. To enable the students to gain absolute knowledge on Darwinism, origin of species, modern synthetic theory and various theories of evolution.
3. To gain in depth knowledge on adaptive variation in the process of evolution.

Course Outcomes:

1. Describe the adaptive features of both primary and secondary aquatic vertebrates, desert reptile and mammals and also experiment the evolutionary aspects.
2. Elucidate the Chemical basis of origin of life and experiments for supporting that idea.
3. Describe and solve the mystery of the origin of new species by understanding the concepts of theory of Evolution considering Darwinism and Modern Synthetic theory.
4. Expound understanding of adaptive significance of coloration and mimicry with respect to environmental influence and the formation of variations in the expression of the characters in the process of evolution.
5. Describe the Isolating mechanisms, modes of speciation, Biological & Evolutionary Species.

MGE- 204: EVOLUTIONARY GENETICS

52hrs

UNIT I

13 hrs

Evolutionary theories: Overview of history and evolutionary thought, Lamarckism and its limitations, Darwinism and its limitations, Mendelian and Biometrician controversy, Neo-Darwinism: [Mendelian population](#), [Gene pool](#), [Allele frequencies and genotype frequencies](#), [Hardy-Weinberg genetic equilibrium and its applications](#).

[Evolutionary forces that affect the allelic frequencies](#), (i) [Mutation](#) (ii) [Migration](#) (iii) [Selection- Stabilizing selection, Directional selection, Disruptive selection, Balancing selection, Frequency dependant selection, Density dependant selection, Group and kin selection, selection coefficient, selective value, Selection in natural populations, Genetic drift, Nonrandom mating](#).

UNIT II

13 hrs

Driving forces of Evolutionary: [Fitness, Selection, Migration, random drift in small population, Non-darwinism, molecular polymorphism, nucleic acids and proteins, molecular clock, neutral theory of evolution, evolution random walk](#).

UNIT III

13 hrs

Isolating mechanisms: Classifications, Geographic isolation, Reproductive isolation, Premating isolation: Climatic, Seasonal, Habitat, Ethological, Post mating isolation: Gametic mortality, Hybrid inviability, Hybrid sterility, Hybrid breakdown, Origin of reproduction isolation, Muller's view. Dobzhansky view.

Speciation: Species types and Species categories, Concepts of species, Models of speciation: Based on distribution-sympatric, allopatric, stasipatric, Based on genetic drift: Genetic revolution, Genetic transilience, Founder flush theory, Hybridization and speciation, Phyletic gradualism and punctuated equilibrium, Molecular aspect of speciation, speciation genes.

UNIT IV

13 hrs

Molecular phylogenetics: Construction of phylogenetic tree, Phylogenetic inferences: Distance method, Parsimony, maximum - likelihood method, Molecular phylogenetics of *Homo sapiens* and related issues, Hominid evolution.

Human population genetics and evolution: Basic attributes and polymorphic structures in human protein coding genes. Mitochondrial DNA polymorphism. Y-chromosome polymorphism and Single nucleotide polymorphism (SNP), Human society.

REFERENCES

1. T. A. Brown, 1999. Genomes, John Wiley & Sons (Asia) PTE Ltd.
2. Scott Freeman & Jon C. Herron, 2001. Evolutionary Analysis (2nd Edition), Prentice Hall.
3. Falconer & Mackay, 1996. Introduction to Quantitative Genetics (IV Edition), Longman.
4. David P. Mindell, 1997. Avian Molecular Evolution & Systematics, Academic Press.
5. Derek A. Roff, 1997. Evolutionary Quantitative Genetics, Chapman & Hall.
6. R.S.Singh & C. Krimbas, 2000. Evolutionary Genetics- From Molecules to Morphology, Cambridge University Press.
7. Peter Donnelly & Simon Tavaré, 1997. Progress in Population Genetics & Human Evolution (Vol. 87), Springer.
8. William S. Klug & Michael R. Cummings, 2000. Concepts of Genetics (Sixth Edition), Prentice Hall.
9. Monre W. Strickberger, 1985. Genetics (Third Edition), Prentice Hall of India.

THEORY SYLLABUS- II SEMESTER

MGE-205: BIOINFORMATICS AND BIOSTATISTICS 40 hrs

Course Objectives:

1. To enable the students to the concepts and principles of biology, computer science, mathematics and Bioinformatics.
2. To facilitate the students to enumerate biological macromolecular structures
3. To make the students to understand different methods to characterize and manage the different types of Biological data.

Course Outcomes:

1. Able to understand and apply the concepts of Bioinformatics
2. Understand the basic principles of biology, computer science and mathematics to address complex biological problems
3. Students are able to enumerate biological macromolecular structures and structure prediction methods
4. Capable of analyzing and understanding different types of protein and other organism specific databases
5. Able to explain about the methods to characterise and manage the different types of Biological data.

MGE-205: BIOINFORMATICS AND BIOSTATISTICS 40 hrs

Part A: Bioinformatics

UNIT I

13hrs

Introduction to bioinformatics: Gene, Genome and Genomics, Proteomics and applications.

Sequence Analysis: Nucleotide and proteomic sequence analysis, Homology sequence analysis – BLAST, FASTA, Pairwise sequence analysis, Multiple sequences- CLUSTALW, Phylogenetic analysis.

UNIT II

13hrs

Biological Databases: Significance, Primary and Secondary databases, Nucleotide and proteome databases, Database querying software's.

Computer applications: Computer organization. Computer hardwares and computer software. Operating system: Basics of Windows, Unix and Linux .Spreadsheet and its applications. Databases, Computer networks: Internet, world wide web and applications. Information technology, Multimedia.Computer applications in genomics.

Part B: Biostatistics

UNIT III

14hrs

Introduction: Data collection, sampling (random and non random). Frequency distribution, histogram and frequency curve. Stem and leaf and box plot techniques. Time series graph. Measures of central tendency and dispersion. Skewness and kurtosis.

Probability: Conditional probability. Addition and multiplication rules of probability. Probability distributions. Binomial, Poisson and Normal distributions. Applications in genetics: simple, linear regression and correlation.

Tests of significance: Chi-square test, T-test, Z- test and F- test. Analysis of variance (one-way and two-way classified data).

REFERENCES

1. Attwood, T.K. & D.J. Parry-Smith (1999): Introduction to bioinformatics, Pearson Education Asia, New Delhi
2. Bergeron (2005): Bioinformatics computing. Pearson Education.
3. Campbell (2004): Discovering Genomics, Proteomics and Bioinformatics, Pearson Education.
4. Higgins, D and W. Taylor (2000): Bioinformatics Sequence, Structure and databanks, Oxford University Press.
5. Krane (2005): Fundamental concepts of Bioinformatics. Pearson Education.
6. Leon and Leon (1999): Information Technology, Leon and Leon publications, Chennai.
7. Pagano, P and G. Kimberlee (2004): Principles of biostatistics. Thomson Publications.
8. Nabendu Pal and Sahadeb Sarkar (2006): Statistics- Concepts and applications. PHI.
9. Glover and Mitchel: Introductory Biostatistics: McGrawhill.
10. Zar (2005): Biostatistical Analysis 4/e Pearson Education.
11. Daniel: (2002): Biostatistics. John Wiley, ISE
12. Medhi, J. (1992) Basic Statistics, New Age Publications.

II SEMESTER – PRACTICAL SYLLABUS

MGE-206 MOLECULAR BIOLOGY

Total : 60 hrs

Course Objectives:

1. To gain expertise in the methods of nucleic acid isolation from various tissues.
2. To perform the estimation of cellular DNA and RNA using standard techniques.
3. To analyze genomic DNA using Agarose Gel Electrophoresis (PAGE) technique.

Course Outcomes:

1. The students gain experience in handling of various tools and equipment used in molecular biology and study the isolation of genomic DNA from plant and animal tissue.
2. The students are adept in the estimation of total RNA by Orcinol method.
3. The course provides valuable experience in the estimation of DNA by Burton's method.
4. The students are able to analyze genomic DNA by agarose gel electrophoresis.
5. The students are introduced to the study of isozymes and proteins by SDS-PAGE.

MGE-206 MOLECULAR BIOLOGY

Total : 60 hrs

1. Isolation of genomic DNA from plant tissue and animal tissue.
2. Estimation of cellular DNA by standard method (Burtons).
3. Estimation of RNA by orcinol method.
4. Analysis of genomic DNA by agarose gel electrophoresis.
5. Study of isozymes by (PAGE) electrophoresis.

II SEMESTER – PRACTICAL SYLLABUS

MGE-207 GENETICS OF DEVELOPMENT

Total : 60 hrs

Course Objectives:

1. To experiment the early development of frog/chick.
2. To expertise in mounting of chick embryos during development.
3. To experience morphogenetic movements in chick *in vivo*.

Course Outcomes:

1. Understand the early development of frog/chick.
2. Acquire knowledge in mounting of chick embryos during development.
3. Acquaint morphogenetic movements in chick *in vivo*.
4. Analyze early embryogenesis in Frog.
5. Experiment imaginal discs in *Drosophila*.

MGE-207 GENETICS OF DEVELOPMENT

Total : 60 hrs

1. Study of the early development of frog/chick.
2. Observation of permanent slides of developmental stages of frog/chick embryo
3. Mounting of chick embryos during development.
4. Morphogenetic movements in chick *in vivo* experiment.
5. Study of imaginal discs in *Drosophila*.
6. Fish: induction, spawning and early embryogenesis.

II SEMESTER – PRACTICAL SYLLABUS

MGE-208: MUTATION AND CANCER BIOLOGY

Total: 60 hrs

Course Objectives:

1. To study mutations in bacteria and the use of Ames test.
2. To study differential gene expression using polytene chromosomes in drosophila
3. To study the MTT assay and its uses.

Course Outcomes:

1. The students analyze differential gene expression in polytene chromosome of *Drosophila*
2. The students are able to analyze mutations using the Ames test.
3. The course enables students understand the genetic basis of insecticide resistance.
4. The students study insecticide susceptibility in Culicine mosquitoes.
5. The students understand the principle of viability assays and study the MTT assay.

MGE-208: MUTATION AND CANCER BIOLOGY

Total: 60 hrs

1. Differential gene expression: demonstration of ecdysone/heat-induced gene expression in polytene chromosome of *Drosophila*
2. Detection of mutation in E.coli by Ames test.
3. Genetic basis of insecticide resistance
4. Susceptibility studies by using different insecticides in Culicine mosquitoes.
5. Genetic basis of insecticide resistance by using adulticide.
6. MTT assay
7. Trypan blue dye exclusion test

II SEMESTER – PRACTICAL SYLLABUS

MGE-209: EVOLUTIONARY GENETICS

Total : 60 hrs

Course Objectives:

1. Enable the students to understand the Quantitative characters in *Drosophila*.
2. To experiment change in gene frequencies.
3. To analyze Hardy-Weinberg principles

Course Outcomes:

1. Students are able to understand the Quantitative characters in *Drosophila*
2. Expertise in analyzing change in gene frequencies.
3. Understand Hardy-Weinberg principles and applications
4. Distinguish homology and analogy of organs in organisms
5. Analyze Genetic drift

MGE-209: EVOLUTIONARY GENETICS

Total : 60 hrs

1. Quantitative characters in *Drosophila*: Sternoplurals and Acrostichals, Mean and standard error.
2. Calculation of change in gene frequencies.
3. Applications of Hardy-Weinberg principles and genetic problems.
4. Experiments on Genetic Drift: a) Population size b) Sampling Error
5. Studies on Homology Analogy

THEORY SYLLABUS- III SEMESTER

MGE-301 GENETIC ENGINEERING

52 Hrs

Course Objectives:

1. To provide adequate knowledge on salient features and applications of tools used in RDT.
2. To enable students to understand the methodology used in construction of recombinant DNA.
3. To facilitate students to obtain deeper insight into the various techniques used in genetic engineering.

Course Outcomes (COs):

1. Elucidate the features of various enzymes used in genetic engineering.
2. Contrast the cloning and expression vectors with respect to their characteristic features.
3. Explain the construction of genomic and c- DNA library and their applications.
4. Comprehend and illustrate the steps and strategies involved in genetic manipulation.
5. Analyze and implement the hybridization techniques in construction of recombinant DNA.

MGE-301 GENETIC ENGINEERING

52 Hrs

UNIT I

13Hrs

Genetic Engineering and Tools of Genetic Engineering:

Genetic Engineering – Introduction, scope and importance

Restriction endonucleases –types, nomenclature, recognition sequences, cleavage pattern, T4 DNA ligase and NAD dependent DNA ligase of *E. Coli* ligation techniques, Vectors –general characteristics of vectors, desirable characters such as size orisite, selection / marker gene, restriction sites and unique multiple cloning sites for cDNA cloning, cloning and expression vectors –Plasmids –PBR 322 pUC vectors, Ti Plasmids – M13 derived pUC vectors, Phage vectors – lambda based vectors, M13, Cosmids, Phagemids, ARS, Mini Chromosome, yeast artificial chromosomal vectors (YAC), Shuttle vectors specific promoters for expression in yeast cells, transcriptional terminators, selection of marker genes for bacteria and yeast cells: Vectors for plants; expression vectors. Vectors for animals – SV40, Bovine papilloma virus (BPV), Retrovirus.

UNIT II

13Hrs

Gene Cloning, gene libraries and transformation techniques:

Cloning and selection of individual gene, gene libraries, preparation of cDNA libraries;

isolation and purification of mRNA ; importance of poly-A tailing in the preparation of cDNA library; Genomic library isolation and purification of total genomic DNA, partial digestion with suitable enzyme size fractionation and end modification.

Transformation Techniques : Preparation of competent cells of bacteria, yeast insect, Methods of DNA transfer, exogenously supplied chemical methods, calcium phosphate precipitation method, liposome mediated method and electroporation, Agrobacterium T-DNA mediated method, gene gun method ; Determination of transformation / transfection efficiency. Lambda DNA based DNA recombinants : In vitro packaging of DNA using packaging extracts infection of bacteria using packaged lambda viruses containing recombinant DNA.

UNIT III

13Hrs

Plating, screening and selection:

Preparation of nutrient media with selection, marker antibiotics and additives for visual screening of recombinant clones, selection of clones, amplification and preservation.

Labeling of DNA, RNA and proteins : Use of radioactive isotopes, Non –radioactive labeling relative advantages and disadvantages, in-vivo labeling, Nick translation, random primer labeling, auto-radiography, auto-fluorography.

UNIT IV

13Hrs

***In vitro* translation and Hybridization techniques :**

Purification of mRNAs and translation using cell free systems from wheat germ extract or rabbit reticulocytes and characterization of protein products on gel electrophoresis. Blotting experiments – southern , Northern western and western / southern blotting methods, agarose gel, polyacrylamide gel and 2D gel electrophoresis ; DNA microarrays (DNA chips) to study gene expression.

REFERENCES:

1. Berger S.L. and A.R. Kimmel, Methods in enzymology –guide to molecular cloning techniques vol. 152, Academic press Inc. San Diego.
2. Davies J.A. and Reznikoff, Butterworth-Heinemann Milestones in Biotechnology , classic papers on genetic engineering.
3. D.V. Goeddel, Methods in enzymology –Gene Expression Technology, Vol. 185, Academic press Inc. San Diego.
4. Glick and Pasternak – Molecular biotechnology, Principles and application of recombinant DNA.
5. Kingsman , S.M and A.J. Kingsman Genetic Engineering : An introduction to Gene analysis and exploitation in Eukaryotes, Blackwell Scientific publications, Oxford.
6. Old R.W. and S.B. Primrose Principles of gene manipulation, Boston Blackwell Scientific Publications.

THEORY SYLLABUS- III SEMESTER
MGE- 302: MICROBIAL AND PLANT GENETICS **52Hrs**

Course Objectives:

1. To gain insight into Microbial Genetics, the generalized life cycles of microbes, Bioremediation and phytoremediation, Biosensors.
2. To study the significance of plants as genetic model systems and gene regulation in plants.
3. To perform an in-depth analysis of Molecular and genetic basis of Crown Gall disease development and the Genetic basis of disease resistance and susceptibility in plants.

Course Outcomes:

1. Students take an in-depth look into Microbial Genetics, an Over view of generalized life cycles of microbes, Non- sexual variation, Tetrad analysis and linkage detection, Bioremediation and phytoremediation, Biosensors.
2. Students perform an Over view of plants as genetic model systems, gene regulation in plants, ABC model of regulation of flower development, Development of dorsal and ventral asymmetry in leaves. Role of KNOX genes in evolution of compound leaf, Mechanism of self-incompatibility in plants
3. Students analyze the Molecular and genetic basis of Crown Gall disease development, Genetic basis of disease resistance and susceptibility in plants. Molecular basis of host pathogen interaction, Mechanism of T-DNA transfer and their utility in production of transgenic plants.
4. Students are able to provide a description of Protoplast technology- Isolation, maintenance and viability tests for protoplast, methods of protoplast fusion and its application
5. Students give an account on Biofertilizers, Production and beneficial roles of Rhizobium, Azotobacter blue green algae, mycorizal fungi and Azolla.

MGE- 302: MICROBIAL AND PLANT GENETICS **52 Hr**

UNIT I

13 Hrs

Microbial Genetics: Overview of Microbes as genetic tools for basic and applied studies. Over view of generalized life cycles of microbes. Non- sexual variation. Significance of haploidy. Heterokaryosis and parasexuality. Tetrad analysis and linkage detection in *Neurospora*. Mitotic recombination in *Neurospora crassa* and *Aspergillus nidulans*, gene conversion in fungi, Bioremediation and phytoremediation, Biosensors.

Fermentation technology: Fermentors, bioreactors, Selection of microbes, Fermentation media, Fermentation enzymes, Production of alcoholic beverages, Vitamins and antibiotics

UNIT II

13 Hrs

Gene regulation in plants: Over view of plants as genetic model systems, gene regulation in plants. Genes involved in regulation of flower development. Homeotic genes, Development of dorsal and ventral asymmetry in leaves. Role of KNOX genes in evolution of compound leaf. Types of abiotic stresses and gene regulation during water deficit and heat stress. Plant nodule genes. Mechanism of self-incompatibility in plants.

UNIT III

13 Hrs

Applied genetics of plants: Genetic basis of disease resistance and susceptibility in plants. Molecular basis of host pathogen interaction. Molecular and genetic basis of Crown Gall disease development. Agrobacterium- Genetics of Ti plasmid. Plant wound genes and control of 'vir' gene expression. Mechanism of T-DNA transfer and their utility in production of transgenic plants.

UNIT IV

13Hrs

Protoplast technology: Isolation, maintenance and viability tests for protoplast, regeneration of plants from protoplast, methods of protoplast fusion and its application.

Biofertilizer: Production and beneficial roles of *Rhizobium*, Innoculants and *Azotobacter* inoculants, field application of *Rhizobium*, *Azotobacter* blue green algae, mycorizal fungi and *Azolla*

REFERENCES

1. Altman A. and Hasegawa, P.M., (2011). *Plant biotechnology and Agriculture – Prospects for the 21st Century*, Elsevier Science Publishers, Amsterdam.
2. Brahma Mishra, (2009). *Fertilizer Technology and Management*, I.K. International Publishing House Ltd., New Delhi.
3. Chawla H.S., (2003). *Plant Biotechnology*, Oxford and IBH publishing Co. Pvt Ltd., New Delhi.
4. Chrispeels M.J. and Sadava D.E, (1994). *Plants, Genes and Agriculture*, Jones and Bartlett Publishers, Boston.
5. Dickinson M., (2003). *Molecular Plant Pathology*. BIOS Scientific, Oxford, UK.
6. Fundamentals of Microbiology –Furbisher, Saunders &Toppan Publications
7. General Microbiology –C.B. Powar, H.F. Dagainawala,Himalayan Publishers
8. Gupta P.K., (1996). *Elements of Biotechnology*, Rastogi and Company, Meerut
9. Industrial Microbiology-Casual Wiley Eastern Ltd
10. Introductory Biotechnology-R.B Singh C.B.D India (1990)
11. Kumar H.D, (1991). *A text book on Biotechnology* (2nd Ed.), Affiliated East-West Press Pvt. Ltd, New Delhi.
12. Purohit, S.S., (2006). *Agricultural Biotechnology*, Agribios, Jodhpur.
13. Rangaswami, G. and Bagyaraj. D.J., (1998). *Agricultural Microbiology* (2nd Ed.), PHI Learning, India.
14. Satyanarayana, U., (2010). *Biotechnology*, Books and Allied (P) Ltd., Kolkata.
15. Srivastava, P.S., Alka Narula, Sheela Srivastava, (2004). *Plant Biotechnology and Molecular Markers*, Anamaya Publishers, New Delhi

THEORY SYLLABUS- III SEMESTER

MGE- 303: HUMAN GENETICS

52 Hrs

Course Objective:

1. To enable the students to grasp the fundamentals of gene therapy, problem solving in the fields of Science, Medicine and Society.
2. To gain knowledge and apply the techniques of principles of inheritance of human traits, diseases related to genes and chromosomes.
3. To familiarize with immune system and the importance of antibody and cell mediated immune responses in defense mechanism to defend human from various pathogenic infections and diseases.

Course Outcomes:

1. Students can synthesize and incorporate the fundamentals of gene technology in order to understand how such technology impacts human.
2. Employ the scientific method for the acquisition of new knowledge to solve problems regarding human genome, diseases and inheritance pattern.
3. Apply to real life situations and one's life the principles of human heredity.
4. Students can access and apply historical and current knowledge regarding human heredity, and understand how such knowledge has influenced law, medicine and society.
5. Understand the pattern of immune response against various pathogenic agents and research and apply the concepts in the field of Clinical genetics.

MGE- 303: HUMAN GENETICS

52 Hrs

UNIT I

13 Hrs

Basics of human genetics:

History of human genetics, karyotype and idiogram. Nomenclature of human chromosomes, Denver, London and Paris and ISH nomenclature. Pedigree, Pattern of inheritance. Identifying recombinants and non-recombinants in pedigrees. Somatic cell fusion, cell hybrids and Radiation hybrids, Genetic and physical map distances, Two-point mapping - LOD score analysis.

UNIT II

13 Hrs

Genetic mapping of complex traits: Difficulties in mapping complex traits. Allele sharing methods- Affected sib pair analysis. Allelic association mapping. Linkage disequilibrium mapping. Transmission disequilibrium test. Whole genome scan and mapping. Integration of Cytogenetic, genetic and physical maps.

Genetic basis of chromosomal syndromes

Chromosomal syndromes: Down's, Turner's, Klinefelter's, Edward's syndrome, Cri-du-chat's, Patau's. Genetic diseases (Cystic fibrosis and Marfan syndrome). Inborn errors of metabolism (Phenylketonuria and Mucopolysaccharidosis),

UNIT III

13 Hrs

Genetic disorders

Neurogenetic disorders (Charcot-Marie-Tooth syndrome and Parkinson disease), Genetic disorders of Haemopoietic systems (Sickle cell anemia and Thalassemia), Genetic disorders of eye (Retinitis pigmentosa, Glaucoma and Cataracts), Muscle genetic disorders (Duchenne and Becker Muscular Dystrophy), Genome imprinting syndromes (Prader-Willi & Angelman syndromes, Beckwith-Wiedeman syndrome, Genetic disorders in skeleton and skin, Congenital heart diseases, Learning disorders, Genetics of Infertility, Cognitive disabilities, Schizophrenia and Anxiety disorders, Complex syndromes (Atherosclerosis, Diabetes mellitus, Rheumatoid Arthritis), Mitochondrial syndromes.

UNIT IV

13 Hrs

Diagnosis: Prenatal diagnosis: (i) Noninvasive methods- X- radiation, Ultrasonography and Fetal echocardiography (ii) Invasive methods- Maternal serum screening, Amniocentesis, Chorionic villus sampling and Fetoscopy. Technology in reproductive assistance

Counseling, Therapy and Ethics:

Genetic counseling: Definition, Components, Psychotherapeutic counseling, Decision making, risk assessment and counseling in Mendelian and multifactorial syndromes, Gene therapy, Management of genetic disorders, Models of eugenics, human right, human genetics and legal, social and ethical considerations.

REFERENCES

1. H. Harris & K. Hirschhorn, 1983. Advances in Human Genetics. (Vol. 10-13), Plenum Press, N.Y. & London.
2. Muin J. Khoury, Julian Little & Wylie Burke, 2004. Human Genome Epidemiology, Oxford University Press.
3. Lai Poh San & Eric P H Yap, 2001. Frontiers in Human Genetics – Diseases & Technologies, World Scientific.
4. Frank A. Barile, 2004. Clinical Toxicology- Principles & Mechanisms, CRC Press.
5. Jeffrey C. Hall & Jay C. Dunlap, 1995. Advances in Genetics – Incorporating Molecular Genetic Medicine (Vol. 32), Academic Press.
6. J. Fernandes, J.M. Saudubray & G. Van den Berghe, 1996. Inborn Metabolic Diseases – Diagnosis and Treatment (Second Edition), Springer.
7. Sally A. Moody, 1999. Cell Lineage and Fate determination, Academic Press.
8. James C. Thomas & David J. Weber (Ed.), 2001. Epidemiological Methods for the Study of Infectious Diseases, Oxford University Press.

III SEMESTER – PRACTICAL SYLLABUS

MGE-305: GENETIC ENGINEERING

Total : 60 hrs

Course Objectives:

1. To study various techniques of plasmid DNA isolation.
2. To provide hands on training in molecular biology techniques like Restriction digestion and Ligation.
3. To introduce various methods of genetic transformation.

Course Outcomes:

1. The students perform Restriction enzyme digestion of DNA and understand the principles and underlying mechanisms involved in Restriction digestion and ligation.
2. The students are able to amplify DNA using PCR method and characterize it using PAGE.
3. The course provides hands on training in basic methods in genetic transformation including the preparation of competent cells and fusion using various methods.
4. The students are introduced to key concepts in Western and Southern Blotting.
5. The students gain experience in various methods of plasmid DNA isolation.

MGE-305: GENETIC ENGINEERING

Total : 60 hrs

1. Isolation of Plasmid DNA
2. Restriction enzyme digestion/Ligation of DNA and calculation of molecular weight of the digested DNA
3. DNA amplification by PCR method.
4. Preparation of competent cells in *E. coli*.
5. Transformation through CaCl₂, PEG methods.
6. Western and Southern Blotting.

III SEMESTER – PRACTICAL SYLLABUS

MGE 306: MICROBIAL AND PLANT GENETICS

Total : 60 hrs

Course Objectives:

1. To gain experience in bacterial culture techniques and media preparation.
2. To study gram staining and its significance.
3. To extract DNA from bacterial cells.
4. To perform nucleic acid staining in paramecium.

Course outcomes:

1. The students gain valuable insight and experience in bacterial media preparation, aseptic techniques and bacterial culture.
2. The students perform the extraction of total DNA from bacterial cells.
3. The students are able to culture and maintain paramecium cultures and perform nucleic acid staining using Methyl green-pyronin.
4. The students study the experimental basis of protoplast extraction.
5. The course enables the students to perform replica plating in bacteria.

MGE 306: MICROBIAL AND PLANT GENETICS

Total : 60 hrs

1. Bacterial culture and Gram staining.
2. Extraction of DNA from bacterial cells.
3. Replica plating technique.
4. Isolation of bacteriophage from sewage water.
5. Methyl green-pyronin staining to localize nucleic acids in appropriate tissue.
6. Plant tissue culture- protoplast extraction.
7. Toluidine blue staining for RNA and DNA.

III SEMESTER – PRACTICAL SYLLABUS

MGE 307: CELLULAR PHYSIOLOGY

Total : 60 hrs

Course Objectives:

1. To understand and appreciate the principles of Chromatography techniques
2. To acquire knowledge in the estimate of RNA and DNA
3. To appreciate the principals involved in the estimation of ascorbic acid contents in the different tissues

Course Outcomes:

1. Students analyze the principle involved in chromatography techniques
2. Able to estimate RNA and DNA
3. Acquaintance of an estimation of ascorbic acid contents in the different tissues
4. Analyze ascorbic acid contents in the different tissues.
5. Determination of rate of active transport of glucose across the intestine

MGE 307: CELLULAR PHYSIOLOGY

Total : 60 hrs

1. Paper chromatography of amino acids.
2. Thin layer chromatography of eye pigments.
3. Estimation of RNA by orcinol method.
4. Determination of myosin ATPase activity.
5. Effect of ATPase in central nervous system in the rats.
6. Estimation of ascorbic acid contents in the different tissues.
7. Determination of rate of active transport of glucose across the intestine.

III SEMESTER – PRACTICAL SYLLABUS

MGE-308: HUMAN GENETICS (Practical)

Total: 60 hrs

Course Objectives:

1. To gain knowledge and able to identify and distinguish normal human karyotype and abnormal human karyotype
2. Acquire knowledge about Lymphocyte culture, harvesting, conventional staining and preparation of human normal karyotype.
3. To impart in-depth knowledge of Chromosome staining and banding techniques.

Course Outcomes:

1. Illustrate the structure and number of normal and abnormal human karyotypes
2. Gain knowledge and hands on experience in Lymphocyte culture, harvesting, conventional staining and preparation of human normal karyotype.
3. Understand and analyze Chromosome staining and banding techniques.
4. Acquire knowledge in differential staining of human blood
5. Acquaintance of blood smear preparation and Blood cell counting.

MGE-308: HUMAN GENETICS (Practical)

Total: 60 hrs

1. Study of normal human karyotype.
2. Study of abnormal human karyotype.
3. Lymphocyte culture, harvesting, conventional staining and preparation of human normal karyotype.
4. Chromosome staining and banding techniques.
5. Chromosomal preparations using solid tumor/leukemia samples.
6. Differential staining of human blood.
7. Blood smear study of drum sticks in Neutrophils.
8. Blood cell counting: using Haemocytometer. (RBC and WBC)

IV SEMESTER THEORY SYLLABUS

MGE- 401: GENOMICS AND PROTEOMICS 52 Hrs

Course Objectives:

1. To introduce the terms-genomics, proteomics and other omics and their significance
2. To perform an analysis of Gene prediction- experimental methods and computer based methods.
3. To describe mapping techniques, sequencing methods and functional analysis techniques.

Course Outcomes:

1. Students analyze the various subfields of genomics, proteomics and other omics including transcriptomics, metabolomics and their significance
2. Students perform an Analysis of Gene prediction- experimental methods and computer based methods, gene prediction rules and various softwares used for prediction.
3. Students are able to provide a description of the experimental methods used in various fields of genomics including mapping techniques, sequencing methods and functional analysis techniques.
4. Students take an indepth look into the various genome databases, the annotation of genomes and taxonomy and significance of genomes of various model organisms.
5. Students can account on the Concepts of evolution of genomes and the hypotheses available to explain the evolution of genomes in lifeforms.

MGE- 401: GENOMICS AND PROTEOMICS 52 Hrs

UNIT I 13 Hrs

Organization of genomes:

Introduction: Genome, Genomics, Omics and importance, General features, C-value paradox. Gene identification; gene prediction rules and software's; Genome databases; Annotation of genome. Genome diversity: taxonomy and significance of genomes – bacteria, yeast, *Caenorhabditis*, *Homo sapiens*, *Arabidopsis*, etc.

UNIT II 13 Hrs

Mapping genomes:

Genetic mapping – i) Cross breeding and pedigree analysis, ii) DNA markers - RFLPs, SSLPs, SNPs

Physical mapping - Restriction mapping, Fluorescent *in situ* hybridization, Radiation hybrid mapping and Sequence tagged site mapping.

UNIT III

13 Hrs

Genomics:

Genome projects: The Human genome project, HapMap Project, The 1000 genome project, and The ENCODE Project.

Structural genomics: Assembly of a contiguous DNA sequence- shotgun method, clone contig method, and whole –genome shotgun sequencing

Understanding a genome sequence: locating the genes in a genome sequence, determining the functions of individual genes and by studying the activity of a protein coded of an unknown gene

UNIT IV

13 Hrs

Pattern of genome evolution:

The origin of genomes- Origin of macromolecules, RNA world and DNA world

Acquisition of new genes (By gene duplication) and Gene families – (Types, Pseudogenes, Origin of gene families (lateral gene transfer, allopolyploidy). Synthetic genomes and their applications

REFERENCES

1. Brown T. A. 2007, Genomes 3. Garland Science Publishing, New York.
2. Dunham, I., 2003. Genome Mapping and sequencing. Horizon Scientific
3. Graur, D and W H Li, 2000. Fundamentals of molecular evolution. Sinauer Associates.
4. Hartwell, L. H., L. Hood, M. L. Goldberg, A. E. Reynolds, L. M. Silver and R. G. Veres. 2004. Genetics from Genes to Genomes. McGraw Hill.
5. Lewin B. 2003. Genes VIII. Oxford University Press. Oxford.
6. The Human Genome 2001, Nature Vol. 409.
7. The *Drosophila* Genome. 2000, Science Vol. 267.
8. The *Caenorhabditis elegans* genome 1998. Science Vol. 282.
9. The Arabidopsis Genome 2000 Nature vol. 408.
10. Primrose, S. B., and R. M. Twyman . 2006. Principles of gene manipulation and Genomics, Blackwell Publishing MA. USA

IV SEMESTER THEORY SYLLABUS

MGE -402 IMMUNOGLOGY AND HEMATOLOGY

52 hrs

Course Objectives:

1. To empower the students to understand the different cells and tissues involved in defence mechanism of defending human beings from diseases caused by various microorganisms.
2. To enable the students to understand the normal and inappropriate immune responses and their consequences and also the importance of vaccination in the process of protecting human from infectious diseases
3. To facilitate the students to understand the apply the knowledge on hemolytic disorders and also to enable them to acquire knowledge in setting up of blood bank and blood safety.

Course Outcomes:

1. Acquire a broad and coherent theoretical and technical knowledge of cells and tissues of immune system.
2. Elucidate pathologies associated with an inappropriate immune response which leads to autoimmune disorders. Also to understand and analyse the importance of vaccination in defending human beings from various infectious diseases.
3. Comprehend a broad and coherent theoretical and technical knowledge of haematology and hemolytic disorders. Also to critically analyse functions of blood cells and platelets in defence mechanism.
4. Acquisition of indepth knowledge on different types of blood groups and able to apply compatibility testing and antihuman globulin test.
5. Understand and apply the acquired knowledge on blood transfusion, administration of blood bank and blood safety.

MGE -402 IMMUNOGLOGY AND HEMATOLOGY

52 hrs

UNIT I

13 Hrs

Overview and Cells of the Immune system: Historical account, innate immunity: Anatomic barriers, Physiologic barriers, Phagocytic barriers, Microbial antagonism, Inflammation, PRRs, TLRs and PAMPs. Acquired immunity: Naturally acquired, artificially acquired and adaptive, Humoral and cell mediated immunity, Complement system: components, activation and biological consequences.

Tissues and cells of immune system: Structure of lymph node, spleen, mucosal associated lymphoid tissue and gut associated lymphoid tissue. Biology of cells of the immune system: Hematopoiesis, Microphages (Neutrophils), Macrophages, T-Lymphocytes, B-Lymphocytes, Dendritic cells and NK cells.

UNIT II

13 Hrs

Antigens, Immunoglobulins and T cell receptors: Factors influencing immunogenicity, Haptens, Classes of immunoglobulins, Structure of IgG, Kinetics of immunoglobulin synthesis, Genetic basis of immunoglobulin diversity, Genetic basis of T cell receptor diversity, MHC molecules – Types and structure (i) Clonal selection and immunological memory, Antigen recognition – exogenous pathway, endogenous pathway, cross presentation.

Vaccines: Principles of vaccination, primary and secondary responses, antibody engineering, Monoclonal antibodies and their applications, antigen-antibody interactions, congenital and acquired immunodeficiency. Autoimmunity and autoimmune diseases, Hypersensitivity.

UNIT III

13 Hrs

Blood composition and its disorders:

Blood: Composition, RBC'S- structure and function. Structure, function and synthesis of hemoglobin, Blood indices, peripheral blood smear, parasite in blood. Sickle cell anaemia, thalassemias.

Screening tests for hemolytic disorders: Disorders of WBC, TC of RBC and WBC, DC of WBC.

Platelet structure and function: Bleeding disorders and investigations, coagulation process and theory, disorders. Coagulation of blood.

UNIT IV

13 hrs

Transfusion medicine:

Blood group and antigens: ABO and sub groups, antigen and antibodies, Rh blood grouping, other blood group systems, compatibility testing, antihuman globulin test.

Blood transfusion: Selection of blood donors, blood transfusion procedures, Complication of blood transfusion, Blood component therapy, organization and administration of blood bank, blood safety.

REFERENCES

- 1 H.Harris & K.Hirschhorn, 1983. Advances in Human Genetics. (Vol. 10-13), Plenum Press, N.Y. & London.
- 2 Muin J. Khoury, Julian Little & Wylie Burke, 2004. Human Genome Epidemiology, Oxford University Press.
- 3 Lai poh San & Eric P H Yap, 2001. Frontiers in Human Genetics – Diseases & Technologies, World Scientific.
- 4 Frank A. Barile, 2004. Clinical Toxicology- Principles & Mechanisms, CRC Press.
- 5 Jeffrey C. Hall & Jay C. Dunlap, 1995. Advances in Genetics – Incorporating Molecular Genetic Medicine (Vol. 32), Academic Press.
- 6 J. Fernandes, J.M.Saudubray & G.Van den Berghe, 1996. Inborn Metabolic Diseases – Diagnosis and Treatment (Second Edition), Springer.
- 7 Sally A. Moody, 1999. Cell Lineage and Fate determination, Academic Press.
- 8 James C. Thomas & David J. Weber (Ed.), 2001. Epidemiological Methods for the Study of Infectious Diseases, Oxford University Press.

THEORY SYLLABUS- IV SEMESTER
MGE- 403: BIOMEDICAL GENETICS

52 Hrs

Course Objectives:

1. To acquaint students with various genetically inherited diseases, diseases caused by viruses, bacteria, fungi and protozoa.
2. To enable students to comprehend how basic pharmacokinetic processes are defined, expressed and affected; how pharmacokinetics together with pharmacodynamics determine the effect intensity and effect duration of a drug.
3. To enable students to demonstrate mastery of cutting edge research approaches in developing various molecular therapeutics and understand the process of drug development.

Course Outcomes (COs):

1. Comprehend and illustrate the role of genetic and genomic assessment in clinical practice, including applications in disease screening, diagnosis, and treatment.
2. Understand and correlate the relationship between pharmacokinetics and pharmacodynamics to prevent adverse medication implications in patients and to relate the concepts with the best and advanced clinical practice to augment drug delivery care.
3. Outline the process of drug development and account for critical factors and decision points in drug development process.
4. Acquaint with how nanotechnology is implemented in treatment of various diseases.
5. Integrate novel biomedical knowledge and emerging technologies in professional practice for enhanced health care.

PAPER-MGE- 403: BIOMEDICAL GENETICS

52 Hrs

UNIT I

13 Hrs

Human Diseases

Etiology, pathology, symptoms and treatment of the genetically inherited diseases – PKU, Alkaptonuria, Galactosemia, Von’Gierke disease, Lesch Nyhan syndrome, Gout, Sickle Cell Anemia, Beta Thalassemia and Diabetes; Evaluation of organ functions – liver, kidney, cardiac and gastric function tests.

Mode of infection, symptoms, epidemiology and control measures of disease caused by – Viruses (HIV, Hepatitis- B, Rabies, HSV-1); Bacteria (Typhoid, Syphilis, TB); Fungi (Aspergillosis, Histoplasmosis, Cryptococcosis); Protozoa (Malaria, Amoebiasis)

UNIT II

13 Hrs

Pharmacodynamics and Pharmacokinetics

Pharmacodynamics – Drug receptors and administration, relationship between drug concentration and response; Pharmacokinetics – ADME, Concepts in toxicology, acute, subacute and chronic toxicity studies, Calculation of LD50 and ED50, biological half-life, physicochemical principles, drug accumulation; Molecular mechanisms of drug action.

Drug discovery

Introduction, conventional drug design approaches, irrational vs rational, Lipinski's rule of five, Drug development process (Preclinical, clinical and toxicological evaluation); Novel Drug Development approaches – QSAR (quantitative structure activity relationship), High throughput screening.

UNIT III

13 Hrs

Molecular therapeutics

Gene therapy, barriers to gene delivery, overview of inherited and acquired diseases as candidates for gene therapy, Liposome-mediated gene delivery, cellular therapy, use of stem cells, recombinant therapy; Erythropoietin in the treatment of Leukemia, Insulin analogues and its role in diabetes, Streptokinase and urokinase in thrombosis, role of recombinant interferons, immunostimulants and immunosuppressors in organ transplants.

UNIT IV

13 Hrs

Nanobiotechnology

Introduction, types and synthesis of nanomaterial, protein-based nano structures, DNA-based nano structures; Applications of nanomaterial – nanobiosensors, drug and gene delivery, disease diagnostics, cancer therapy.

Genetics and Society

Population screening for genetic diseases, Ethical issues involved in medical genetics, Human genome project and its practical implications, Eugenic and dysgenic effects.

REFERENCES:

1. Bartram G. Katzung, . Basic and Clinical Pharmacology, Mc Graw Hill publications, USA.
2. Burtis and Ashwood, . Tietz Fundamentals of Clinical Chemistry , WB Saunders Company, Oxford Science Publication, USA.
3. Devlin, Text book of biochemistry with clinical correlations , John Wiley and Sons, New York.
4. Jawetz, Melnick and Adelgerg, . Medical Microbiology, Lange Medical Publications, California.
5. Judit Pongracz and Mary Keen, . Medical Biotechnology, Elsevier publications, Churchill, Livingstone.
6. Lachman, L., Lieberman A.H., Joseph and Kanig,.The Theory & Practice of Industrial Pharmacy, Vergese Publishing House, Bombay.

7. Lalit M Srivatsava, Nibhriti Das and Subrata Sinha, Essentials of practical Biochemistry, CBS publishers, India.
8. Sawhney and Randhir Singh, Introduction to practical Biochemistry, Narosa publishing house, London.
9. Wilson, K. and Walker, J., Practical Biochemistry, Cambridge University Press, UK.

IV SEMESTER – THEORY SYLLABUS

MGE-404: PLANT AND ANIMAL BIOTECHNOLOGY

52hrs

Course Objectives:

1. To provide students new knowledge and widening of the knowledge of handling of classical and modern plant biotechnology processes, including breeding of healthy plants, plants with improved characteristics and plants for biomolecule production.
2. To facilitate the students to obtain skills on biotechnological processes such as cell and tissue culture, gene transfer in plants and also applicative value in pharmaceutical and food industry, in agriculture and in ecology.
3. To illustrate the techniques, procedure and growth patterns of animal tissue and organ culture, cell lines and commercial applications of animal tissue culture.

Course Outcomes:

1. Apply knowledge acquired in plant breeding which is of disease resistant, healthy and improved characteristics.
2. Construct the techniques involved in cell and tissue culture and gene transfer in plants and also its applications in pharmaceutical, agriculture and food industries.
3. Illustrate and experiment the techniques, procedure and growth patterns of animal cell culture.
4. Outline the history and structure of animal cell and describe the in vitro applications of animal cell culture.
5. Construct the techniques in production of cloned animal and its applications. Also to make the students to understand the uses of animal cells in vaccine production.

UNIT I:

Introduction to Cell and Tissue Culture

13 hrs

Plant tissue culture media (composition, types and preparation); Plant growth regulators in tissue culture, Selection and preparation of explant; Micropropagation – Direct regeneration, Indirect regeneration – callus culture and organogenesis, Somatic embryogenesis; Protoplast isolation and culture, somatic hybridization; Haploid production – Androgenic haploids (anther, pollen culture) and Gynogenic haploids (ovary, ovule culture); Somaclonal variation and its significance; Cell suspension culture; Cell culture methods for secondary metabolite production; Cryopreservation, Gene banks for germplasm conservation.

UNIT II:

13 hrs

Gene Transfer in Plants

Promoters – 35S, Ubiquitin; Marker genes – Reporter genes (OS, CAT, GUS, Lux, Luc, GFP), Selectable markers (antibiotic resistance marker, antimetabolite resistance marker, herbicide resistant marker); Gene transfer methods – Vector or Agrobacterium mediated gene transfer – Ti and Ri plasmids, virulence genes, Agrobacterium vectors – cointegrate vectors and binary vectors; Plasmid vectors – pBLUESCRIPT IIKs, pBin 19, pGreen vectors; Virus mediated gene transfer – Caulimo viruses, Gemini viruses, RNA viruses; Vectorless or Direct gene transfer – Physical methods - particle bombardment, electroporation, microinjection; Chemical methods – PEG mediated, Calcium phosphate coprecipitation, polycation DMSO.

ANIMAL BIOTECHNOLOGY

UNIT III:

13 hrs

Animal tissue culture requirements and methods:

Introduction, Types of culture- Organ culture, cell culture, organotypic culture, histotypic culture.

Design and layout of animal tissue culture laboratory, maintenance of sterile condition

Equipments – Essential, beneficial and useful equipments, consumable items.

Culture medium- Physico-chemical properties, complete media, serum, serum free media, balanced salt solutions, selection of medium and serum.

Preparation and sterilization – Apparatus, Reagents and media, storage Contamination- Source and types of contamination

Primary culture- Types (Primary explant and primary cell cultures). Primary explant culture method (mouse/chick embryo tissues). Primary cell culture method- disaggregation (enzymatic, mechanical) and culturing. Lymphocyte culture method (Suspension culture)

UNIT IV

13Hrs

Cell-lines, Organ culture, large scale cultures and applications of animal tissue culture: Cell lines: Definition, Evolution of cell lines, continuous cell lines, cell line designation, maintenance, subculture, maintenance records. Cell line banking, cryopreservation, cell viability assays

Organ culture - Methods, Raft and grid methods, Watch glass technique, Maximow single slide technique, agar gel technique, histotypic culture ; Gel and sponge technique, hollow fibres, spheroids

Large scale cultures – Fermentor design, scaleup in suspension and monolayer. Downstream processing.

Use of animal cells as replacement for whole animal in toxicity testing.

Commercial application of animal tissue culture – Uses of animal cells in vaccine production, Cell cultures in the production of medically important compounds – pharmaceuticals, enzymes, hormones, interleukins, interferon's.

REFERENCES:

1. Ballinic C.A., Philips J.P and Moo Young M, (1989). Animal Biotechnology, Pergamon
2. Butler, M., (2006). Animal Cell Culture and Technology, Bios, Oxford, UK
3. Cartwright T(1994) Animal cells as bioreactors, Vol.VI, CU Publishers, Cambridge
4. Cheryl, D.H. and Cyndi, L.M. (2005). Basic cell culture protocols, Humana press, New Jersey.
5. Davis John. M. (2011). Animal Cell Culture Essential Methods, Wiley-Blackwell, Sussex, UK.
6. Freshney R. I. (2000&2005) Culture of animal cells: A manual of basic technique, IV&V Edition, Alan R. Liss, Inc. New York.
7. Freshney, R.I. (Ed.) (1992) Animal cell culture, A practical approach II edition, IRL press, Oxford
8. Glick B.R and Pasternak J.J., (1998). Molecular Biotechnology, ASM Press, Washington DC.

IV SEMESTER – PRACTICAL SYLLABUS

MGE-406 & 407: GENOMICS AND PROTEOMICS AND IMMUNOLOGY AND HAEMATOLOGY (Practical)

Total : 60

hrs

Course Objectives:

1. To facilitate the students to understand the apply the knowledge on hemolytic disorders and also to enable them to acquire knowledge in setting up of blood bank and blood safety.
2. Elucidate pathologies associated with an inappropriate immune response which leads to autoimmune disorders.
3. To describe mapping techniques, sequencing methods and functional analysis techniques.

Course Outcomes:

1. Acquisition of in-depth knowledge on different types of blood groups and able to apply compatibility testing and antihuman globulin test.
2. Acquire a broad and coherent theoretical and technical knowledge of cells and tissues of immune system.
3. Comprehend a broad and coherent theoretical and technical knowledge of hematology and hemolytic disorders.
4. Students take an in-depth look into the various genome databases, the annotation of genomes and taxonomy and significance of genomes of various model organisms.
5. Students perform an Analysis of Gene prediction- experimental methods and computer based methods, gene prediction rules and various softwares used for prediction.

MGE-406 & 407: GENOMICS AND PROTEOMICS AND IMMUNOLOGY AND HAEMATOLOGY (Practical)

Total: 60

hrs

1. Estimation of cellular DNA by spectrophotometric method or EtBr method.
2. Studies on Serum proteins by electrophoresis.
3. Single radial immunodiffusion and determination of immunoglobulin concentration.
4. Double radial immunodiffusion by Ouchterlony method.
5. Enzyme-linked immunosorbent assay.
6. TC, DC blood counts.
7. PAGE of haemoglobin.

IV SEMESTER – PRACTICAL SYLLABUS

MGE-408&409: BIOMEDICAL GENETICS AND PLANT AND ANIMAL BIOTECHNOLOGY

Total: 60

hrs

Course Objectives:

1. To provide students new knowledge and widening of the knowledge of handling of classical and modern plant biotechnology processes.
2. To facilitate the students to obtain skills on biotechnological processes such as cell and tissue culture, gene transfer in plants.
3. To understand various approaches related to disease diagnostic assays and many other assays involved in human health management.

Course Outcomes:

1. To familiarize with the techniques of plant tissue culture, mechanisms of gene transfer and various molecular markers.
2. To have the basic understanding of plant tissue culture and its maintenance, callus culture and suspension culture
3. Able to perform tissue culture with various explants and also to isolate protoplast used in transformation studies.
4. Demonstrate the knowledge about importance of different important parameters in Cell culture technique.
5. Demonstrate various disease diagnostic assays involved in animal health management.

MGE-408&409: BIOMEDICAL GENETICS AND PLANT AND ANIMAL BIOTECHNOLOGY

Total: 60

hrs

1. Introduction to general requirements of animal tissue culture laboratory.
2. Cleaning, washing, Preparation and sterilization methods for tissue culture work.
3. Preparation of media, serum, BSS, PBS, Trypsin etc.,
4. Plant tissue culture techniques.
5. Lymphocyte culture technique, Preparation of human metaphase Chromosomes.
6. Separation of peripheral blood mononuclear cells (PBMCs) - Histopaque method.
7. Primary explant culture of mouse pup/adult/ chick embryo organs.
8. Mouse bone marrow/hemopoietic cell cultures.
9. Contamination of cultures.
10. Pedigree analysis.
11. Molecular diagnosis of biochemical disorders. (Phenylketonuria, Alkaptonuria and Survey of mucopolysaccharide disorders)



Employability



Entrepreneurship



Skill Development

DEPARTMENT OF MICROBIOLOGY
M.Sc. Microbiology

MMB 102: EUKARYOTIC MICROBIOLOGY

Total Hours 52

Course Objectives:

1. The major objective of the course is to outline the structure, cultivation and significance of algae and fungi.
2. To analyze the characteristics and classification of Fungi.
3. To understand the evolutionary tendencies in fungi, algae and protozoa.

Unit 1

Protozoa: Introduction, structure and significance: of Leishmania, Trichomonas, Entamoeba, Plasmodium, Isolation and cultivation of protozoa.

4 Hours

Unit 2

Algae: Distribution, morphology and classification (Smith) of Algae; Isolation from soil and water; algal ecology, Media and methods used for culturing algae, measurement of algal growth, strain selection and large scale cultivation, Symbiotic algae: Lichens, Coral reef and sea sponges. Structure and reproduction of Spirogyra, Euglena, Exuviaella, Diatoms, Sargassum and Porphyra.

12 Hours

Unit 3

Biological and economic importance of algae: As primary producers and as commercial products [food, green energy (biofuel) and therapeutic uses], heavy metal removal, immobilized and labeled algae; algal blooms and toxins.

4 Hours

Unit 4

Fungi: Structure of Fungal cells and growth; Hyphae and non-motile unicells, motile cells, spores, dormancy, growth of population and colonies, Mechanism of growth in Fungi, Measurement and kinetics of growth, nutritional and environmental requirements; Prevention of fungal growth. Heterothallism, parasexuality, sex hormones in fungi; physiological specialization, phylogeny of fungi.

10 Hours

Unit 5

Classification: Evolutionary tendencies in fungi, Classification (Ainsworth) of fungi. Salient features of Division and Subdivision of Fungal Kingdom:

Myxomycota: Classes: Acrasiomycetes, Hydromyxomycetes, Myxomycetes, Plasmodiophoromycetes

Eumycota: Mastigomycotina: Classes: Chytridiomycetes, Hyphochytridiomycetes, Oomycetes

Zygomycotina: Classes: Zygomycetes, Trichomycetes

Ascomycotina: Classes: Hemiascomycetes, Plectomycetes, Pyrenomycetes, Discomycetes, Laboulbeniomyces, Loculoascomycetes

Basidiomycotina: Classes: Teliomycetes, Hymenomycetes, Gasteromycetes

Deuteromycotina: Classes: Hyphomycetes, Coelomycetes, Blastomycetes

Structure and reproduction of: Dictyostelium, Allomyces, Pilobolus, Claviceps, Puccinia, Fusarium.

15 Hours

Unit 6

Fungi and ecosystem: Substrate groups: saprophytic, parasitic, keratinophilic, coprophilous; substrate successions, parasitism, predation, mutualism and symbiosis with plants and animals. Diversity of aquatic and terrestrial fungi. Economic importance of fungi.

MMB 104: Microbial and Biochemical Techniques

Total Hours 52

Course Objectives:

1. To introduce basic concepts of qualitative and quantitative analysis of a given organism or a biomolecule produced by the organism.
2. To study various spectrophotometric, spectroscopic techniques and its instrumentation.
3. To understand the concepts of microscopy, separation science and its applications.

Unit 1 Isolation techniques of microorganisms: Isolation of pure cultures; dilution, spread plate, streak plate, pour plate, micromanipulator method, colony morphology and other characteristics of cultures. Maintenance and preservation of pure cultures, culture collection centers-national and international.

Microscopy: Working principle of phase contrast microscopy, fluorescent microscopy electron microscopy (TEM and SEM), confocal microscopy, scanning probe microscopy and their staining techniques: image processing methods in microscopy. Micrometry. **12 Hours**

Unit 2 Measurement of microbial growth: Direct method: Direct microscopic count, standard plate count, membrane filtration, MPN, Indirect method: turbidity, metabolic activity and dry weight. Automated microbial identification system. **6 Hours**

Unit 3 Culture independent analysis of microbes: Metagenomics, nucleic acid, phospholipids and Fatty acids analysis, Fluorescent in situ hybridization (FISH), Genomic in situ hybridization (GISH), Immunohistochemistry - FITC – protein (antibody), PCR.

Analysis of Biomolecules: Flow cytometry and X-ray diffraction. **7 Hours**

Unit 4 Spectrophotometry: Principle and applications of spectrophotometer UV/visible, fluorescence.

Spectroscopy: Principle and applications of circular dichroism, NMR, Mass spectroscopy. **9 Hours**

Unit 5 Chromatography: Principles and applications of Chromatography: Thin layer chromatography (TLC), Gel filtration chromatography, Ion exchange chromatography, Affinity chromatography, Gas chromatography (GC) and High performance liquid chromatography (HPLC).

Electrophoresis: Definition, principles and applications; different types of Electrophoresis-PAGE, SDS-PAGE, IEF, 2D-PAGE, Agarose gel electrophoresis, PFGE. **12 Hours**

Unit 6 Isotope techniques: Stable and radioactive isotopes, radio isotopic labeling, autoradiography, scintillation counters, non-radioactive labeling, labeling techniques, safety guidelines. **6 Hours**

MMB201: MICROBIAL GENETICS

Course Objectives:

1. The major objective of the course is to understand how microorganisms can be used as tools to understand various biological phenomena.
2. To acquaint types of mutation, gene regulation and transposable element
3. To understand the concepts in prokaryotic, eukaryotic, and viral genetics

Total Hours: 52

Unit 1

Prokaryotic Genome: E. coli chromosome- coiled, supercoiled (plectonemic, solenoid), folded fiber model. Mycoplasma genitalium and E. coli genome. **4 Hours**

Unit 2

Eukaryotic Genome: Structure of chromatin, chromosome, centromere, telomere, nucleosome, genome organization, split gene, overlapping genes and Cot curves, chromatin remodeling; types of histones, histone modifications- methylation, acetylation, phosphorylation and their effects on structure and function of chromatin, DNA methylation, repetitive and non-repetitive DNA sequence. Law of DNA constancy, C value paradox and genome size, karyotype and idiogram, chromosome banding pattern, types of chromosomes. Organelle genome. **12**

Hours

Unit 3

Gene and Mutation: Gene as unit of mutation, molecular basis of spontaneous and induced mutations and their role in evolution; mutagens, types of mutations, transposon mutagenesis, [site directed mutagenesis](#); [environmental mutagenesis](#); [Ames and other toxicity testing](#). **8**

Hours

Unit 4

Genetic recombination: Genetic recombination in bacteriophages and E. coli, synopsis of homologous duplexes, breakages and re-union role of RecA and other recombinases, legitimate & illegitimate recombination, gene conversion, overview of bacterial genetic map. **10**

Hours

Unit 5

Gene transfer mechanisms: Bacterial transformation; Host cell restriction; [CRISPR Transduction](#); [complementation](#); [conjugation and transfection](#), mechanisms and applications, genetic analysis of virus, bacteria and yeast genomes. Genetics of fungi alteration of generation, induction of mutation in Neurospora crassa and yeast, cytoplasmic inheritance and biochemical mutants. **10 Hours**

Unit 6

Plasmids and Bacteriophages: Plasmids, F-factors - description and their uses in genetic analysis, Colicins and Col Factors, R plasmids. Lysogeny and lytic cycle in bacteriophages, Life cycle and their uses in microbial genetics. Lytic phages-T7 and T4, Lysogenic phages-Lambda, M13 and ΦX174.

8 Hours

MMB203: ENVIRONMENTAL MICROBIOLOGY

Course Objectives:

1. The major objective of the course is to impart knowledge about structure, composition and functioning of microbial communities of diverse environment.
2. To understand the use of microbial population in mineral recovery, management of various types of pollutants and conversion processes of various types of wastes into value added products
3. To understand bioremediation, xenobiotics, and effluent treatment methods

Total Hours: 52

Unit 1

Aerobiology: Air microflora in different layers of atmosphere, bioaerosol, [assessment of air quality using principles of sedimentation, impaction, impingement, suction and filtration](#). Brief account of transmission of airborne microbes; Microbiology of indoor and outdoor. Allergy: Causes and tests for detection of allergy.

10 Hours

Unit 2 Aquatic Microbiology: Fresh(Springs,rivers,streams,lake)and marine ecosystem (estuaries, mangroves, deep sea,hydrothermal vents, salt pans, coral reefs). Zonation of water ecosystem; upwelling, eutrophication; food chain in aquatic ecosystems. Role of methanotrophs in ecosystem. [Potability of water, microbial assessment of water, water purification](#). Ground water types and their contamination. [Coaggregation and biofilm among environmental microbes, biofouling- importance](#).

Waste treatment: sewage and effluent treatment; primary, secondary and tertiary treatment, Solid waste treatment. Solid wastes as sources of energy and food.

12 Hours

Unit 3 Soil Microbiology: Biotic and abiotic interactions, concepts of habitat and niche. Microbialcommunities; nature, structure and attributes, levels of species diversity, succession and stability, r and K selection, genetic exchange between communities. Biodiversity management and conservation. Role of microbes in decomposition in decomposition of organic matter in various types of soils, subterranean microbes. Biogeochemical cycles of carbon, nitrogen, phosphorous and sulphur.

10 Hours

Unit 4 Diversity in anoxic eco system: Methanogens-reduction of carbon monoxide- reduction of iron, sulphur, manganese, nitrate and oxygen. Microbial transformations of Carbon, Phosphorus, Sulphur, Nitrogen and Mercury.

4 Hours

Unit 5 Extremophiles: The domain Archaea, acidophilic, alkalophilic, thermophilic, barophilic and osmophilic and radiodurant microbes- mechanisms and adaptation. Halophilic- membrane variation- electron transport and extremophiles-Applications, Astromicrobiology.

6 Hours

Unit 6 Biodegradation: [Role of microbes in degradation, Biodegradation of Xenobiotics-hydrocarbons, pesticides and plastics](#). Biodeterioration of wood, pulp and paper; Biosorption/bioaccumulation of heavy metals. Bioremediation of soil, air and water: various methods, advantages and disadvantages, Oil degrading genetically engineered *Pseudomonas putida*- a case

MMB204: FOOD MICROBIOLOGY

Course Objectives:

1. The major objective of the course is to teach the strategies to develop fermented and non-fermented milk products, plant based products, fish products, meat products bioactive compounds and malt beverages, wines, distilled liquors and vinegar.
2. To understand food spoilage microorganisms; the microbiology of food preservation and food commodities; fermented and microbial foods; principles and methods for the microbiological examination of foods; micro biological quality control, and quality schemes.
3. To create awareness among the students about the food quality analysis and the role of government organizations involved in food quality control.

Total Hours: 52

Unit 1 Introduction: Development of food microbiology as a science, scope of food microbiology. Food as substrate for microorganisms, intrinsic and extrinsic factors affecting the growth of microbes, important microorganisms in food (molds, yeasts and bacteria) and their source (air, soil, water, plants and animals).

6 Hours

Unit 2 Food contamination and spoilage: Sources of food contamination. Principles of food spoilage; spoilage of cereals, sugar products, vegetables, fruits, meat and meat products, milk and milk products, fish and sea foods, poultry; spoilage of canned foods; [conventional and modern methods for detection of spoilage and characterization](#).

10 Hours

Unit 3 Food-borne infections and intoxication: Bacterial- Brucella, Bacillus, Clostridium, Escherichia, Listeria; Food intoxication- Botulism, Staphylococcal. Mycotoxins & their types – aflatoxins, ochratoxins, fumonisins, trichothecenes, zealenone, ergot alkaloids; [food borne outbreaks and lab testing procedures](#). Preventive measures. Molds, Algae, Protozoa, Viruses.

10 Hours

Unit 4 Food preservation: Principles and methods of food preservation- Physical (temperature, irradiation, drying, canning, processing for heat treatment-D, Z and F values) Chemical (Organic acids, food additives. Class I and Class II preservatives), Biopreservation (Lactic acid bacteria). Food Packaging- Types of packaging materials, properties and benefits.

10 Hours

Unit 5 Microbial and Fermented foods: SCP- Nutritional & therapeutic importance, Quorn and SCO and their Industrial production. Fermented Vegetables (olives, cucumbers), Meat (sausages),

Beverage (cocoa and coffee); Bread, Idli, Dairy foods (cheese, srikhand).production methods of Kefir, Yogurt, Acidophilus milk; Probiotics, Prebiotics and Synbiotics, Nutraceuticals (Cr/Se yeast), functional foods and their quality standards. Application of fungal pigments in food industry.

12 Hours

MMB205: BIOINFORMATICS (Soft core)

Course Objectives:

1. The major objective of the course is to provide an overview of various bioinformatics tools, databases available and sequence analysis
2. To Provide knowledge on database concept, management, retrieval along with utilization in gene and protein analysis
3. To learn various computational technique and online tools of bioinformatics

Total Hours: 26

Unit 1 Introduction to Computer: Binary, Octal and Hexadecimal number systems– Binary arithmetic, Binary code. Computer Architecture- internal and external Devices. Computer software operating system- Windows, UNIX, Linux, Application software- word processor, spread sheet. Introduction to statistical software (SPSS).

3 hours

Unit 3 Databases: Introduction - Relational Databases Management (RDMS) - Oracle, SQL, Database generation. Biological Databases: Datamining and applications, accessing bibliographic databases- Pubmed, Nucleic acid sequence databank – NCBI and EMBL. Protein sequence databank-NBRF-PIR, SWISSPROT. Structural databases - protein data Bank (PDB). Metabolic pathway data bank (Pub gene), Microbial genomic database (MBGD), Cell line database (ATCC), Virus data bank (UICTVdb). Sequence alignment - Global and Local alignment, scoring matrices.

Restriction mapping - NEB CUTTER, Similarity searching (FASTA and BLAST), Pair wise comparison of sequences, Multiple Sequence alignment of sequences, Identification of genes in genomes and Phylogenetic analysis with reference to nucleic acids and protein sequences, Identification of ORFs, Identification of motifs.

10

hours

Unit 4 Protein Structure and Molecular Interaction: Chemical bonding and nonbonding interactions, stability of electrovalent bond. Co-valent bond – partial ionic character of co-valent bonds and Vander Waals forces. Introduction to protein structure - secondary structure prediction, tertiary structure prediction, protein modelling- principles of homology and comparative modelling. Threading, structure evaluation and validation and ab initio Modelling, Applications - Molecular docking –Autodoc.

8 Hours

MMB303: RECOMBINANT DNA TECHNOLOGY

Course Objectives:

1. The major objective of the course is to understand various applications of microbes for the development of various products of agriculture, industrial and clinical application.
2. To acquire knowledge about the methods used to clone genes, make and screen libraries, and the various applications of the polymerase chain reaction.
3. To understand how recombinant DNA technology has been exploited in the study of biology as well as in the production of pharmaceutical products

Total Hours: 52

Unit 1 Tools of recombinant DNA technology: Restriction endonucleases: types, nomenclature, recognition sequences, cleavage pattern. Ligases: mechanism of ligation, other DNA modifying enzymes-(Polymerases, DNase, RNase, Polynucleotide kinases, Alkaline Phosphatases). Vectors: Cloning and expression vectors, plasmids (pBR 322, pUC, Ti), phages, cosmids, Phagemids, shuttle vectors, ARS, mini chromosomes, BACs, PACs and YACs. Promoter probe vectors, PET, BAC vectors, SV40, plant viruses as vectors. **14 Hours**

Unit 2 Cloning and Expression: Cloning in Prokaryotes (E.coli) and Eukaryotes: (Saccharomyces cerevisiae and Pichia pastoris); construction of cDNA and genomic DNA library. Transformation into bacteria and yeast, transfection into plant and animal cells, selection of recombinant cells, expression of recombinant proteins. **10 Hours**

Unit 3 Molecular techniques: PCR - Principles, designing of primers, PCR methodology, PCR variants- RT - PCR, multiplex PCR, nested PCR- Identification of PCR product- Factors influencing PCR- Cloning of PCR products- Application of PCR technology - Molecular markers: RFLP, RAPD, AFLP, SSCP and SNP, 16s r-DNA typing, gene chip and micro array; applications in disease profile, DNA finger printing and forensic science – DNA Foot printing. **12 Hours**

Unit 4 DNA sequencing: Dideoxy and chemical methods, sequence assembly, automated sequencing, genome sequencing, mapping of genes and fine structure analysis of genes. **5 Hours**

Unit 5 Chemical synthesis of genes: Phosphodiester, phosphotriester, phosphate trimer approaches: Enzymatic synthesis of DNA; application of synthetic oligonucleotides, synthesis of complete gene. **5 Hours**

Unit 6 Application of rDNA technology: genetically modified organisms (Bt cotton). Overview of Transgenic plants, GM foods (golden rice, tomato, corn, brinjal), transgenic animals (cow, sheep, poultry, fish). Gene therapy. **6 Hours**

MMB401: AGRICULTURAL MICROBIOLOGY

Course Objectives:

1. The major objective of the course is to provide the students a basic understanding of agricultural microbiology including agricultural welfare, ecosystem wellness and the fate of microbial pathogens in the agricultural fields.
2. To know the importance of biofertilizers and biopesticides and to know about various techniques involved in biofertilizers and biopesticides production
3. To give an overview on plant microbe interaction and impart in-depth information on soil and agriculture

Total Hours: 52

Unit 1 Microbes and soil fertility: Role of microbes in soil fertility. Decomposition of organic matter by microorganisms - cellulose, hemicellulose, lignin, xylan and pectin. Soil fertility evaluation and improvement. Effect of pesticides on soil microflora. **4 Hours**

Unit 2 Biological nitrogen fixation(BNF): Nitrification, denitrification; symbiotic nitrogen fixation(Rhizobium, Frankia), non-symbiotic nitrogen fixation (Azotobacter, Azospirillum); Nitrogenase enzyme, nif genes and molecular mechanism of nitrogen fixation. Role of nodulin genes in nodule development and symbiosis. Genetic engineering of BNF. **8 Hours**

Unit 3 Plant-microbe interactions: Mutualism, commensalism, parasitism, amensalism, synergism. Rhizosphere microorganisms, phyllosphere, spermosphere and rhizoplane, methods of enumeration, rhizosphere effect, factors influencing rhizosphere microbes. PGPR, Siderophores and VAM. **10 Hours**

Unit 4 Bioinoculants: Biofertilizer - types, production and quality control. Cultivation and mass production of bioinoculants- Azotobacter, Rhizobium, Azospirillum, Cyanobacteria, phosphate solubilising microorganisms, Azolla. Carrier-based inoculants - production and applications. Biopesticides—types and applications (Pseudomonas fluorescence, Bacillus thuringiensis, Trichoderma spp, Nuclear Polyhedrosis Virus) **10 Hours**

Unit 5 Molecular plant pathology: Recognition and entry of pathogens into host cells. Alteration of host cell behaviour by pathogens. Molecular mechanisms of disease establishment; enzymes, phytotoxins, growth regulators. Involvement of elicitors; role of R and r genes in disease development. Molecular mechanisms of disease diagnosis. Resistance mechanisms in plants, Systemic resistance, resistance genes, phytoalexins, PR proteins, signalling mechanisms. **6 Hours**

Unit 6 Plant diseases: (Symptomatology, etiology & control) Diseases caused by

a) Fungi: Fusarium Wilt, Downy mildews (Millets), Powdery mildews (grapes), Rusts (wheat)

b) Bacteria: (Tomato wilt, Bacterial blight of rice, Angular leaf spot of cotton, Citrus canker)

c) Mycoplasmal diseases: (Sandal spike, Grassy shoot of sugar cane)

d) Viral diseases: (Cauliflower mosaic disease, Banana bunchy top, Cow pea mosaic, tomato leaf curl)

e) Viroids: (Potato spindle tuber viroid). Strategies for disease management, Post-harvest diseases and control measures. Integrated pest management. **14 Hours**

MMB402: INDUSTRIAL MICROBIOLOGY

Course Objectives:

1. The major objective of the course is to provide the design of bioreactors, media formulations and factors affecting the industrial production of bio-chemicals along with approaches that can be used for enhanced production
2. To analyze the role of micro-organism in production of organic acids, alcohols, wine, vinegar, enzymes, vitamins, antibiotics, amino-acids and steroids

3. To understand the strategies for development of microbial strains, process optimization, large scale production and product recovery will be covered for industrially relevant microbial products and therapeutic proteins

Total Hours: 52

Unit 1 Introduction: Scope of Industrial Microbiology and fermentation technology. Study of industrially important micro-organisms and their preservation. Criteria for selection and strategies for strain improvement; maintenance and containment of recombinant organisms. **8 Hours**

Unit 2 Modes of Fermentation and process control: Batch, fed batch and continuous culture: growth kinetics; effect of environment: temperature, pH, nutrient concentration; monitoring microbial growth in culture: cell number, direct and apparent viscosities; anti-foam agents. **10 Hours**

Unit 3 Fermentors: basic features, design & components–Typical fermentor. Sterilization of fermentor, medium, air supply; aseptic inoculation and sampling methods; scale up of fermentation process (parameters used in scale up, problems associated). Merits & demerits. Fermentation media: Media formulation strategies, sources of carbon, nitrogen, vitamins and minerals; role of buffers, precursors, inhibitors and inducers. Specialized bioreactors (Photobioreactors, membrane, fluidized bed, tubular and packed bed reactor). **10 Hours**

Unit 4 Solid state fermentation (SSF): Estimation of growth in SSF, concept of sterility. Comparison of SSF with SmF. Factors influencing SSF, kinetics, design of fermentor in SSF (Koji fermentor). Production of commercially important products by SSF. **6 Hours**

Unit 5 Downstream processing: Objectives and criteria, foam separation, precipitation methods, filtration, centrifugation, cell disruption methods, liquid extraction, membrane filtration, chromatography, drying devices, crystallization. Solvent recovery. Effluent treatment. Quality control of fermented products, Process economics. **8 Hours**

Unit 6 Intellectual Property Rights (IPR): Introduction to Intellectual Property & IPR, patent, copyrights, trademarks, trade secret, geographical indications, Industrial designs. Patent laws, Legislations covering IPR's in India, Patenting of living organisms, procedure involved in patenting, patent infringement, patent filing and international patent law, PCT, provisional and complete specification, patentable and non-patentable materials, product planning and development, Trade related aspects (TRIPS), WTO, WIPO (international & regional).

Entrepreneurship: Introduction, concept and theories of entrepreneurship, entrepreneurial traits and motivation, nature and importance of entrepreneurs. Entrepreneurship in India, barriers in entrepreneurship, agreements. Valuation & business concerns. Government regulations for microbial products. **10 Hours**

MMB403: MICROBIAL BIOTECHNOLOGY

Course Objectives:

1. The major objective of the course is to understand the microbial biotechnology through handling the microorganisms
2. To expose on various techniques involve in genetic engineering

3. To provide knowledge and in-depth study on plant & animal tissue culture techniques, Fermentation techniques & Biosensors, Environment & Energy, Concepts & Scope in Genetic Engineering and Applications of Genetic engineering

Total Hours: 52

Unit 1 Introduction: Principle, applications, economics and milestones in microbial technology.

2Hours

Unit 2 Microbial products for commercial use: Industrial production of organic acids (acetic acid, lactic acid). Amino acids (lysine, glutamic acid), Solvents (acetone, ethanol), Antibiotics (Cephalosporin, Streptomycin), Microbial polysaccharides (xanthan) and polyesters (PHB). Hormones (insulin), anticholesterol compound (Lovastatin). Vaccines (recombinant). Microbial insecticides. Secondary metabolites in bacteria and fungi (anti-cancer and anti-diabetic compounds). Biosimilars, Surfactants of Microbial Origin (Lecithin) **14**

Hours

Unit 3 Microbial enzymes: Industrial production of lipase, protease & asparaginase. Enzymes in - starch processing, food, textile, detergent, leather, breweries, pharmaceuticals, therapeutics, and diagnostics. Recombinant enzymes. Immobilized enzymes and cells: Techniques and types of immobilization, industrial applications of immobilization: merits and demerits. **10 Hours**

Unit 4 Microbial transformation and organic synthesis: Transformation of steroids and sterols, over production of glutathione by genetically engineered cells. **Metabolic engineering for vitamin C production, synthesis of acrylamide by nitrile hydratase (synthesis of optically pure drugs).** **10 Hours**

Unit 5 Nanotechnology: Introduction, Tools of nanosciences, Synthesis of Nanomaterials using microbes. Biopolymeric nanoparticles; nanosensors, biomedical applications, antimicrobial nanoparticles. **8 Hours**

Unit 6 Bioethics and biosafety: Introduction, Human genome project and its ethical, legal and social implications. Biosafety guidelines and regulations for GMOs. GLP and GMP. Labelling of GM products. Ethics and safety of GM food. Testing of drugs on human volunteers. **8 Hours**

Department of Lifesciences

MATRIX AND SYLLABUS

For the Programme B.Sc

Microbiology

B.Sc. (Basic and Honours Degree)

NEP Based Curriculum

2023-2024

PEOs	Programme Educational Objectives
PEO1	To provide in-depth knowledge on core areas of biosciences in a wide-ranging context which involves the use of evolved and practicable skills for a lifelong learning.
PEO2	To make students competent in the field of biosciences and allied areas by providing them hands-on experience using multifarious tools and techniques.
PEO3	To inculcate, facilitate, motivate and promote knowledge to critically evaluate, and apply technical skills to validate and solve environmental, industrial and agricultural issues through core bio-scientific interventions.
PEO4	To develop graduates with a strong professional ethics and moral duties combined with enhanced vocabulary that will positively affect their profession, community, society and nation at large.
PEO5	To equip students so as to take up a suitable career in industry or research or from a multidisciplinary environment from the imbibed communicative, linguistic, analytical and bioinstrumentation competencies.

PO	Programme Outcomes
PO1	After completion in the core areas of biosciences program students are able to get exposed to strong theoretical and practical background in fundamental concepts.
PO2	Develop an ability to solve, analyze and interpret data generated from laboratory work and research activities that help to develop critical understanding of the latest development in the core areas of biosciences.
PO3	Students are able to use skills required for the extraction, separation, and synthesis of a variety of biomolecules utilized in clinical diagnosis, pharmaceutical, industrial, agricultural sector or in research laboratories.
PO4	Apply knowledge and understandings of Biological Science and skills to new and unfamiliar contexts to identify, analyze problems, issues and seek solutions to real-life problem
PO5	Able to undertake hands on laboratory work and activities that help to develop practical knowledge and skills that are required for pursuing career in clinical diagnosis, drug design, vaccine development, pharmaceutical industry, teaching, research and environmental monitoring

PO_ID	Programme Specific Outcomes
PSO1	At the end of the programme the student will understand and be able to explain concepts related to the domains of study.
PSO2	Students will be able to explain various applications of Microbiology such as in Environmental, Medical, Industrial, Agricultural and Food Microbiology.
PSO3	Students will be able to design and execute experiments related to Basic Microbiology, Immunology, Molecular Biology, Recombinant DNA Technology, Microbial Genetics, Environmental, Medical, Industrial, Agricultural and Food Microbiology.
PSO4	Students will be equipped to take up a suitable position in academia or industry, and to pursue a career in research if so desired and Acquire the knowledge to design the protocol to solve environmental, industrial, agricultural issues through evolved expertise.
PSO5	Students will be able to execute a research project incorporating techniques of Basic and Advanced fields of study under supervision.

NEP-2020

Programme Name- B.Sc. Microbiology (w.e.f. 2021-22 Onwards)

I Semester							
Code	Course Code	Course	Teaching Hours	Course Components			Credits
				L	T	P	
AECC	LAN 1.1	Kannada / other languages	45	2	1	-	3
AECC	LAN 1.2	English / Hindi	45	2	1	-	3
DSC - 1T	S21 MB1.1	General Microbiology	60		4	-	4
DSC - 1P	S21 MB 1.2	General Microbiology	45		-	4	3
DSC		Other Discipline - Theory	60		4	-	4
DSC		Other Discipline - Lab	45		-	4	3
OE-1T	MBL301	Microbial Technology for Human Welfare	45		3	-	3
SEC-1T	MBL701	Microbiological Methods and Analytical Techniques	15		1		1
SEC-1P	MBL701	Microbiological Methods and Analytical Techniques	45			3	2
SEC-3	VBC 1.2	Physical Education for fitness - Yoga				1	1
Total							25
II Semester							
AECC	LAN 2.1	Kannada / Functional Kannada	45	2	1	-	3
AECC	LAN 2.2	English / Hindi	45	2	1	-	3
AECC	EVS 2.1	Environmental Studies	30		2	-	2
DSC-2T	MBL 102	Microbial Biochemistry and Physiology	60		4		4
DSC-2P	MBL 102	Microbial Biochemistry and Physiology	45			3	2
DSC		Other Discipline - Theory	60		4		4
DSC		Other Discipline - Lab	45			3	2
OE- 2T	MBL 302	Environmental and Health Microbiology	60		4		3
SEC-4	VBC 2.1	NCC/NSS/Cultural	30			1	1
SEC-5	VBC 2.2	Physical Education - Sports	30			1	1
Total							25

III Semester							
Code	Course Code	Course	Teaching Hours	Course Components			Credits
				L	T	P	
AECC	LAN 3.1	Kannada / Hindi	45	2	1	-	3
AECC	LAN 3.2	English / Hindi	45	2	1	-	3
DSC7	S21 MB 3.1	Microbial diversity - Theory	60		4	-	4
DSC8	S21 MB 3.2	Microbial diversity – Lab	60		-	4	2
DSC9		Other Discipline - Theory	60	3	1	-	4
DSC10		Other Discipline - Lab	60	-	-	2	2
OECC	OECC MB 3.1	Cosmetic Microbiology	45	-	3	-	3
SEC-6	SBC 3.1	Artificial Intelligence / Power Business Intelligence / Cyber Security	30	-	1	1	2
SEC-7	VBC 3.1	Sports	30	-	-	1	1
SEC-8	VBC 3.2	NCC/NSS/R&R/Cultural	30	-	-	1	1
Total							25
IV Semester							
AECC	LAN 4.1	Kannada / Functional Kannada	45	2	1	-	3
AECC	LAN 4.2	English / Hindi	45	2	1	-	3
AECC	EVS 4.3	Constitution of India	30	2	-	-	2
DSC11	S21 MB 4.1	Microbial Enzymology and Metabolism	60	4	-	-	4
DSC12	S21 MB 4.2	Microbial Enzymology and Metabolism	60	-	-	4	2
DSC13		Other Discipline - Theory	60	3	1	-	4
DSC14		Other Discipline - Lab	60	-	-	2	2
OECC	OECC MB 4.1	Microbial Biotechnology	45	2	1	-	3
SEC-9	VBC 4.1	Sports	30	-	-	1	1
SEC-10	VBC 4.2	NCC/NSS/YRCS/Cultural	30	-	-	1	1
Total							25

AECC- Ability Enhancement Compulsory Courses
DSC- Discipline Specific Course

VBC- Value-based Course
 SEC- Skill Enhancement
 Course DSE- Discipline
 Specific Elective OE- Open
 Elective

V Semester							
Code	Course Code	Course	Teaching Hours	Course Components			Credits
				L	T	P	
DSC15	S21 MB 5.1	Microbial Genetics and Molecular Biology – Theory	60		4	-	4
DSC16	S21 MB 5.2	Microbial Genetics and Molecular Biology – Lab	60		-	4	2
DSC17	S21 MB 5.3	Immunology and Medical Microbiology – Theory	60	3	1	-	4
DSC18	S21 MB 5.4	Immunology and Medical Microbiology - Lab	60	-	-	4	2
DSC19		Other Discipline Theory	60	-	3	-	4
DSC20		Other Discipline Lab	30	-	1	1	2
DSC21		Other Discipline Theory	30	-	-	1	4
DSC22		Other Discipline Lab	30	-	-	1	2
SEC-11		R-Programming – A practical approach	30	1	-	2	2
Total							26
VI Semester							
DSC23	S21 MB 6.1	Food and Dairy Microbiology- Theory	60	4	-	-	4
DSC24	S21 MB 6.2	Food and Dairy Microbiology- Lab	60	-	-	4	2
DSC25	S21 MB 6.3	Industrial Microbiology and Bioprocess Technology - Theory	60	3	1	-	4
DSC26	S21 MB 6.4	Industrial Microbiology and Bioprocess Technology - Lab	60	-	-	4	2
DSC27		Other Discipline Theory	60	3	1	-	4
DSC28		Other Discipline Lab	60	-	-	2	2
DSC29		Other Discipline Theory	60	3	1	-	4

DSC30		Other Discipline Lab	60	-	-	2	2
SEC-12		Professional Communication	45	2	-	1	2
Total							
1							

DSC- Discipline-Specific Course

SEC- Skill Enhancement Course

**Continuous Internal Assessment – Scheme of Evaluation for
Theory Courses**

End Semester Examination: 60%

Continuous Internal Assessment: 40%

Activities (CIA: 40 Marks)	Proposed and Approved Scheme		Total Marks (40)
	IA-1	IA-2	
Session Test Maximum Marks	30	30	
1. Weightage (Marks)	10	10	20
2. Assignment (Marks)	20		20
i. Writing	10		10
ii. Snap Quiz / Oral Viva Voce (T)/Reflective Essay	05		05
iii. Classroom participation	05		05
Total			40

**Continuous Internal Assessment – Scheme of Evaluation For
Practical Courses**

End-Semester Examination: 50%

Continuous Internal Assessment: 50%

CIA (25 marks) + End Semester Exam (25 marks)	
Maximum Marks (Internal Assessment)	25
1. Weightage (Marks)	15
2. Record work (Marks)	05
3. Quiz/Presentation/creating diagrams/charts/Lab work/	05
Total (Marks)	25

SEMESTER – I
S21 MB 1.1 : General Microbiology

Total Teaching Hours: 60 Hours

No. of Hours / Week: 4

CObj_ID	Course Objectives
CObj_1	The objective of the course is to Know General bacteriology and microbial techniques for isolation of pure cultures of bacteria, fungi and algae.
CObj_2	To Master aseptic techniques and be able to identify the unknown microorganisms.
CObj_3	To understand the basic microbial structure and function and study the comparative characteristics of prokaryotes and eukaryotes.

CO_ID	Course Outcomes
CO_1	Comprehend the various methods for identification of unknown microorganisms.
CO_2	Apply practical skills in microscopy handling and staining techniques.
CO_3	Understand about the various physical and chemical means of sterilization.
CO_4	Understand the microbial transport systems and the modes and mechanisms of energy conservation in microbial metabolism.
CO_5	Knowledge about the microbial nutrition - Autotrophy and heterotrophy mode of nutrition.

CO-PO Mapping

	PO_ 1	PO_ 2	PO_ 3	PO_ 4	PO_ 5	PSO_ 1	PSO_ 2	PSO_ 3	PSO_ 4	PSO_ 5
CO_1	*					*				
CO_2		*				*				
CO_3	*					*				
CO_4			*					*		
CO_5			*				*			

Course Content

S. No	Module title	Module Content	Number of Hours	Skills Developed
1	Historical development, major contributions, origin of microorganisms and microscopy	Historical development of microbiology - Theory of spontaneous generation, Biogenesis and Abiogenesis. Contributions of Anton Von Leeuwenhoek, Louis Pasteur, Robert Koch, Joseph Lister and Edward Jenner, Alexander Fleming, Martinus Beijerinck, Sergei Winogradsky, Elie Metchnikoff. Contributions of Indian scientists in the field of Microbiology. Fossil evidences of microorganisms. Origin of life, primitive cells and evolution of microorganisms. Microscopy- working principle, construction and operation of simple and compound microscopes.	15 Hours	Analytical Skills 1. EMP 2. SKD 3. EDP
2	Staining, sterilization and preservation of microorganisms	Staining: Nature of strains, principles, mechanism, methods and types of staining- Simple, Differential-Gram staining, Acid fast staining, staining of capsule, cell wall, endospore, inclusion bodies. Sterilization: Principles, types and techniques, Physical, chemical, radiation and mechanical Preservation of microorganisms: Methods of preservation of microorganism, slant culture, stab culture, soil culture mineral oil overlaying, glycerol preservation.	15 Hours	Cognitive Skills 1. EMP 2. SKD 3. EDP

3	Types, structure, organisation and reproduction of prokaryotic microorganisms	Overview of Prokaryotic Cell Structure: Size, shape, arrangement. Diagram of Prokaryotic cell organisation, cell wall structure and Gram staining, cell membrane; Bacterial and Archaeal, Cytoplasmic matrix- Cytoskeleton, ribosome, inclusion granules: Composition and function. Nuclear Materials – Bacterial chromosomes structure (its differences with the Eukaryotic chromosome); Extra Chromosomal materials. Components external to cell wall- capsule, slime, s-layer, pilli, fimbriae, flagella; structure, motility, chemotaxis. Bacterial Endospore - Examples of spore forming organisms, habitats, function, formation and germination. Reproduction in bacteria and bacterial cell cycle.	15 Hours	Transferrable Skills 1. EMP 2. SKD 3. EDP
4	Types, structure, organisation and reproduction of eukaryotic microorganisms	Overview of eukaryotic cell structure: General structure and types of cells; External cell coverings and cell membrane. Structure and function of Cytoplasmic matrix- cytoskeleton: Structure and function; single Membrane organelles- Endoplasmic reticulum, Golgi complex, Lysosomes, Vesicles and Ribosomes; Double Membrane organelles- Nucleus, Mitochondrion and Chloroplast: Structure and Functions; Peroxisomes; Organelles of motility- Structure and movement of flagella and cilia.	15 Hours	Transferrable Skills 1. EMP 2. SKD 3. EDP

Total Teaching Hours: 45

No. of Hours / Week: 3

S. No	Module title	Total Number of Hours	Skills Developed
1	Microbiological laboratory standards and safety protocols	3	Analytical Skills 1. EMP 2. SKD 3. EDP
2	Standard aseptic conditions of Microbiological laboratory	3	
3	Operation and working principles of Light/Compound microscope.	3	
4	Working principles and operations of basic equipments of microbiological laboratory (Autoclave, Oven, Incubator, pH meter, Spectrophotometer, Colorimeter, vortex, magnetic stirrer etc).	3	
5	Applications of basic microbiological tools (Pipettes, Micropipette, Bunsen burner, Inoculation loop, Spreader).	3	
6	Demonstration and observations of microorganisms from natural sources under light microscope (Algae, Yeast and Protozoa).	3	
7	Demonstration of bacterial motility by hanging drop method.	3	
8	Simple staining.	3	
9	Differential staining - Gram staining.	3	
10	Acid fast staining.	3	
11	Structural staining - Flagella and Capsule.	3	
12	Bacterial endospore staining.	3	
13	Staining of reserved food materials.	3	
14	Staining of fungi by Lactophenol cotton blue.	3	
15	Negative staining.	3	

Books for References

- Prescott, Harley, Klein's Microbiology, J.M. Willey, L.M. Sherwood, C.J. Woolverton, 7th International, edition 2008, McGraw Hill.
- Foundations in Microbiology, K. P. Talaro, 7th International edition 2009, McGraw Hill.

- A Textbook of Microbiology, R. C. Dubey and D. K. Maheshwari, 1st edition, 1999, S. Chand & Company Ltd.
- Brock Biology of Microorganisms, M.T.Madigan, J.M.Martinko, P. V. Dunlap, D. P. Clark- 12th edition, Pearson International edition 2009, Pearson Benjamin Cummings.
- Microbiology – An Introduction, G. J.Tortora, B. R.Funke, C. L. Case, 10th ed. 2008,Pearson Education.
- General Microbiology, Stanier, Ingraham et al, 4th and 5th edition 1987, Macmillan education limited.
- Microbiology- Concepts and Applications, Pelczar Jr,Chan, Krieg, International ed, McGraw Hill.
- Alexopoulos, C.J., Mims, C.W., and Blackwell, M. 2002. Introductory Mycology. John Wiley and Sons (Asia) Pvt. Ltd. Singapore. 869 pp.
- Atlas, R.M. 1984. Basic and practical microbiology. Mac Millan Publishers, USA. 987pp.
- Black, J.G. 2008. Microbiology principles and explorations. 7edn. John Wiley and Sons Inc., New Jersey 846 pp.
- Pommerville, J.C. Alcamo's Fundamentals of Microbiology. Jones and Bartlett Pub..Sudbury, 835 pp.
- Schlegel, H.G. 1995.General Microbiology. Cambridge University Press, Cambridge, 655 pp.
- Tortora, G.J., Funke, B.R. and Case, C.L. 2007. Microbiology 9th ed. Pearson Education Pte. Ltd., San Francisco. 958pp.

Course 2 : Theory: OE 1T, MBL 301, Microbial Technology for Human Welfare**Total Teaching Hours : 42****No. of Hours / Week: 3**

CObj_ID	Course Objectives
CObj_1	The major objective of the course is to teach the strategies to develop fermented products
CObj_2	To know the importance of biofertilizers, biopesticides and Mushroom Cultivation.
CObj_3	To understand the strategies for development of microbial strains, process optimization, large scale production and product recovery by industrially relevant microbial products

CO_ID	Course Outcomes
CO_1	Create the knowledge about the microbial food products and agencies
CO_2	Make use of microorganisms in the production of bio fertilizer and biopesticide
CO_3	Learn techniques in commercial cultivation of mushroom and biogas production
CO_4	Get hands-on knowledge of disinfection, sterilization, microbial assays, pharmacopoeia standards and antimicrobial agents.
CO_5	Determine the recovery and purification of microbial products such as microbial drugs and antibiotic therapy vaccine

CO-PO Mapping

	PO_ 1	PO_ 2	PO_ 3	PO_ 4	PO_ 5	PSO_ 1	PSO_ 2	PSO_ 3	PSO_ 4	PSO_ 5
CO_1	*						*			
CO_2			*				*			
CO_3		*						*		
CO_4				*					*	
CO_5				*						*

Course Content

S. No	Module title	Module Content	Number of Hours	Skills Developed
1	Food and Fermentation Microbial Technology	Fermented Foods – Types, Nutritional Values, Advantages and Health Benefits Prebiotics, Probiotics, Synbiotics and Nutraceutical Foods. Fermented Products – Alcoholic and nonalcoholic beverages, fermented dairy products, Fruit fermented drinks.	14 Hours	Transferrable and Cognitive Skills 1. EMP 2. SKD 3. EDP
2	Agriculture Microbial Technology	Microbial Fertilizers, Microbial Pesticides, Mushroom Cultivation, Biogas Production	14 Hours	Analytical Skills 1. EMP 2. SKD 3. EDP
3	Pharmaceutical Microbial Technology	Microbial Drugs – Types and Development of Drug Resistance Antibiotics – Types, Functions and Antibiotic Therapy Vaccines – Types, Properties, Functions and Schedules	14 Hours	Evaluation and Synthesis 1. EMP 2. SKD 3. EDP

Text Books / References

1. Prescott, Harley, Klein's Microbiology, J.M. Willey, L.M. Sherwood, C.J. Woolverton, 7th International, edition 2008, McGraw Hill.
2. Foundations in Microbiology, K. P. Talaro, 7th International edition 2009, McGraw Hill.
3. A Textbook of Microbiology, R. C. Dubey and D. K. Maheshwari, 1st edition, 1999, S. Chand & Company Ltd.
4. Brock Biology of Microorganisms, M.T.Madigan, J.M.Martinko, P. V. Dunlap, D. P. Clark- 12th edition, Pearson International edition 2009, Pearson Benjamin Cummings.
5. Microbiology – An Introduction, G. J.Tortora, B. R.Funke, C. L. Case, 10th ed. 2008,Pearson Education.
6. General Microbiology, Stanier, Ingraham et al, 4th and 5th edition 1987, Macmillan education limited.
7. Microbiology- Concepts and Applications, Pelczar Jr,Chan, Krieg, International ed, McGraw Hill.
8. Alexopoulos, C.J., Mims, C.W., and Blackwell, M. 2002. Introductory Mycology. John Wiley and Sons (Asia) Pvt. Ltd. Singapore. 869 pp.

9. Atlas, R.M. 1984. Basic and practical microbiology. Mac Millan Publishers, USA. 987pp.
10. Black, J.G. 2008. Microbiology principles and explorations. 7edn. John Wiley and Sons Inc., New Jersey 846 pp.
11. Pommerville, J.C. Alcamo's Fundamentals of Microbiology. Jones and Bartlett Pub..Sudbury, 835 pp.
12. Schlegel, H.G. 1995.General Microbiology. Cambridge University Press, Cambridge, 655 pp.
13. Toratora, G.J., Funke, B.R. and Case, C.L. 2007. Microbiology 9th ed. Pearson Education Pte. Ltd., San Francisco. 958pp.
14. Stanbury, P. F., A. Whitaker and S. Hall, *Principles of fermentation technology*.Elsevier Science B.V., Amsterdam, Netherlands, Aditya Books (P) Ltd, New Delhi.
15. Subbarao, N. S., *Soil Microorganisms and Plant Growth*.Oxford and IBH publishing Company, New Delhi.

SEMESTER – II

S21 MB 2.1: Microbial Biochemistry and Physiology

Total Teaching Hours: 60 Hours

No. of Hours / Week: 4

CObj_ID	Course Objectives

CObj_1	The major objective of the course is to develop a clear understanding of various aspects of microbial physiology along with diverse metabolic pathways existing in bacteria in relation to its survival and propagation.
CObj_2	To provide the core principles and specialized knowledge of Carbohydrates, Lipids, Proteins, Vitamins, Porphyrin, cellular transport, law of thermodynamics, Lipid and Nitrogen metabolism.
CObj_3	To acquaint various life processes like photosynthesis, respiration, fermentation and anaerobic respiration.

CO_ID	Course Outcomes
CO_1	Evaluate the metabolic process of microbial system
CO_2	Apply the knowledge of biomolecules in biochemistry
CO_3	Analysis of the mechanism of bioenergetics and photosynthesis.
CO_4	Analysis of the mechanism of fermentation and anaerobic respiration.
CO_5	Able to predict the intermediate product which can be used for industrial production processes.

CO-PO Mapping

	PO_ 1	PO_ 2	PO_ 3	PO_ 4	PO_ 5	PSO_ 1	PSO_ 2	PSO_ 3	PSO_ 4	PSO_ 5
CO_1	*					*				
CO_2		*					*			
CO_3			*					*		
CO_4				*				*		
CO_5					*				*	*

Course Content

S. No	Module title	Module Content	Number of Hours	Skills Developed
1	Biochemical Concepts	Basic Biochemical Concepts: Major elements of life and their primary characteristics, atomic bonds and molecules – bonding properties of carbon, chemical bonds- covalent and non covalent, Hydrogen bonds and Vander Waal Forces. Biological Solvents: Structure and properties of water molecule, Water as an universal solvent, polarity, hydrophilic and hydrophobic interactions, properties of water, Acids, bases, electrolytes, hydrogen ion concentration, pH, buffers and physiological buffer system, Handerson – Hasselbatch equation.	15 Hours	Transferrable Skills 1. EMP 2. SKD 3. EDP
2	Macromolecules – Types, Structure and Properties	Carbohydrates: Definition, classification, structure and properties. Amino acids and proteins: Definition, structure, classification and properties of amino acids, Structure and classification of proteins. Lipids and Fats: Definition, classification, structure, properties and importance of lipids. Porphyrins and Vitamins: Definition, structure, properties and importance of chlorophyll, cytochrome and hemoglobin.	15 Hours	Cognitive Skills 1. EMP 2. SKD 3. EDP
3	Microbial Physiology	Microbial Growth: Definition of growth, Mathematical expression, Growth curve, phases of growth, calculation of generation time and specific growth rate. Synchronous growth, Continuous growth (chemostat and turbidostat), Diauxic growth. Measurement of Growth: Direct Microscopic count - Haemocytometer; Viable count, Membrane filtration; Electronic Counting; Measurement of cell mass; Turbidity measurements- Nephelometer and spectrophotometer techniques; Measurements of cell	15 Hours	Analytical Skills 1. EMP 2. SKD 3. EDP

		constituents. Growth Yield (definition of terms). Influence of environmental factors on growth. Microbial growth in natural environments. viable non-culturable organisms. Quorum sensing. Microbial Nutrition: Microbial nutrients, Classification of organisms based on carbon source, energy source and electron source, Macro and micronutrients. Membrane Transport: Structure and organization of biological membranes, Types of Cellular transport, Passive, Facilitated, Active, Group Translocation, Membrane bound and binding protein transport system, Carrier models, Liposomes, Ion transduction Na K^+, ATPase.		
4	Microbial Physiology-Bioenergetics, Microbial Respiration, Microbial Photosynthesis	Bioenergetics: Free energy, Enthalpy, Entropy, Classification of high energy compounds, Oxidation reduction reactions, equilibrium constant, Redox potential, Law of thermodynamics. Microbial Respiration: Respiratory electron transport chain in bacteria, oxidation – reduction reactions, protein translocation, oxidative and substrate level phosphorylation – inhibitors and mechanism, chemiosmotic coupling. Fermentation reactions (homo and hetero) Microbial Photosynthesis: Light reaction: Light harvesting pigments Photophosphorylation, CO_2 fixation pathways: Calvin cycle, CODH pathway, Reductive TCA pathway.	15 Hours	Transferrable Skills 1. EMP 2. SKD 3. EDP

Books for Reference:

1. Prescott, Harley, Klein's Microbiology, J.M. Willey, L.M. Sherwood, C.J. Woolverton, 7th International, edition 2008, McGraw Hill.
2. Foundations in Microbiology, K. P. Talaro, 7th International edition 2009, McGraw Hill.
3. A Textbook of Microbiology, R. C. Dubey and D. K. Maheshwari, 1st edition, 1999, S. Chand & Company Ltd.
4. Brock Biology of Microorganisms, M.T.Madigan, J.M.Martinko, P. V. Dunlap, D. P. Clark- 12th edition, Pearson International edition 2009, Pearson Benjamin Cummings.
5. Microbiology – An Introduction, G. J.Tortora, B. R.Funke, C. L. Case, 10th ed.2008,Pearson Education.
6. General Microbiology, Stanier, Ingraham et al, 4th and 5th edition 1987, Macmillaneducation limited.
7. Microbiology- Concepts and Applications, Pelczar Jr,Chan, Krieg, International ed, McGraw Hill.
8. Alexopoulos, C.J., Mims, C.W., and Blackwell, M. 2002. Introductory Mycology. John Wiley and Sons (Asia) Pvt. Ltd. Singapore. 869 pp.
9. Atlas, R.M. 1984. Basic and practical microbiology. Mac Millan Publishers, USA. 987pp.
10. Black, J.G. 2008. Microbiology principles and explorations. 7edn. John Wiley and Sons Inc., New Jersey

846 pp.

11. Pommerville, J.C. Alcamo's Fundamentals of Microbiology. Jones and Bartlett Pub..Sudbury, 835 pp.
12. Schlegel, H.G. 1995.General Microbiology. Cambridge University Press, Cambridge, 655pp.
13. Toratora, G.J., Funke, B.R. and Case, C.L. 2007. Microbiology 9 th ed. Pearson Education Ptv. Ltd., San Francisco. 958pp.

S21 MB2.1: Microbial Biochemistry and Physiology

Total Teaching Hours: 45Hours

No. of Hours / Week: 3

Course Content

S. No	Module title	Number of Hours	Skills Developed
1	Preparation of Solution: Normal and Molar solutions	3	Analytical Skills 1. EMP 2. SKD 3. EDP
2	Calibration of pH meter and determination of pH of natural samples	3	
3	Preparation of Buffer Solutions	3	
4	Qualitative determination and identification of Carbohydrates	3	
5	Qualitative determination and identification of Proteins	3	
6	Qualitative determination and identification of Amino Acids	3	
7	Qualitative determination and identification of Fatty Acids	3	
8	Quantitative estimation of Reducing Sugar by DNS method	3	
9	Quantitative estimation of Proteins by Biuret and Lowry's method	3	
10	Determination of lipid saponification values of fats and iodine number of fatty acids	3	
11	Determination of bacterial growth by spectrophotometric method & calculation of generation time	3	
12	Effect of pH, temperature and Salt concentration on bacterial growth	3	
13	Effect of Salt concentration on bacterial growth	3	
14	Effect of Temperature on bacterial growth	3	
15	Demonstration of aerobic and anaerobic respiration in microbes	3	

Books for Reference:

1. Felix Franks, 1993; Protein Biotechnology, Humana Press, New Jersey.
2. Stryer L, 1995; Biochemistry, Freeman and Company, New York.
3. Voet & Voet, 1995; Biochemistry, John Wiley and Sons, New York.
4. Nelson and Cox, 2000; Lehninger Principles of Biochemistry, Elsevier Publ.
5. Harper, 1999; Biochemistry, McGraw Hill, New York.
6. Palmer T. (2001), Biochemistry, Biotechnology and Clinical Chemistry, Harwood Publication,

Chichester.

7. Boyer R. (2002), Concepts in Biochemistry 2nd Edition, Brook/ Cole, Australia.
8. Moat A. G., Foster J.W. Spector. (2004), Microbial Physiology 4th Edition Panama Book Distributors.
9. Caldwell, D. R. (1995) – Microbial Physiology and Metabolism. Brown Publishers.
10. Lodish H, T. Baltimore, A. Berck B.L. Zipursky, P. Mastsydaire and J. Darnell. (2004) –
11. Molecular Cell Biology, Scientific American Books, Inc. Newyork.

Course 2 : Theory: OE 1T, OE- 2T, MBL 302, Environmental and Health Microbiology

Total Teaching Hours : 42

No. of Hours / Week: 3

CObj_ID	Course Objectives
CObj_1	The major objective of the course is to give hands- on experience on isolation and characterization of microbes environmental samples(air water and soil).
CObj_2	To analyze the microbial assessment of water and potability test for water Microbiology
CObj_3	To survey and surveillance of microbial infections.

CO_ID	Course Outcomes
CO_1	Analyze the characteristics of microbes in air, water and soil
CO_2	Understand the role of microorganisms in soil
CO_3	Know the microbial analysis of drinking water
CO_4	Aware about airborne, waterborne and foodborne microbial infections
CO_5	Elaborate the epidemiology of microbial infections, their detection and control.

CO-PO Mapping

	PO_ 1	PO_ 2	PO_ 3	PO_ 4	PO_ 5	PSO_ 1	PSO_ 2	PSO_ 3	PSO_ 4	PSO_ 5
CO_1		*				*				
CO_2			*				*			
CO_3			*				*			
CO_4				*					*	
CO_5			*							*

Course Content

S. No	Module title	Module Content	Number of Hours	Skills Developed
1	Soil and Air Microbiology	Soil and Air as a major component of environment. Types, properties and uses of soil and air. Distribution of microorganisms in soil and air. Major types of beneficial microorganisms in soil. Major types of harmful microorganisms in soil.	14 Hours	Transferrable and Cognitive Skills 1. EMP 2. SKD 3. EDP
2	Water Microbiology	Water as a major component of environment. Types, properties and uses of water. Microorganisms of different water bodies. Standard qualities of drinking water	14 Hours	Analytical Skills 1. EMP 2. SKD 3. EDP
3	Health Microbiology	Public health hygiene and communicable diseases. Survey and surveillance of microbial infections. Airborne microbial infections, waterborne microbial infections, Food borne microbial infections. Epidemiology of microbial infections, their detection and control.	14 Hours	Evaluation and Synthesis 1. EMP 2. SKD 3. EDP

Text Books / References

1. Prescott, Harley, Klein's Microbiology, J.M. Willey, L.M. Sherwood, C.J. Woolverton, 7th International, edition 2008, McGraw Hill.
2. Foundations in Microbiology, K. P. Talaro, 7th International edition 2009, McGraw Hill.
3. A Textbook of Microbiology, R. C. Dubey and D. K. Maheshwari, 1st edition, 1999, S. Chand & Company Ltd.
4. Brock Biology of Microorganisms, M.T.Madigan, J.M.Martinko, P. V. Dunlap, D. P. Clark- 12th edition, Pearson International edition 2009, Pearson Benjamin Cummings.
5. Microbiology – An Introduction, G. J.Tortora, B. R.Funke, C. L. Case, 10th ed. 2008,Pearson Education.
6. General Microbiology, Stanier, Ingraham et al, 4th and 5th edition 1987, Macmillan education limited.
7. Microbiology- Concepts and Applications, Pelczar Jr,Chan, Krieg, International ed, McGraw Hill.

8. Alexopoulos, C.J., Mims, C.W., and Blackwell, M. 2002. Introductory Mycology. John Wiley and Sons (Asia) Pvt. Ltd. Singapore. 869 pp.
9. Atlas, R.M. 1984. Basic and practical microbiology. Mac Millan Publishers, USA. 987pp.
10. Black, J.G. 2008. Microbiology principles and explorations. 7edn. John Wiley and Sons Inc., New Jersey 846 pp.
11. Pommerville, J.C. Alcamo's Fundamentals of Microbiology. Jones and Bartlett Pub..Sudbury, 835 pp.
12. Schlegel, H.G. 1995.General Microbiology. Cambridge University Press, Cambridge, 655 pp.
13. Toratora, G.J., Funke, B.R. and Case, C.L. 2007. Microbiology 9th ed. Pearson Education Pte. Ltd., San Francisco. 958pp.
14. Hurst, C. J., *Environment Microbiology*.ASM Press, Washington D.C.
15. Anathanarayana and Paniker, *Textbook of Microbiology*.Orient and Longman, New Delhi.

SEMESTER – III
Course code & Title: S21 MB 3.1 - Microbial diversity

Total Teaching Hours: 60

No. of Hours / Week: 4

CObj	Course Objectives
CObj_1	To expand knowledge on evolution and microbial diversity.
CObj_2	To understand bacterial taxonomy.
CObj_3	To study various classes of fungi in terms of their characteristic features.

CO	Course Outcomes
CO1	To demonstrate an understanding of bacterial, fungal, cyanobacterial, viral and rickettsial classifications, culturing, reproduction and significance.
CO2	The student will learn the techniques of studying bacterial growth curve and factors affecting growth curve.
CO3	The students will gain knowledge about role of macronutrients and micronutrients in growth of microbes.
CO4	Develop an understanding of physiological and molecular diversity within a community of microbes.
CO5	Understand the principles and methods behind studying and identifying cultured and uncultured microorganisms.

CO-PO Mapping

	PO1	PO2	PO3	PO4	PO5	PSO 1	PSO 2	PSO 3	PSO4	PSO5
CO1	*					*				
CO2		*				*				
CO3	*					*				
CO4			*					*		
CO5			*				*			

(Note: This table is already available, kindly copy and paste it here)

Course Content

S. No	Unit title	Course Content	Number of Hours	Skills Developed
Unit 1	Introduction to Microbial Diversity	Biodiversity- Microbial evolution and types of diversity. Introduction and overview of microbial taxonomy, taxonomic ranks of microorganisms and classification systems (Phenetic, phylogenetic and polyphasic classification). Major characteristics used in taxonomy: classical and molecular characteristics. Introduction and overview of Metagenomics and its applications. Ecological niche of microorganisms	09 Hours	Transferrable Skills 1. EMP 2. SKD 3. EDP

Unit 2	Prokaryotic Diversity	Introduction and overview of Bergey's Manual, habitat and distinguishing features of Gram negative & positive bacteria. Aerobic/Microaerophilic, Gram negative bacteria: Motile, helical & vibrioid, Non-motile curved bacteria, Rods and cocci, Facultative anaerobic Gram negative bacteria: Rods, curved and helical bacteria, Dissimilatory Sulfate reducers, Anaerobic Gram negative bacteria: Anaerobic cocci, Phototrophic bacteria (Anoxygenic and oxygenic phototrophs), Gram positive bacteria –General features of: Endospore forming rods and cocci, Asporogenous rods and cocci, Mycobacteria and Actinomycetes.	18 Hours	Cognitive Skills 1. EMP 2. SKD 3. EDP

Unit 3	Diversity of unusual prokaryotes	Bacteria with unusual morphology. Budding and appendaged bacteria. Sheathed bacteria, Mycoplasma, Bacteria with gliding motility, Rickettsia and Chlamydia, Archaeobacteria. Introduction and general features of Archaea. Types of Extremophilic Microorganisms: Overview of Thermophiles, Halophiles, Acidophiles, Alkalophiles, Barophiles and Methanogens. Importance of prokaryotic microorganism.	15 Hours	Cognitive Skills 1. EMP 2. SKD 3. EDP
Unit 4	Eukaryotic Diversity	FUNGI: General Characteristics, Occurrence, Structure, Reproduction (Penicillium and Aspergillus) & “Marine and endophytic fungi” ALGAE: General Characteristics, Occurrence Structure, Reproduction (Anabaena, Spirulina) & Economic importance of Algae. PROTOZOA: General Characteristics, Occurrence, Structure, Reproduction (Plasmodium, Leishmania). VIRUSES: General Characteristics, Occurrence, Structure, Reproduction (T4, TMV).	18 Hours	Cognitive & Analytical Skill 1. EMP 2. SKD 3. EDP

Books for Reference:

1. Prescott, M.J., Harley, J.P., Klein, D.A. (2002). Microbiology, 5th Edition. New York: WCBMcGrawHill publication.
2. Pelczar, M.J., Chan E.C.S., Krieg, N.R., Microbiology, 5 Edition. Tata McGrawHill Publication Co.Ltd. New Delhi.
3. Salle, S.J. (1974).Fundamental Principals of Bacteriology, Tata McGraw Hill Publication Co. Ltd.NewDelhi.
4. Purohit, S.S.,Microbiology-Fundamentals and Applications-6thEdition,Agrobios Publications, Delhi.
5. Stainer, R.Y., Ingraham, J.L., Wheelis, M.L., Painter, R.K. General Microbiology, 5th Edition.MacMillan Press Ltd., London.
6. Powar and Daginawala, General Microbiology Vol-II. Himalaya Publishing House, Mumbai.
7. Modi, H.A. Elementary Microbiology -Vol –I & II, Akta Prakashan, Nadiyad.
8. Tortora, Funke & Case. Microbiology-An Introduction, 8 Edition, Pearson Education, Delhi.
9. Ronald M. Atlas, Richard Bartha, Microbial Ecology, Fundamentals and Applications 2nd Edition, Milan Publishing Co.

SEMESTER III

Practical: S21 MB 3.2 - Microbial diversity

Total Teaching Hours: 45

No. of Hours / Week: 3

CObj	Course Objectives
CObj_1	To know various culture media and their applications.
CObj_2	To understand, learn and gain skills of isolation, culturing and maintenance of pure culture.
CObj_3	To train the students in advance microbial techniques.

CO	Course Outcomes
CO1	Student will be able to use the knowledge for isolation and identification of microorganisms from variety of sources.
CO2	Student will be able to understand evolution of microbial species.
CO3	Student will be able to classify the microorganisms based on classical and advanced methods.
CO4	Student will be able to understand microbial diversity, species and estimation of various microbial species from different sources.
CO5	Students gain knowledge of analytical methods in biological sciences.

S. No	Module title	Total Number of Hours	Skills Developed
1	Preparation of media, Sterilization and dispensing of media into plates, tubes, slants (NA, NB, PDA MRBA)	3	Analytical Skills 1. EMP 2. SKD 3. EDP
2	Isolation of bacteria from soil and water: a) preparation of serial dilutions b) Spread plate and pour plate technique	3	
3	Study of colony characteristics of bacteria	3	
4	Identification of bacteria by IMViC test	6	
5	Cultivation of anaerobic microorganisms –Pyrogallol method.	3	
6	Isolation of yeast from fruits.	3	
7	Isolation of Bacteriophage from sewage.	3	
8	Isolation of Protozoa from soil.	3	
9	Isolation of Actinomycetes from soil.	3	
10	Staining of Actinomycetes.	3	
11	Fungal slide culture technique.	3	
12	Preparation of Wet mount technique - fungi and algae.	3	
13	Study of <i>E.coli</i> / <i>Staphylococcus</i> / <i>Penicillium</i> / <i>Aspergillus</i> .	3	
14	Study of <i>Anabaena</i> / <i>Spirogyra</i> / <i>Plasmodium</i> / <i>Leishmania</i> .	3	

References Books

1. Tortora GJ, Funke BR and Case CL. (2008). Microbiology: An Introduction. 9th edition. Pearson Education 2.Madigan MT, Martinko JM, Dunlap PV and Clark DP. (2014).
2. Brock Biology of Microorganisms. 14th edition. Pearson International Edition.
3. Prescott's Microbiology. 5th Edition. McGraw Hill International.

4. Atlas RM. (1997). Principles of Microbiology. 2nd edition. WM.T.Brown Publishers.
5. Pelczar MJ, Chan ECS and Krieg NR. (1993). Microbiology. 5th edition. McGraw Hill Book Company.
6. Stanier RY, Ingraham JL, Wheelis ML, and Painter PR. (2005). General Microbiology. 5th edition. McMillan.

Open Elective: OEC MB 3.1 Cosmetic Microbiology

Total Teaching Hours: 42

No. of Hours / Week: 3

CObj	Course Objectives
CObj_1	To know scope and applications of microorganisms producing cosmetic products.
CObj_2	To understand, learn and gain skills of isolation, culturing and maintenance of microbial cultures producing cosmetic products.
CObj_3	To train students in techniques of cosmetic and anti- microbial importance.

CO	Course Outcomes
CO1	Student will be able to use the knowledge for isolation and identification of cosmetic products from microorganisms.
CO2	Student will be able to understand the microbial quality control measures used in cosmetology
CO3	Student will be able to relate and synthesize microbial products used in cosmetics
CO4	Student will be able to understand the mode of action of natural cosmetic products
CO5	Students gain knowledge of analytical methods in cosmetic sciences.

S. No	Unit title	Course Content	Number of Hours	Skills Developed
Unit 1	Microorganisms and cosmetics	Scope of cosmetic microbiology, - Role of microbes in cosmetics preparation. Microorganisms in cosmetics – Preservation of cosmetics – Mechanisms of action of Cosmetic preservatives – Enzymes in cosmetics. Quality control measures in cosmetics preparation – Microbial resistance – Critical Control point.	14 Hours	Transferrable Skills and Analytical Skills 1. EMP 2. SKD 3. EDP
Unit 2	Antimicrobial properties of natural cosmetic products	Honey, Garlic, Neem, Turmeric, Aloe vera, tea tree, Tulsi, Green Tea, Chamomile, Neem, Rosemary, Sandalwood, lemon grass, avocado and shea butter	14 Hours	Cognitive Skills 1. EMP 2. SKD 3. EDP
Unit 3	Microbial Products in Cosmetics	Lactic acid, Astaxanthin, β -carrageenan, α - cyclodextrin, Ceramide, Hyaluronic acid, Surfactin – C, β - Carotene and Glutathione	14 Hours	Cognitive Skills 1. EMP 2. SKD 3. EDP

References Books:

Donald S. Orth. 2010. Insights into Cosmetic Microbiology. 1st Edition., Allured Pub Corp.

Donald S. Orth, Stephen P. Denyer, Jon J Kabara, S.K. Tan. 2006. Cosmetic and Drug Microbiology. 1st Edition., CRC Press.

Philip, A.G. 2006. Cosmetic Microbiology. A Practical approach. 2nd Edition., Taylor & Francis group.

Daniel K. Brannan. 1997, Cosmetic Microbiology: A practical handbook, CRC Press.

SEMESTER – IV

S21 MB 4.1: Microbial Enzymology and Metabolism

Total Teaching Hours: 60**No. of Hours / Week: 4**

CObj	Course Objectives
CObj_1	To understand the mechanism of enzyme kinetics
CObj_2	To develop clear understanding of various aspects of microbial physiology along with diverse metabolic pathways existing in bacteria in relation to its survival and propagation
CObj_3	To provide the core principles and specialized knowledge of Carbohydrates, Lipids, Proteins metabolism
CO	Course Outcomes
CO1	The students will be able to make qualitative and quantitative description of the basic enzymatic phenomena and processes
CO2	Understand the importance of mathematical and statistical methods required for the description, interpretation of enzymatic phenomena and processes
CO3	Knows the basic concepts, terms and techniques used in enzymology
CO4	Understand the regulation of biochemical pathway and possible process modifications for improved control over microorganisms for microbial product synthesis.
CO5	Concepts of lipid and nitrogen metabolism, oxidation of fatty acid

CO-PO Mapping

	PO1	PO2	PO3	PO4	PO5	PSO1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	*						*			

CO2			*				*			
CO3		*						*		
CO4				*					*	
CO5				*						*

S. No	Module title	Module Content	Number of Hours	Skills Developed
Unit-1	Basic concept in Enzymology	Terms involved in enzymology, Nomenclature of enzymes, Classification of enzymes, properties. Coenzyme- Structure and function, TPP, NAD, NADP, FAD, FMN. Enzyme specificity, Mechanism of enzyme action- Lock and Key model, Induced fit model.	10 Hours	Cognitive & Analytical Skills 1. EMP 2. SKD 3. EDP
Unit 2	Enzyme Kinetics	Importance of kinetics, Concept of steady state and rapid Equilibrium kinetics. Factor affecting enzyme activity, temperature, pH, Concentration, Substrate. Derivation of Michaelis – Menton equation, LB plots. Unit of enzyme activity, Enzymeturnover number. Enzyme Regulation - Allosteric and Feed back inhibition. Reversible (competitive, noncompetitive and uncompetitive) and irreversibleinhibitions. Method of purification of enzymes - Ammonium sulphate precipitation, dialysis, chromatography, solvent precipitation.	20 Hrs	Analytical Skills 1. EMP 2. SKD 3. EDP

Unit 3	Metabolism of Carbohydrates	Introduction to Metabolism, Catabolism, Anabolism, Amphibolic pathways, Intermediary metabolism, Types of Metabolic regulations. Break down of complex sugars, Glycolysis, TCA cycle and ATP production. Alternative pathways: HMP pathway, Gluconeogenesis, Glucuronic acid pathway and ED Pathway Energy production: Substrate level phosphorylation. Electron transport chain, Oxidative phosphorylation -Structure of ATPase complex, Chemiosmotic theory. Mitochondrial shuttle system.	15 Hrs	Transferrable Skills 1. EMP 2. SKD 3. EDP
Unit 4	Lipid, Protein & Nucleic acid Metabolism	Fatty acid oxidation – β oxidation. Biosynthesis of saturated and unsaturated fatty acids. Metabolism of Cholesterol, Triglycerides and ergosterols. General aspects of amino acid metabolism; Deamination, Transamination and Decarboxylation, Urea cycle. Biosynthesis of purine and pyrimidine nucleotides <i>denovo</i> and salvage pathway. Biosynthesis of Peptidoglycan.	15 Hrs	Cognitive Skills 1. EMP 2. SKD 3. EDP

REFERENCES

1. Fundamentals of Biochemistry, J.L. Jain, S.Chand publications, 2004.
2. Lehninger's Principles of Biochemistry (2000) by Nelson, David L. and Cox, M.M. Macmillan / Worth, NY.
3. Harper's Biochemistry Robert K. Murray, Daryl K. Granner, Peter A. Mayes, Victor W. Rodwell, 24th edition, Prentice Hall International. Inc.
4. Principles of Biochemistry, Geoffrey L. Zubay, 3rd edition William W. Parson, Dennis E. Vance, W.C. Brown Publishers, 1995.
5. Principles of Biochemistry, David L. Nelson, Michael M.Cox, Lehninger, 4th edition, W.H. Freeman and company.

6. Biochemistry, Lubert Stryer, 4th edition, W.H. Freeman & Co, 1995. 7. Fundamentals of Biochemistry (1999) by Donald Voet, Judith G. Voet and Charlotte W Pratt, John Wiley & Sons, NY.

SEMESTER IV

Practical: S21 MB 4.2 Microbial Enzymology and Metabolism

Total Teaching Hours: 45

No. of Hours / Week: 3

CObj	Course Objectives
CObj_1	To learn and understand the fundamentals of cellular metabolism of carbohydrates, lipids, aminoacids, and nucleic acids
CObj_2	To learn the detection and estimation of biomolecules
CObj_3	To Study of enzyme kinetics, Km and Vmax

CO	Course Outcomes
CO1	The student will be able to learn Carbohydrate catabolism by fermentation
CO2	Learn about enzyme kinetics, effect of enzymes concentration, pH and temperature on kinetics of enzyme reactions
CO3	The students will learn to perform assay of clinically important enzyme
CO4	Learn different immobilization techniques and Industrial scope of enzymes
CO5	The expertise gained by the student in this course can be useful in food industries, pharma industries, clinical and microbiological labs

S.No	Module title	Total Number of Hours	Skills Developed
1	Carbohydrates Fermentation - Glucose, Fructose, Sucrose, Mannitol	3	Analytical Skills 1. EMP 2. SKD 3. EDP
2	Detection of proteins using spectrophotometry	3	
3	Estimation of DNA & RNA	6	
4	Determination of enzyme (Amylase/Protease/Invertase) activity at varied pH	3	
5	Determination of optimum temperature for enzyme activity.	3	
6	Isolation of lipolytic microbes from soil-plate method	3	
7	Separation of amino acids by paper chromatography.	6	
8	Immobilization techniques.	3	
9	Enzyme Assay of Amylase	3	
10	Study of protein secondary and tertiary structures with the help of models	3	
11	Study of enzyme kinetics, Km and Vmax	3	
12	Demonstration of and thin layer chromatography	6	

REFERENCE BOOKS:

1. Principles & Techniques Of Practical Biochemistry 5Th Edition. Keith Wilson, ISBN-10 0521799651, Academic Foundation
2. An Introduction to Practical Biochemistry | 3rd Edition. David Plummer. McGrawHill Education; 3rd edition, ISBN-13 : 978-0070994874. Publisher : McGraw Hill

Education

3. Richard J. Simpson. (2005). Proteins and Proteomics: A Laboratory Manual. I.K. International Publishing House Ltd. New Delhi.
4. Alcamo, I.E. (2001). Laboratory fundamentals of Microbiology, Jones and Barlett.
5. Fundamentals of Biochemistry, J.L. Jain, S.Chand publications, 2004.
6. Lehninger's Principles of Biochemistry (2000) by Nelson, David I. and Cox, M.M. Macmillan / Worth, NY.
7. Harper's Biochemistry Robert K. Murray, Daryl K. Granner, Peter A. Mayes, Victor W. Rodwell, 24th edition, Prentice Hall International. Inc.

OE MB 4.1: Microbial Biotechnology

Total Teaching Hours : 42

No. of Hours / Week: 3

CObj_ID	Course Objectives
CObj_1	To upraise the components and units of a bioprocess industry
CObj_2	To impart the knowledge on the various industrial bioproducts
CObj_3	To give an insight on the role of microorganism in food industries
CO_ID	Course Outcomes
CO_1	Students understand the microbial biotechnology through handling the microorganisms
CO_2	Creates knowledge about the Production of various industrial bioproducts from industrially relevant microbes in students

CO_3	Potential applications of bioprocessing in various fields involving microorganism are understood by students
CO_4	Students can explain the importance of different types of food in balanced diet and planning
CO_5	Students will be able to evaluate the microbial food products and their role in processing and consumption

Course Content

S. No	Module title	Module Content	Number of Hours	Skills Developed
1	Fermentation Technology	Introduction to Fermentation Technology, Isolation, Preservation and Maintenance of Industrial Microorganisms. Media for industrial fermentation; Sterilization. Fermentor part and components. Recovery of Fermentation products.	14 Hours	Transferrable and Cognitive Skills 1. EMP 2. SKD 3. EDP
2	Microbial Bioproducts	Microbial synthesis of organic acids (Citric acid), alcohol (ethanol), antibiotics production (penicillin), vitamin(B12) and amino acid(Tryptophan), beverage (wine), food flavourants and pigment.	14 Hours	Analytical Skills and Cognitive Skills 1. EMP 2. SKD 3. EDP
3	Food Technology	Microbes as direct food (Single cell protein and Baker's yeast). General principles in manufacture of Cheese and Yogurt; Fermented foods: Soy sauce and Miso; Fermented vegetables: Sauerkraut and pickles. Fermented sausages. Food processing aids through biotechnology.	14 Hours	Transferrable and Analytical Skills 1. EMP 2. SKD 3. EDP

Text Books / References

1. Peter F Stanbury, Allan Whitaker, Steohen J Hall, 2013, Principles of Fermentation Technology, Elsevier Science Ltd, Second Edition.
2. Arnold. L. Demain and Julian Davies, Manual of Industrial Microbiology and Biotechnology, III edition, ASM press, Washington DC, 2010.

3. Hui YH, Meunier-Goddick, Hansen AS, Josephsen J, Nip W, Stanfield PS and Toldrih F. 2011. Handbook of food & beverage fermentation technology. CRC Press.
4. Prescott and Dunn's. Industrial Microbiology, by Gerald Reed. 1983, 4th Edition, AVI Publishing Company Inc. Conneticut.
5. Frazier, Food Microbiology- 1987, Tata McGraw-Hill Education.
6. Adams M.R. and Moss M.O (2000) Food Microbiology. Royal Publishing Corporation.

SEMESTER V

Content of Course 5: Theory: S21 MB 5.1 – Microbial Genetics and Molecular Biology

CObj_ID	Course Objectives
CObj_1	The major objective of the course is to to understand how microorganisms can be used as tools to understand various biological phenomena.
CObj_2	To acquaint types of mutation, gene regulation and transposable element
CObj_3	To acquire in-depth study on structure and organization of chromosome, replication process, transcription process, translation process and mutagenesis.

CO_ID	Course Outcomes
CO_1	Outline the structure of the prokaryotic and eukaryotic genome and discuss the types mutation and DNA repair mechanism.
CO_2	Analyze the genetic recombination and the overview of bacterial genetic maps and interpret the gene transfer mechanism in bacteria.
CO_3	Understand the central dogma and regulation of gene expression.
CO_4	Evaluate the operon model and molecular techniques with different samples.
CO_5	Apply the recombinant DNA technology in the agricultural, medical and industrial and environmental field.

S. No	Module title	Module Content	Number of Hours	Skills Developed
Unit 1	Microbe Genome Organization and Mutation	Prokaryotic Genome - <i>E. coli</i> genome. Eukaryotic Genome – <i>Saccharomyces</i> , Structure of chromatin, types of histones, histone modifications- methylation, acetylation, phosphorylation and function of chromatin, karyotype and idiogram, Mutations and mutagenesis: Definition and types of Mutations; Physical and chemical mutagens; Transposon mutagenesis, site directed mutagenesis; environmental mutagenesis; Ames test.	15 hours	Analytical Skills 1. EMP 2. SKD 3. EDP
Unit 2	Plasmids and Gene Transfer Mechanism	Types of plasmids – F plasmid, R Plasmids, colicinogenic plasmids, Ti plasmids, linear plasmids and Cosmids. Lysogeny and lytic cycle in bacteriophages, Life cycle and their uses in microbial genetics. Lytic phages-T7 and T4, Lysogenic phages- Lamda, M13 and ΦX174. Transformation, Conjugation, Transduction and transfection mechanism and its applications.	15 hours	Transferable skills 1. EMP 2. SKD 3. EDP
Unit 3	DNA damage, repair mechanism and replication	Central dogma. Structure of DNA, DNA polymorphism (A, B, Z DNA). Structure and function of different types of RNA. Types of DNA damage –deamination, oxidative damage, alkylation, pyrimidine dimers; Repair pathways – photo-reactivation, excision repair, post replication repair, SOS repair, methyl directed mismatch repair, very short patch repair. DNA replication in prokaryotes and viruses (Rolling circle and M13 bacteriophages replication), Origin of replication, replication fork- leading and lagging strands, enzymes involved at different steps of replication.	15 hours	Cognitive skills 1. EMP 2. SKD 3. EDP
Unit 4	Transcription, Translation and regulation of gene expression	Transcription factors and machinery, formation of initiation complex, transcription activators and repressors, RNA polymerases. Initiation, elongation and termination. Polycistronic and monocistronic mRNA, post transcriptional modifications. Transcription in	15 hours	Analytical skills 1. EMP 2. SKD 3. EDP

		Eukaryotes Ribosome assembly, initiation factors and their regulation, formation of initiation complex, Initiation, elongation and termination of polypeptide chain, elongation factors and releasing factors, translational proof-reading, post-translational modification. Lac Operon concept, Tryptophan operon. Regulation of prokaryotic and eukaryotic gene expression, role of chromatin in regulating gene expression. Transcriptional and post transcriptional gene silencing-RNAi pathway (siRNA and miRNA)		

References:

1. Robert F. Weaver. (2009). Molecular Biology, 4th Edition. McGraw-Hill.
2. B.B. Buchanan. (2007). Biochemistry and Molecular Biology of Plants. I.K. International Publishing House Ltd. New Delhi.
3. Chris. R. Callbine., Hallace. R. Bin. F. Leus. and Andrew, A. Travers. (2006) Understanding DNA (3rd Ed.). Academic Press.
4. Raymond F Gesteland. (2006). The RNA World, Third Edition. I.K. International Publishing House.
5. Bruce Alberts, Alexander Johnson, Julian Lewis, Martin Raff, Keith Roberts, Peter Walter, (2002). Molecular Biology of the Cell. Garland Pub. 4th Ed.
6. Twyman R.M., (1998). Advanced Molecular Biology. 1st Ed. Viva Books Pvt Ltd., New Delhi.
7. Joset F., Michel G, (1993). Prokaryotic Genetics, Genome Organization, Transfer and Plasticity, Boston. Blackwell.
8. Adams R.L.P, (1992). DNA Replication. IPL Oxford, England.
9. Streips and Yasbin, (1991). Modern Microbial Genetics. Wiley Ltd.
10. Thomas D. Brock, (1990). The Emergence of Bacterial Genetics, CSH lab Press.
11. Mark Ptashne, (1986). A Genetic Switch. Gene Control and Phage λ . Cell Press

SEMESTER V

Practical: S21 MB 5.2 – Microbial Genetics and Molecular Biology

Total Teaching Hours: 45

No. of Hours / Week: 3

S. No	Module title	Total Number of Hours	Skills Developed
1	Demonstration of streaking plate using toothpicks	3	Analytical skills 1. EMP 2. SKD 3. EDP
2	Preparation of Master and Replica Plates	3	
3	Effect of UV radiation on microorganisms	3	
4	Isolation of streptomycin-resistant strain of bacteria by gradient plate method	3	
5	Isolation of genomic DNA from microorganisms (Bacteria/Fungi/Algae) and separation by Gel electrophoresis	6	

6	Isolation of plasmid DNA from microorganisms (Bacteria/Fungi/Algae) and separation by Gel electrophoresis	6	
7	Demonstration of bacterial transformation by CaCl_2 method	3	
8	Demonstration of Transduction in <i>E.coli</i>	3	
9	Ampicillin selection for the enrichment of auxotroph	3	
10	Isolation of Spheroplast and Protoplast from Bacteria	3	
11	Charts on genetic engineering – pBR 322, pUC 18 and 19, SV 40, Bacteriophages – Lambda, Gene cloning	3	
12	Restriction digestion of DNA	3	
13	Polymerase Chain reaction	3	

References

1. Watson JD, Baker TA, Bell SP, Gann A, Levine M and Losick R (2008) Molecular Biology of the Gene, 6th edition, Cold Spring Harbour Lab. Press, Pearson Publication
2. Becker WM, Kleinsmith LJ, Hardin J and Bertoni GP (2009) The World of the Cell, 7th edition, Pearson Benjamin Cummings Publishing, San Francisco
3. De Robertis EDP and De Robertis EMF (2006) Cell and Molecular Biology, 8th edition. Lippincott Williams and Wilkins, Philadelphia
4. Karp G (2010) Cell and Molecular Biology: Concepts and Experiments, 6th edition, John Wiley & Sons. Inc.
5. Sambrook J and Russell DW. (2001). Molecular Cloning: A Laboratory Manual. 4th Edition, Cold Spring Harbour Laboratory press.
6. Klug WS, Cummings MR, Spencer, C, Palladino, M (2011). Concepts of Genetics, 10th Ed., Benjamin Cummings
7. Krebs J, Goldstein E, Kilpatrick S (2013). Lewin's Essential Genes, 3rd Ed., Jones and Bartlett Learning
8. Pierce BA (2011) Genetics: A Conceptual Approach, 4th Ed., Macmillan Higher Education Learning
9. Watson JD, Baker TA, Bell SP et al. (2008) Molecular Biology of the Gene, 6th Ed., Benjamin Cummings
10. Gardner EJ, Simmons MJ, Snustad DP (2008). Principles of Genetics. 8th Ed. Wiley-India
11. Russell PJ. (2009). i Genetics- A Molecular Approach. 3rd Ed, Benjamin Cummings
12. Sambrook J and Russell DW. (2001). Molecular Cloning: A Laboratory Manual. 4th Edition, Cold Spring Harbour Laboratory press.
13. Maloy SR, Cronan JE and Friefelder D (2004) Microbial Genetics 2nd EDITION., Jones and Barlett Publishers
14. Krebs J, Goldstein E, Kilpatrick S (2013). Lewin's Essential Genes, 3rd Ed., Jones and Bartlett Learning
15. Gardner EJ, Simmons MJ, Snustad DP (2008). Principles of Genetics. 8th Ed. Wiley-India

B.Sc. (Basic and Honors Degree in Microbiology)
(Choice Based Credit System – 2021 scheme)
As per NEP 2020 guidelines
SEMESTER V

Content of Course 6: Theory: S21 MB 5.3 – Immunology and Medical Microbiology

	Objective
CObj_1	To develop students' understanding of medical microbiology with hand on experience in the isolation and identification of the microorganisms from different clinical samples
CObj_2	To strengthen the knowledge of students in immunology and immunodiagnostics
CObj_3	To explain the various pathological events during the progression of an infectious disease caused by common pathogenic microorganisms

	Outcome
CO1	Illustrate the cells, tissues, organs of the immune system and types of immunity.
CO2	Understand the properties, functions of Antigens, antibodies and complement system and antigen and antibody reactions
CO3	Analyze the symptoms, pathogenesis, laboratory diagnosis and control measures of bacterial, fungal, viral and protozoa
CO4	Elaborate the antimicrobial agents to handle microorganism in risk groups
CO5	Apply the immuno and molecular techniques for the diagnosis of disease.

S. No	Module title	Module Content	Number of Hours	Skills Developed
Unit 1	Immunobiology	Innate immunity & immunological barriers; The cellular players: Phagocytic cells, Lymphocytic cells, DCs; The innate immune response: Inflammation, Acute Phase Reaction; Molecular basis of diversity of immunoglobulin molecules; Autoimmunity and transplantation; Manipulations of the immune response.	15 Hours	Cognitive Skills 1. EMP 2. SKD 3. EDP
Unit 2	Histochemical and Immunotechniques And Public Health Management	Antibody generation; Detection of molecules using ELISA; RIA; western blot; immunoprecipitation; flow cytometry and immunofluorescence microscopy; detection of molecules in living cells; in situ localization by techniques such as FISH and GISH. Frequency measures; morbidity frequency measures; mortality frequency measures; natality (birth) measures; measures of association; measures of public health impact. Public health surveillance: Purpose and characteristics; identifying health problems for surveillance; collecting data for surveillance;	15 Hours	Analytical Skills 1. EMP 2. SKD 3. EDP

		analyzing and interpreting data; disseminating data and interpretation; evaluating and improving surveillance.		
Unit 3	Normal microflora of the human body and host pathogen interaction And Antimicrobial agents: General characteristics and mode of action	Normal microflora of the human body: Importance of normal microflora, normal microflora of skin, throat, gastrointestinal tract, urogenital tract. Host pathogen interaction: Definitions - Infection, Invasion, Pathogen, Pathogenicity, Virulence, Toxigenicity, Carriers and their types, Opportunistic infections, Nosocomial infections. Transmission of infection, Pathophysiologic effects of LPS. Antibacterial agents: Five modes of action with one example each: Inhibitor of nucleic acid synthesis; Inhibitor of cell wall synthesis; Inhibitor of cell membrane function; Inhibitor of protein synthesis; Inhibitor of metabolism Antifungal agents: Mechanism of action of Amphotericin B, Griseofulvin Antiviral agents: Mechanism of action of Acyclovir, Azidothymidine Antibiotic resistance, MDR, XDR, MRSA, NDM-1	15 Hours	Cognitive Skills 1. EMP 2. SKD 3. EDP
Unit 4	Medical Microbiology	Detailed Study of following infections including Etiology, Transmission, Pathogenesis, Clinical Manifestations, Lab diagnosis, Prophylaxis, and Treatment: - Polio, Herpes, Hepatitis, Dengue, Influenza, Chikungunya and Corona, <i>Streptococcus pyogenes</i>, <i>Staphylococcus aureus</i>, <i>Mycobacterium tuberculosis</i>, <i>Salmonella typhi</i>, <i>Vibrio cholera</i>, <i>Clostridium tetani</i>, Malaria, <i>Leishmania</i>, Epidermophyton, <i>Candida</i>	15 Hours	Transferable Skills 1. EMP 2. SKD 3. EDP

References Books

1. Abul K. Abbas, Andrew K. Lightman, Jordan S. Pober. (1998). Cellular and Molecular Immunology. Saunders College Pub.
2. Connie R Mahon. (2010). Textbook of Diagnostic Microbiology. 3rd edition. Pearson.
3. Credric, A. Mims. (2004) Medical microbiology. (3rd Ed.). Mosby Inc.

4. Frank, Steven A. (2002). Immunology and Evolution of Infectious Disease. Princeton University Press.
5. Fritz H. Kayser. (2005). Medical microbiology. Thieme Verlag.
6. Jenson, Wright, Robinson. (1997), Microbiology for the Health Sciences 4th edition, Prentice hall.
7. Klaus D. Elgert (1996). Immunology-understanding of the Immune system. Wiley-Liss. NY.
8. Kuby, J. (2006). Immunology 6th Edition. WH. Freeman and Company, New York.
9. Leslic Collier, John Oxford. (2000) Human virology: a textbook for students of medicine, dentistry & microbiology (2nd Ed.) Oxford University Press.
10. Mackie and McCarthy (1996), Medical microbiology vol 1, Microbial infection. vol 2, practical medical microbiology, Churchill Livingstone,
11. Marjorie Cowan, Kathleen Park Talaro. (2009). Microbiology: A Systems Approach. 2nd Edition. The McGraw/Hill.
12. Nester, Roberts, Pearsall, Anderson. (1998). Microbiology -A Human Perspective, 2nd edition, McGraw- Hill
13. Roitt, I.M. (2006). Essentials of Immunology. 7th Edition. Elsevier.
14. Topley & Wilson's (1995). Textbook on Principles of Bacteriology, Virology and Immunology, IX Edition (5 volumes) Edward Arnold, London.
15. Wadher, and Bhoosreddy. (2005). Manual of Diagnostic Microbiology. Himalaya Publisher.
16. Warren Levinson (2000) Medical Microbiology and Immunology: Examination and Board Review. 8th ed. McGraw Hill.

SEMESTER V

Practical: S21 MB 5.4 – Immunology and Medical Microbiology

Total Teaching Hours: 45

No. of Hours / Week: 3

S. No	Module title	Total Number of Hours	Skills Developed
1	Isolation and identification of clinically important microbes from clinical specimens: (throat swab, sputum, nasal swab, urine, blood, lesions)	9 Hours	Analytical Skills 1. EMP 2. SKD 3. EDP
2	Isolation and identification of dermatomycosis by wet mount	3 Hours	
3	Identification of pathogens on selective, differential and enrichment media	3 Hours	
4	Different staining techniques a) Ziehl-Neelsen method of AFB b) Leishman's staining	3 Hours	

	c) Giemsa staining		
5	Special staining methods to demonstrate granules, capsules and endospores	3 Hours	
6	Determination of MIC by tube method	3 Hours	
7	Purification of antigens (bacterial, fungal)	3 Hours	
8	Induction and Purification of antibodies	3 Hours	
9	Precipitation reaction on gel (ODD, SRID)	3 Hours	
10	Agglutinations (slide) - WIDAL, RPR	3 Hours	
11	Blood grouping and Rh typing	3 Hours	
12	Determination of bactericidal activity of goat serum	3 Hours	
13	ELISA (dot)	3 Hours	

References Books

1. Credric, A. Mims. (2004) Medical microbiology. (3rd Ed.). Moshy Inc.
2. James H. Jorgensen, Manual of Clinical Microbiology, 11th 2015, ASM Press
3. Mackie and McCarthey (1996), Medical microbiology vol 1, Microbial infection. vol 2, practical medical microbiology, Churchil Livingstone.
4. Patrick R. Murray, Manual of Clinical Microbiology: 1 & 2 Volume 2007, ASM Press
5. Wadher, and Bhoosreddy. (2005). Manual of Diagnostic Microbiology. Himalaya Publisher

B.Sc (Basic and Honors Degree in Microbiology)
(Choice Based Credit System – 2021 scheme)
As per NEP 2020 guidelines
SEMESTER VI

Content of Course 7: Theory: S21 MB 6.1 – Food and Dairy Microbiology

	Objective
CObj_1	To understand microbiology of fermented food commodities.
CObj_2	To describe the role of microorganisms in food spoilage and principles of food preservation.
CObj_3	To analyze the microbiological quality control, and quality schemes.

	Outcome
CO1	Analyze the character of microbes in food spoilage using various examination and evaluation of preservation techniques for food.
CO2	Evaluate the microbiology of fermented milk products.
CO3	Discuss the government regulatory practices and policies in food quality and safety.
CO4	Apply the techniques to assay the food borne infections and intoxication.
CO5	Create the knowledge about the microbial food products and determine the role of various agencies in food sanitation and control.

S. No	Module title	Module Content	Number of Hours	Skills Developed
Unit 1	History and Food as substrate for microorganisms	History, Development and Scope of food microbiology; Concept of food and nutrients; Physiochemical properties of food; Importance and types of microorganisms in food (bacteria, mold and yeast). Sources of contamination of microorganisms in foods, Factors influencing microbial growth in food - Extrinsic and intrinsic factors. Applications of food microbiology: Beneficial uses of microorganisms in food, Intestinal beneficial bacteria, Probiotics, Prebiotics –Definition, functional foods, types, importance and economic values, Recombinant foods, Biosensors in food industry	15	Cognitive Skills 1. EMP 2. SKD 3. EDP
Unit 2	Food-borne infections and spoilage	Food borne diseases. Bacterial and nonbacterial - with examples of infective and toxic types - <i>Brucella</i> , <i>Bacillus</i> , <i>Clostridium</i> , <i>Escherichia</i> , <i>Salmonella</i> , <i>Shigella</i> , <i>Staphylococcus</i> , <i>Vibrio</i> , <i>Yersinia</i> , Nematodes, protozoa, algae, fungi and viruses. Foodborne outbreaks-laboratory testing procedures. Spoilage of fruits, vegetables, meat, poultry, fish and seafood. Cereals, sugar products, vegetables, fruits, meat and meat products, Fish and sea foods-poultry-spoilage of Canned foods. Detection of spoilage and	15	Transferrable Skills 1. EMP 2. SKD 3. EDP

		characterization		
Unit 3	Dairy microbiology and Dairy products	Sources of microorganisms in milk – Classification of microbes – Biochemical types, characteristics and pathology. Microflora of milk and milk products, Fermented milk and milk products: Sauerkraut, Buttermilk, Cream, Yogurt, Cheese, Kefir and Kumis. Microbes involved in fermentation: Starter lactic acid cultures. Spoilage of milk and milk products. Milk borne diseases –bacterial (Mastitis, Anthrax, Brucellosis, Diphtheria, Tetanus) and viral diseases (Food and mouth disease, Rinderpest, Cowpox, and Virus diarrhea) in cattle's – Control measures.	15	Analytical Skills 1. EMP 2. SKD 3. EDP
Unit 4	Preservation and sanitation	Principles and methods of food preservation-Physical (temperature, irradiation, drying, canning, processing for heat treatment) Chemical (Organic acids, food additives. Class I and Class II preservatives), Biopreservation (Lactic acid bacteria). Food Packaging- Types of packaging materials, properties and benefits. Good Hygiene Practices, Sanitation in manufacture and retail trade; food control agencies and their regulation, hazard analysis and critical control points (HACCP); GMP, plant sanitation – employees' health standard, waste treatment, disposal, quality control. Sanitation of dairy processing plants, food control agencies and their regulations. Recent trends and development in food technologies in India	15	Transferrable Skills 1. EMP 2. SKD 3. EDP

REFERENCES:

1. Frazier WC and Westhoff DC. (1992). *Food Microbiology*. 3rd edition. Tata McGraw-Hill Publishing Company Ltd, New Delhi, India.
2. Adams MR and Moss MO. (1995). *Food Microbiology*. 4th edition, New Age International (P) Limited Publishers, New Delhi, India.
3. Banwart JM. (1987). *Basic Food Microbiology*. 1st edition. CBS Publishers and Distributors, Delhi, India
4. Dubey. R.C. and Maheswari. D.K. A Textbook of Microbiology, 1999. 1 ed.
5. Fundamentals of Dairy Microbiology by Prajapati.
6. James. M. Jay, 1992, Modern food microbiology 4ed.
7. B. C. Hobbs and D. Roberts. 1993. Food Poisoning and Food Hygiene. Edwards Arnold. London.
8. A. E. Yousef and C. Caristrom. 2003. Food Microbioiogy - A Laboratory manual, Wiley Interscience.

9. J. M, Jay. 2000. Modern Food Microbiology. Aspen Publishers.

10. Robinson, R.K. 1990. Dairy Microbiology. Elsevier Applied Science. London

SEMESTER VI

Practical: S21 MB 6.2 – Food and Dairy Microbiology

Total Teaching Hours: 45

No. of Hours / Week: 3

S. No	Module title	Total Number of Hours	Skills Developed
1	Isolation and identification of microbes from fermented and stored foods	3	Analytical skills 1. EMP 2. SKD 3. EDP
2	Isolation and identification of microbes from infected fruits and vegetables	3	
3	Isolation of lipolytic organism from any spoiled dairy products	3	
4	Detection of number of bacteria in milk by SPC	3	
5	Detection of number of bacteria in milk by breed count	3	
6	Determination of quality of a milk sample by methylene blue reduction test	3	
7	Determination of quality of a milk sample by resazurin test	3	
8	Estimation of Fat content in milk by Gerber's method	3	
9	Estimation of Lactose in milk	3	
10	Estimation of Lactic acid in milk.	3	
11	Production of yogurt	3	
12	Role of yeasts in bread making	3	
13	Production and detection of Aflatoxins from fungi by thin layer chromatography (TLC)	3	
14	Study of foodborne pathogens - <i>Clostridium</i> , <i>E.coli</i> , <i>Staphylococcus</i> , <i>Shigella</i> and <i>Salmonella</i>	3	
15	Visit to food and dairy industry and report submission	3	

REFERENCES:

1. J.G. Cappuccino and N.Sherman. Microbiology – A lab manual. New York: Benjamin Cummins. 1996.
2. Kannan, N. Laboratory Manual in General Microbiology. Palani: Palani Paramount Publication, 1996.
3. Jayaraman, J. Laboratory Manual in Biochemistry. New Delhi: Wiley Eastern Ltd., 1985.
4. Plummer, D.T. An Introduction to Practical Biochemistry. New Delhi: Tata McGraw-Hill.. 1998. 5.
- Harley Precott. Laboratory Exercises in Microbiology The MacGraw Hill companies. 5th edition. 2002.

B.Sc (Basic and Honors Degree in Microbiology)
(Choice Based Credit System – 2021 scheme)
As per NEP 2020 guidelines

SEMESTER VI

Content of Course 8: Theory: S21 MB 6.3 – Industrial Microbiology and Bioprocess Technology

COBJ_ID	Course Objectives
COBJ_1	The major objective of the course is to provide the design of bioreactors, media formulations and factors affecting the industrial production of bio-chemicals along with approaches that can be used for enhanced production.
COBJ_2	To analyze the role of micro-organism in production of organic acids, alcohols, wine, vinegar, enzymes, vitamins, antibiotics, amino-acids and steroids
COBJ_3	To understand the strategies for development of microbial strains, process optimization, large scale production and product recovery will be covered for industrially relevant microbial products and therapeutic proteins

CO_ID	Course Outcomes
CO_1	General design of fermenter, media and the process of fermentation and optimization of fermentation process
CO_2	Isolation of industrially important microbial strains and fermentation media
CO_3	Students will be able to select industrially important microbes for economical use including protein products.
CO_4	Types of fermentation processes, bio-reactors and measurement of fermentation parameters
CO_5	Microbial production of industrial products (microorganisms involved, media, fermentation conditions, downstream processing and uses)

S. No	Module title	Module Content	Number of Hours	Skills Developed
Unit 1	Introduction to industrial microbiology and Upstream process	Scope and development of Industrial Microbiology; Industrially important microorganisms – Isolation methods and Screening Techniques- Primary and Secondary; Preservation of cultures; Strain improvement- protoplast fusion, rDNA technology, mutation; Development of inoculum for various fermentation processes; Types of industrial fermentation processes: Batch, Continuous, Surface, Submerged and	16 Hours	Analytical Skills 1. EMP 2. SKD 3. EDP

		SSF; Fermentor: Basic structure, construction and various types-typical stirred aerated fermentor, tower fermentor, air lift and bubble cap fermentor; Media components and formulation, crude media components, antifoam agents, precursors, inducers and inhibitors and buffering agents; Process parameters-aeration, agitation, temperature regulation, foam regulation and pH regulation, Cell mass regulation		
Unit 2	Downstream process	Primary separation – removal of insoluble products/cell (centrifugation, filtration and sedimentation); Cell disruption (physical, chemical and enzymatic); Product isolation and separation – solvent extraction, adsorption, aqueous two-phase system and precipitation; Purification techniques (Chromatography - ion exchange, gel permeation and affinity); Membrane separation (micro-filtration, ultrafiltration and reverse phase electrophoresis); Product polishing (crystallization, drying) and packaging – diafiltration.	14 Hours	Analytical skills 1. EMP 2. SKD 3. EDP
Unit 3	Immobilization and biotransformation	Techniques and types of immobilizations- (1) non-covalent adsorption and deposition, (2) physical entrapment, (3) covalent attachment, and (4) bio-conjugation, industrial applications of immobilization: merits and demerits; Biotransformation of steroids	12 Hours	Technical skills 1. EMP 2. SKD 3. EDP
Unit 4	Microbial derived products	Industrial production of antibiotics (Penicillin and Streptomycin), amino acids (Glutamic acid and lysine), beverages (Wine, Whisky and Beer), biofuels (Biogas), enzymes (Amylase, Lipase, and Protease), hormones (insulin and gibberellic acid), organic acid (Citric acid and acetic acid), vitamins (Vit B12), SCP and recombinant vaccines	18 Hours	Technical skills 1. EMP 2. SKD 3. EDP

References Books

1. Richard H. Baltz. Julian E Davies and Arnold L. Demain Manual of Industrial Microbiology and Biotechnology. 3rd edition, ASM Press (2010).
2. Daniel Forciniti. Industrial Bioseparation: Principles and practice. 1st edition, Wiley Blackwell (2008).
3. Reed. G. Prescott and Dunn's Industrial Microbiology. CBS Publishers. (1999).
4. Demain, A. L. Industrial Microbiology and Biotechnology. 2nd Edition. (2001).
5. EL Mansi. E.M.T. Fermentation Microbiology and Biotechnology. 4ndEdition,CRC Taylor & Francis (2020).
6. Waites, M.J., Morgan, N.L., Rockey, J.S. and Higton, G. Industrial Microbiology: An introduction. Blackwell Science Publishers (2002).
7. Casida LE, Industrial Microbiology, J. Wiley, (Reprint2008).
8. Pelczar, MJ Chan ECS and Krieg NR, Microbiology McGraw-Hill(2021) Willey, Sherwood, Woolverton. Prescott, Harley, and Klein's Microbiology McGraw-Hill publication,7th edition2008

9. Tortora, Funke, 10th edition (2010). Microbiology. Pearson Benjamin Cummings.
10. JACQUELYN G. BLACK. Microbiology Principles and explorations. JOHN WILEY & SONS (2018)
11. Madigan, Martinko, Bender, Buckley, Stahl. Brock Biology of Microorganisms. Pearson 14th edition, 2015
12. Tom Besty, D.C Jim Koegh. Microbiology Demystified McGRAW-HILL, 2005.
13. Wulf Crueger. Cruegers Biotechnology: A Textbook of Industrial Microbiology 2017
14. Dr. R.C. Dubey, Dr. D.K. Maheswari 2012. Practical Microbiology
15. S. Ram Reddy and G. Ram reddy 2012. Practical Microbiology,

SEMESTER VI

Practical: S21 MB 6.4 - Industrial Microbiology and Bioprocess Technology

Total Teaching Hours: 45

No. of Hours / Week: 3

S. No	Module title	Total Number of Hours	Skills Developed
1	Isolation of amylase producing microbes and determination of enzyme activity	6 h	Analytical skills 1. EMP 2. SKD 3. EDP
2	Isolation of antibiotic producing microbes by crowded plate technique and determination of antibacterial activity	6 h	
3	Production of ethanol by fermentation, recovery and estimation by dichromate method	6 h	
4	Microbial fermentation for the organic acid production and estimation of organic acid by titrimetric method	6 h	
5	Immobilization of yeast cells, enzymes and evaluation of its efficiency	3 h	
6	Production of biofertilizer	3 h	
7	Production of wine using grapes	3 h	
8	Mushroom cultivation	3 h	
9	Microbial fermentation for the pigment production	3 h	
10	Production of biofuel using domestic wastes - Demonstration	3 h	
11	A visit to any educational institute/industry to see an industrial fermenter/bioreactor, and other downstream processing operations		

Reference:

1. Casida, L. E., *Industrial Microbiology*. Wiley, Eastern Ltd, New Delhi.
2. McNeil, B. and L. M. Harvey, *Fermentation, a practical approach*. IRL Press, New York.
3. Michael J Waites, Neil L Morgan, John S Rockey and G. Higton, *Industrial Microbiology: An Introduction*. Blackwell Science, New Delhi.
4. Prescott, S. C. and C. C. Dunn, *Industrial Microbiology*. Tata McGraw-Hill, New Delhi.
5. Stanbury, P. F., A. Whitaker and S. Hall, *Principles of fermentation technology*. Elsevier Science B.V., Amsterdam, Netherlands, Aditya Books (P) Ltd, New Delhi.



Employability

Entrepreneurship

Skill Development

DEPARTMENT OF MICROBIOLOGY
M.Sc. Microbiology

MMB 102: EUKARYOTIC
MICROBIOLOGY

Total Hours 52

Course
Objectives:

1. The major objective of the course is to outline the structure, cultivation and significance of algae and fungi.
2. To analyze the characteristics and classification of Fungi.
3. To understand the evolutionary tendencies in fungi, algae and protozoa.

Unit 1

Protozoa: Introduction, structure and significance: of Leishmania, Trichomonas, Entamoeba, Plasmodium, Isolation and cultivation of protozoa.

4 Hours

Unit 2

Algae: Distribution, morphology and classification (Smith) of Algae; Isolation from soil and water; algal ecology, Media and methods used for culturing algae, measurement of algal growth, strain selection and large scale cultivation, Symbiotic algae: Lichens, Coral reef and sea sponges. Structure and reproduction of Spirogyra, Euglena, Exuviaella, Diatoms, Sargassum and Porphyra.

12 Hours

Unit 3

Biological and economic importance of algae: As primary producers and as commercial products [food, green energy (biofuel) and therapeutic uses], heavy metal removal, immobilized and labeled algae; algal blooms and toxins.

4 Hours

Unit 4

Fungi: Structure of Fungal cells and growth; Hyphae and non-motile unicells, motile cells, spores, dormancy, growth of population and colonies, Mechanism of growth in Fungi, Measurement and kinetics of growth, nutritional and environmental requirements; Prevention of fungal growth. Heterothallism, parasexuality, sex hormones in fungi; physiological specialization, phylogeny of fungi.

10 Hours

Unit 5

Classification: Evolutionary tendencies in fungi, Classification (Ainsworth) of fungi. Salient features of Division and Subdivision of Fungal Kingdom:

Myxomycota: Classes: Acrasiomycetes, Hydromyxomycetes, Myxomycetes,

Plasmodiophoromycetes Eumycota: Mastigomycotina: Classes: Chytridiomycetes,

Hyphochytridiomycetes, Oomycetes Zygomycotina: Classes: Zygomycetes, Trichomycetes

Ascomycotina: Classes: Hemiascomycetes, Plectomycetes, Pyrenomycetes, Discomycetes, Laboulbeniomycetes, Loculoascomycetes, Basidiomycotina: Classes: Teliomycetes,

Hymenomycetes, Gasteromycetes Deuteromycotina: Classes: Hyphomycetes, Coelomycetes, Blastomycetes. Structure and reproduction of: Dictyostelium, Allomyces, Pilobolus, Claviceps, Puccinia, Fusarium.

15 Hours

Unit 6

Fungi and ecosystem: Substrate groups: saprophytic, parasitic, keratinophilic, coprophilous; substrate successions, parasitism, predation, mutualism and symbiosis with plants and animals. Diversity of aquatic and terrestrial fungi. Economic importance of fungi.

MMB 104: Microbial and Biochemical Techniques

Total Hours 52

Course Objectives:

1. To introduce basic concepts of qualitative and quantitative analysis of a given organism or biomolecule produced by the organism.
2. To study various spectrophotometric, spectroscopic techniques and its instrumentation.
3. To understand the concepts of microscopy, separation science and its applications.

Unit 1 Isolation techniques of microorganisms: Isolation of pure cultures; dilution, spread plate, streak plate, pour plate, micromanipulator method, colony morphology and other characteristics of cultures. Maintenance and preservation of pure cultures, culture collection centers-national and international.

Microscopy: Working principle of phase contrast microscopy, fluorescent microscopy electron microscopy (TEM and SEM), confocal microscopy, scanning probe microscopy and their staining techniques: image processing methods in microscopy. Micrometry.

12 Hours

Unit 2 Measurement of microbial growth: Direct method: Direct microscopic count, standard plate count, membrane filtration, MPN, Indirect method: turbidity, metabolic activity and dry weight. Automated microbial identification system.

6 Hours

Unit 3 Culture independent analysis of microbes: Metagenomics, nucleic acid, phospholipids and Fatty acids analysis, Fluorescent in situ hybridization (FISH), Genomic in situ hybridization (GISH), Immunohistochemistry - FITC – protein (antibody), PCR.

Analysis of Biomolecules: Flow cytometry and X-ray diffraction.

7 Hours

Unit 4 Spectrophotometry: Principle and applications of spectrophotometer UV/visible, fluorescence. **Spectroscopy:** Principle and applications of circular dichroism, NMR, Mass spectroscopy.

9 Hours

Unit 5 Chromatography: Principles and applications of Chromatography: Thin layer chromatography (TLC), Gel filtration chromatography, Ion exchange chromatography, Affinity chromatography, Gas chromatography (GC) and High performance liquid chromatography (HPLC).

Electrophoresis: Definition, principles and applications; different types of Electrophoresis- PAGE, SDS-PAGE, IEF, 2D-PAGE, Agarose gel electrophoresis, PFGE. **12 Hours**

Unit 6 Isotope techniques: Stable and radioactive isotopes, radio isotopic labeling, autoradiography, scintillation counters, non-radioactive labeling, labeling techniques, safety guidelines. **6 Hours**

MMB201: MICROBIAL GENETICS

Course Objectives:

1. The major objective of the course is to understand how microorganisms can be used as tools to understand various biological phenomena.
2. To acquaint types of mutation, gene regulation and transposable element
3. To understand the concepts in prokaryotic, eukaryotic, and viral genetics

Total Hours: 52

Unit 1

Prokaryotic Genome: E. coli chromosome- coiled, supercoiled (plectonemic, solenoid), folded fiber model. Mycoplasma genitalium and E. coli genome.

4 Hours

Unit 2

Eukaryotic Genome: Structure of chromatin, chromosome, centromere, telomere, nucleosome, genome organization, split gene, overlapping genes and Cot curves, chromatin remodeling; types of histones, histone modifications- methylation, acetylation, phosphorylation and their effects on structure and function of chromatin, DNA methylation, repetitive and non-repetitive DNA sequence. Law of DNA constancy, C value paradox and genome size, karyotype and idiogram, chromosome banding pattern, types of chromosomes. Organelle genome.

12 hours

Unit 3

Gene and Mutation: Gene as unit of mutation, molecular basis of spontaneous and induced mutations and their role in evolution; mutagens, types of mutations, transposon mutagenesis, [site directed mutagenesis](#); [environmental mutagenesis](#); [Ames and other toxicity testing](#).

8 Hours

Unit 4

Genetic recombination: Genetic recombination in bacteriophages and E. coli, synopsis of homologous duplexes, breakages and re-union role of RecA and other recombinases, legitimate & illegitimate recombination, gene conversion, overview of bacterial genetic map.

10

H

o

u

r

s

U

n

i

t

5

Gene transfer mechanisms: Bacterial transformation; Host cell restriction; CRISPR Transduction; complementation; conjugation and transfection, mechanisms and applications, genetic analysis of virus, bacteria and yeast genomes. Genetics of fungi alteration of generation, induction of mutation in Neurospora crassa and yeast, cytoplasmic inheritance and biochemical mutants. **10 Hours**

Unit 6

Plasmids and Bacteriophages: Plasmids, F-factors - description and their uses in genetic analysis, Colicins and Col Factors, R plasmids. Lysogeny and lytic cycle in bacteriophages, Life cycle and their uses in microbial genetics. Lytic phages-T7 and T4, Lysogenic phages-Lambda, M13 and ΦX174.

8 Hours

MMB203: ENVIRONMENTAL MICROBIOLOGY

Course Objectives:

1. The major objective of the course is to impart knowledge about structure, composition and functioning of microbial communities of diverse environment.
2. To understand the use of microbial population in mineral recovery, management of various types of pollutants and conversion processes of various types of wastes into value added products
3. To understand bioremediation, xenobiotics, and effluent treatment methods

Total Hours: 52

Unit 1

Aerobiology: Air microflora in different layers of atmosphere, bioaerosol, [assessment of air quality using principles of sedimentation, impaction, impingement, suction and filtration](#).

Brief account of transmission of airborne microbes; Microbiology of indoor and outdoor.

Allergy: Causes and tests for detection of allergy.

10 Hours

Unit 2 Aquatic Microbiology: Fresh (Springs, rivers, streams, lake) and marine ecosystem (estuaries, mangroves, deep sea, hydrothermal vents, salt pans, coral reefs). Zonation of water ecosystem; upwelling, eutrophication; food chain in aquatic ecosystems. Role of methanotrophs in ecosystem. [Potability of water, microbial assessment of water, water purification](#). Ground water types and their contamination. [Coaggregation and biofilm among environmental microbes, biofouling- importance](#).

Waste treatment: [sewage and effluent treatment; primary, secondary and tertiary treatment, Solid waste treatment. Solid wastes as sources of energy and food](#).

12 hours

Unit 3 Soil Microbiology: Biotic and abiotic interactions, concepts of habitat and niche. Microbial communities; nature, structure and attributes, levels of species diversity, succession and stability, r and K selection, genetic exchange between communities. Biodiversity management and conservation. Role of microbes in decomposition of organic matter in various types of soils, subterranean microbes. Biogeochemical cycles of carbon, nitrogen, phosphorus and sulphur.

10 Hours

Unit 4 Diversity in anoxic eco system: Methanogens-reduction of carbon monoxide-reduction of iron, sulphur, manganese, nitrate and oxygen. Microbial transformations of Carbon, Phosphorus, Sulphur, Nitrogen and Mercury.

4 Hours

Unit 5 Extremophiles: The domain Archaea, acidophilic, alkalophilic, thermophilic, barophilic and osmophilic and radiodurant microbes- mechanisms and adaptation. Halophilic-membrane variation- electron transport and extremophiles-Applications, Astromicrobiology.

6 Hours

Unit 6 Biodegradation: [Role of microbes in degradation, Biodegradation of Xenobiotics-hydrocarbons, pesticides and plastics](#). Biodeterioration of wood, pulp and paper; Biosorption/bioaccumulation of heavy metals. Bioremediation of soil, air and water: various methods, advantages and disadvantages, Oil degrading genetically engineered *Pseudomonas putida*- a case

study. [Bioleaching of iron, copper, gold and uranium.](#)

10 hours

MMB204: FOOD MICROBIOLOGY

Course Objectives:

1. The major objective of the course is to teach the strategies to develop fermented and non-fermented milk products, plant based products, fish products, meat products bioactive compounds and malt beverages, wines, distilled liquors and vinegar.
2. To understand food spoilage microorganisms; the microbiology of food preservation and food commodities; fermented and microbial foods; principles and methods for the microbiological examination of foods; microbiological quality control, and quality schemes.
3. To create awareness among the students about the food quality analysis and the role of government organizations involved in food quality control.

**Tot
al
Ho
urs
: 52**

Unit 1 Introduction: Development of food microbiology as a science, scope of food microbiology. Food as substrate for microorganisms, intrinsic and extrinsic factors affecting the growth of microbes, important microorganisms in food (molds, yeasts and bacteria) and their source (air, soil, water, plants and animals).

6 Hours

Unit 2 Food contamination and spoilage: Sources of food contamination. Principles of food spoilage; spoilage of cereals, sugar products, vegetables, fruits, meat and meat products, milk and milk products, fish and sea foods, poultry; spoilage of canned foods; [conventional and modern methods for detection of spoilage and characterization.](#)

10 Hours

Unit 3 Food-borne infections and intoxication: Bacterial- Brucella, Bacillus, Clostridium, Escherichia, Listeria; Food intoxication- Botulism, Staphylococcal. Mycotoxins & their types – aflatoxins, ochratoxins, fumonisins, trichothecenes, zealenone, ergot alkaloids; [food borne outbreaks and lab testing procedures.](#) Preventive measures. Molds, Algae, Protozoa, Viruses.

10 Hours

Unit 4 Food preservation: Principles and methods of food preservation- Physical (temperature, irradiation, drying, canning, processing for heat treatment-D, Z and F values) Chemical (Organic acids, food additives. Class I and Class II preservatives), Biopreservation (Lactic acid bacteria). Food Packaging- Types of packaging materials, properties and benefits.

10 Hours

Unit 5 Microbial and Fermented foods: SCP- Nutritional & therapeutic importance, Quorn and SCO and their Industrial production. Fermented Vegetables (olives, cucumbers), Meat (sausages),

Beverage (cocoa and coffee); Bread, Idli, Dairy foods (cheese, srikhand).production methods of Kefir, Yogurt, Acidophilus milk; Probiotics, Prebiotics and Synbiotics, Nutraceuticals (Cr/Se yeast), functional foods and their quality standards. Application of fungal pigments in food industry.

12 Hours

MMB205: BIOINFORMATICS (Soft core)

Course Objectives:

1. The major objective of the course is to provide an overview of various bioinformaticstools, databases available and sequence analysis
2. To Provide knowledge on database concept, management, retrieval along withutilization in gene and protein analysis
3. To learn various computational technique and online tools of bioinformatics

Total Hours: 26

Unit 1 Introduction to Computer: Binary, Octal and Hexadecimal number systems– Binaryarithmetic, Binary code. Computer Architecture- internal and external Devices. Computersoftwaresooperating system- Windows, UNIX, Linux, Application software- word processor, spread sheet. Introduction to statistical software (SPSS).

3 hours

Unit 3 Databases: Introduction - Relational Databases Management (RDMS) - Oracle, SQL,Database generation. Biological Databases: Datamining and applications, accessing bibliographic databases- Pubmed, Nucleic acid sequence databank – NCBI and EMBL. Protein sequence databank-NBRF- PIR, SWISSPROT.Structural databases - protein data Bank (PDB). Metabolic pathway data bank(Pub gene), Microbial genomic database (MBGD), Cell line database (ATCC), Virus data bank (UICTVdb). Sequence alignment - Global and Local alignment, scoring matrices.

Restriction mapping - NEB CUTTER, Similarity searching (FASTA and BLAST), Pair wise comparison of sequences, Multiple Sequence alignment of sequences, Identification of genes ingenomes and Phylogenetic analysis with reference to nucleic acids and protein sequences, Identification of ORFs, Identification of motifs.

10

hours

Unit 4 Protein Structure and Molecular Interaction: Chemical bonding and nonbonding interactions, stability of electrovalent bond. Co-valent bond – partial ionic character of co-valentbonds and Vander Waals forces.Introduction to protein structure - secondary structure prediction, tertiary structure prediction, protein modelling- principles of homology and comparative modelling. Threading, structure evaluation and validation and abintio Modelling, Applications - Molecular docking –Autodoc.

8 Hours

MMB303: RECOMBINANT DNA TECHNOLOGY

Course Objectives:

1. The major objective of the course is to understand various applications of microbes for the development of various products of agriculture, industrial and clinical application.
2. To acquire knowledge about the methods used to clone genes, make and screen libraries, and the various applications of the polymerase chain reaction.
3. To understand how recombinant DNA technology has been exploited in the study of biology as well as in the production of pharmaceutical products

Total Hours: 52

Unit 1 Tools of recombinant DNA technology: Restriction endonucleases: types, nomenclature, recognition sequences, cleavage pattern. Ligases: mechanism of ligation, other DNA modifying enzymes-(Polymerases, DNase, RNase, Polynucleotide kinases, Alkaline Phosphatases). Vectors: Cloning and expression vectors, plasmids (pBR 322, pUC, Ti), phages, cosmids, Phagemids, shuttle vectors, ARS, mini chromosomes, BACs, PACs and YACs. Promoter probe vectors, PET, BAC vectors, SV40, plant viruses as vectors. **14 Hours**

Unit 2 Cloning and Expression: Cloning in Prokaryotes (E.coli) and Eukaryotes: (Saccharomyces cerevisiae and Pichia pastoris); construction of cDNA and genomic DNA library. Transformation into bacteria and yeast, transfection into plant and animal cells, selection of recombinant cells, expression of recombinant proteins. **10 Hours**

Unit 3 Molecular techniques: PCR - Principles, designing of primers, PCR methodology, PCR variants- RT - PCR, multiplex PCR, nested PCR- Identification of PCR product- Factors influencing PCR- Cloning of PCR products- Application of PCR technology - Molecular markers: RFLP, RAPD, AFLP, SSCP and SNP, 16s r-DNA typing, gene chip and micro array; applications in disease profile, DNA finger printing and forensic science – DNA Foot printing. **12 Hours**

Unit 4 DNA sequencing: Dideoxy and chemical methods, sequence assembly, automated sequencing, genome sequencing, mapping of genes and fine structure analysis of genes. **5 Hours**

Unit 5 Chemical synthesis of genes: Phosphodiester, phosphotriester,

phosphate trimer approaches: Enzymatic synthesis of DNA; application of synthetic oligonucleotides, synthesis of complete gene.

5

Hours

Unit 6 Application of rDNA technology: genetically modified organisms (Bt cotton). Overview of Transgenic plants, GM foods (golden rice, tomato, corn, brinjal), transgenic animals (cow, sheep, poultry, fish). Gene therapy.

6 Hours

MMB 401: AGRICULTURAL MICROBIOLOGY

Course Objectives:

1. The major objective of the course is to provide the students a basic understanding of agricultural microbiology including agricultural welfare, ecosystem wellness and the fate of microbial pathogens in the agricultural fields.
2. To know the importance of biofertilizers and biopesticides and to know about various techniques involved in biofertilizers and biopesticides production
3. To give an overview on plant microbe interaction and impart in-depth information on soil and agriculture

Total

Hours: 52

Unit 1 Microbes and soil fertility: Role of microbes in soil fertility. Decomposition of organic matter by microorganisms - cellulose, hemicellulose, lignin, xylan and pectin. Soil fertility evaluation and improvement. Effect of pesticides on soil microflora.

4 Hours

Unit 2 Biological nitrogen fixation (BNF): Nitrification, denitrification; symbiotic nitrogen fixation (Rhizobium, Frankia), non-symbiotic nitrogen fixation (Azotobacter, Azospirillum); Nitrogenase enzyme, nif genes and molecular mechanism of nitrogen fixation. Role of nodulin genes in nodule development and symbiosis. Genetic engineering of BNF.

8 Hours

Unit 3 Plant-microbe interactions: Mutualism, commensalism, parasitism, amensalism, synergism. Rhizosphere microorganisms, phyllosphere, spermosphere and rhizoplane, methods of enumeration, rhizosphere effect, factors influencing rhizosphere microbes. PGPR, Siderophores and VAM. **10 Hours**

Unit 4 Bioinoculants: Biofertilizer - types, production and quality control. Cultivation and massproduction of bioinoculants- Azotobacter, Rhizobium, Azospirillum, Cyanobacteria, phosphate solubilising microorganisms, Azolla. Carrier-based inoculants - production and applications. Biopesticides- types and applications (Pseudomonas fluorescence, Bacillus thuringiensis, Trichoderma spp., Nuclear Polyhedrosis Virus)

10 Hours

Unit 5 Molecular plant pathology: Recognition and entry of pathogens into host cells. Alteration of host cell behaviour by pathogens. Molecular mechanisms of disease establishment; enzymes, phytotoxins, growth regulators. Involvement of elicitors; role of R and r genes in disease development. Molecular mechanisms of disease diagnosis. Resistance mechanisms in plants, Systemic resistance, resistance genes, phytoalexins, PR proteins, signalling mechanisms.

6 Hours

Unit 6 Plant diseases: (Symptomatology, etiology & control) Diseases caused by

- a) Fungi: Fusarium Wilt, Downy mildews (Millets), Powdery mildews (grapes), Rusts (wheat)
- b) Bacteria: (Tomato wilt, Bacterial blight of rice, Angular leaf spot of cotton, Citrus canker)
- c) Mycoplasmal diseases: (Sandal spike, Grassy shoot of sugar cane)
- d) Viral diseases: (Cauliflower mosaic disease, Banana bunchy top, Cow pea mosaic, tomato leaf curl)
- e) Viroids: (Potato spindle tuber viroid). Strategies for disease management, Post-harvest diseases and control measures. Integrated pest management.

14 Hours

MMB402: INDUSTRIAL MICROBIOLOGY

Course Objectives:

1. The major objective of the course is to provide the design of bioreactors, media formulations and factors affecting the industrial production of biochemicals along with approaches that can be used for enhanced production
2. To analyze the role of micro-organism in production of organic acids, alcohols, wine, vinegar, enzymes, vitamins, antibiotics, amino-acids and steroids
3. To understand the strategies for development of microbial strains, process optimization, large scale production and product recovery will be covered for industrially relevant microbial products and therapeutic proteins

**Total
Hours: 52**

Unit 1 Introduction: Scope of Industrial Microbiology and fermentation technology. Study of industrially important micro-organisms and their preservation. Criteria for selection and strategies for strain improvement; maintenance and containment of recombinant organisms.

8 Hours

Unit 2 Modes of Fermentation and process control: Batch, fed batch and continuous culture: growth kinetics; effect of environment: temperature, pH, nutrient concentration; monitoring microbial growth in culture: cell number, direct and apparent viscosities; anti-foam agents. **10 Hours**

Unit 3 Fermentors: basic features, design & components–Typical fermentor. Sterilization of fermentor, medium, air supply; aseptic inoculation and sampling methods; scale up of fermentation process (parameters used in scale up, problems associated). Merits & demerits. Fermentation media: Media formulation strategies, sources of carbon, nitrogen, vitamins and minerals; role of buffers, precursors, inhibitors and inducers. Specialized bioreactors (Photobioreactors, membrane, fluidized bed, tubular and packed bed reactor).

10 Hours

Unit 4 Solid state fermentation (SSF): Estimation of growth in SSF, concept of sterility. Comparison of SSF with SmF. Factors influencing SSF, kinetics, design of fermentor in SSF (Koji fermentor). Production of commercially important products by SSF.

6 Hours

Unit 5 Downstream processing: Objectives and criteria, foam separation,

precipitation methods,filtration, centrifugation, cell disruption methods, liquid extraction, membrane filtration, chromatography,drying devices, crystallization.Solvent recovery.Effluent treatment.Quality control Of fermented products, Process economics.

8 Hours

Unit 6 Intellectual Property Rights (IPR): Introduction to Intellectual Property & IPR, patent,copyrights, trademarks, trade secret, geographical indications, Industrial designs. Patent laws,Legislations covering IPR's in India, Patenting of living organisms, procedure involved in patenting, patent infringement, patent filing and international patent law, PCT, provisional and complete specification, patentable and non-patentable materials, product planning and development, Trade related aspects (TRIPS), WTO, WIPO (international & regional).

Entrepreneurship: Introduction, concept and theories of entrepreneurship, entrepreneurial traits and motivation, nature and importance of entrepreneurs. Entrepreneurship in India, barriers in entrepreneurship,agreements.Valuation& business concerns.Government regulations for microbial products.

10 Hours

MMB403: MICROBIAL BIOTECHNOLOGY

Course Objectives:

1. The major objective of the course is to understand the microbial biotechnology through handling the microorganisms
2. To expose on various techniques involve in genetic engineering
3. To provide knowledge and in-depth study on plant & animal tissue culture techniques, Fermentation techniques & Biosensors, Environment & Energy, Concepts & Scope in Genetic Engineering and Applications of Genetic engineering

Total Hours: 52

Unit 1 Introduction: Principle, applications, economics and milestones in microbial technology.

2 Hours

Unit 2 Microbial products for commercial use: Industrial production of organic acids (acetic acid, lactic acid). Amino acids (lysine, glutamic acid), Solvents (acetone, ethanol), Antibiotics (Cephalosporin, Streptomycin), Microbial polysaccharides (xanthan) and

polyesters (PHB). Hormones (insulin), anticholesterol compound (Lovastatin). Vaccines (recombinant). Microbial insecticides. Secondary metabolites in bacteria and fungi (anti-cancer and anti-diabetic compounds). Biosimilars, Surfactants of Microbial Origin (Lecithin) **14**

Hours

Unit 3 Microbial enzymes: Industrial production of lipase, protease & asparaginase. Enzymes in - starch processing, food, textile, detergent, leather, breweries, pharmaceuticals, therapeutics, and diagnostics. Recombinant enzymes. Immobilized enzymes and cells: Techniques and types of immobilization, industrial applications of immobilization: merits and demerits.

10 Hours

Unit 4 Microbial transformation and organic synthesis: Transformation of steroids and sterols, over production of glutathione by genetically engineered cells. Metabolic engineering for vitamin C production, synthesis of acrylamide by nitrile hydratase (synthesis of optically pure drugs). **10 Hours**

Unit 5 Nanotechnology: Introduction, Tools of nanosciences, Synthesis of Nanomaterials using microbes. Biopolymeric nanoparticles; nanosensors, biomedical applications, antimicrobial nanoparticles.

8 Hours

Unit 6 Bioethics and biosafety: Introduction, Human genome project and its ethical, legal and social implications. Biosafety guidelines and regulations for GMOs. GLP and GMP. Labelling of GM products. Ethics and safety of GM food. Testing of drugs on human volunteers.

8 Hours

Department of Life Sciences
Zoology

V Semester B.Sc.

Non-chordates and Economic Zoology

Course Code: S21ZO5.1

Total Hours: 60

Credits: 4

CObj	Course objective
CObj_1	To understand the taxonomic position of non-chordate
CObj_2	To understand the body organization and general characteristics of animals belonging to different phyla
CObj_3	To understand the experiential learning on the methodology and economic aspects of culturing animals

CO	Course outcomes
	After completion of this module, students should be able to
CO1	Develop appreciation on diversity of life on earth.
CO2	Recognize different levels of biological diversity through the systematic classification of non-chordates
CO3	Comprehend the evolutionary significance of non-chordates
CO4	Understand the economic aspects of culturing animals
CO5	Acquire knowledge on various useful and harmful organisms

Course Content

Sl. No.	Unit/chapter title	Content	Number of hours	Skills developed
1	Unit 1: Animal architecture	Definition, types - spherical symmetry, radial symmetry, biradial symmetry and bilateral symmetry (volvox, star fish, comb jellies, flat worms)	15 hours	Cognitive skills
		Protoplasmic level of organisation, cellular level of organisation, tissue level of organisation and organ level of organisation.		
		Definition, origin and types- acoelom, pseudo coelom, eucoelom (enterocoelom and schizocoelom)		
		Definition, types - pseudometamerism, true metamerism-homonomous and heteronomous.		
	Protozoa-Animal like protists	General characters of the phylum up to classes with examples.		Cognitive skills Analytical skills
		Holozoic, Holophytic, Saprozoic, Mixotrophic and Parasitic nutrition with an example for each.		
		Locomotory organelle - Pseudopodia, Cilia and Flagella. Modes of locomotion - Amoeboid movement (Walking movement and Sol-Gel theory), Flagellar and Euglenoid movement, ciliary movement (Paddle stroke theory) and Metabolic movement (Gregarines and Euglena).		
2	Porifera	General characters of the phylum up to classes with examples.	15 hours	Cognitive Skills Analytical skills EMP SKD EDP
		Morphology, microscopic structure of body wall of Sycon		
	Unit 2: Cnidaria	Asconoid, Syconoid, Leuconoid and Rhagonoid types of canal system		
		General characters of the phylum up to classes with examples.		
		Externals, nerve net in Hydra		
		Meaning, polymorphism in Halistemma.		

		Meaning, types, theories on coral reef formation		Cognitive skills Research skills
		General organisation and affinities of Ctenophora		
	Helminthes	General characters of the phylum Platyhelminthes up to classes with examples.		
		Externals, digestive system, excretory system of planaria		
		General characters of the Phylum Nematoda with examples.		
	Annelida	General characters of the phylum Annelida up to classes with examples.		
		Morphology, digestive system, excretory system, reproductive system, development in Earthworm		
	Arthropoda	General characters of the phylum up to classes with examples.		
		Unique features of Peripatus, affinities with Annelida and Arthropoda		
		Penaeus - Morphology, structure of a typical appendage, concept of serial homology, structure and function of appendages, circulatory system, reproductive system and life cycle		
3	Unit 3: Mollusca	General characters of the phylum up to classes with examples.	15 hours	Cognitive skills Thinking skills
		Unio- Morphology, Externals, structure of shell (sectional view), digestive and reproductive system and life cycle.		
		Modification of Foot- Chiton, Pila, Dentalium, Unio, Octopus		
	Echinodermata	General characters of the phylum up to classes with examples.		Cognitive skills
		Star fish - Externals, water vascular systems, reproduction and life history		
		Structure and significance of the following larvae- Bipinnaria, Ophiopluteus, Echinopluteus and Auricularia.		
	Hemichordata	Link between Non-Chordates and Chordates Affinities and systematic position		Analytical skills

		Morphology, coelom of Balanoglossus		
4	Unit 4: Economic Zoology	Vermiculture and vermicomposting	15 hours	Employable skills
		Parasitism: definition and types, Parasitic adaptations- Parasitic flat worms and leech		Cognitive skills
		Occurrence, disease caused, mode of transmission, life cycle of • <i>Plasmodium vivax</i> • <i>Taenia solium</i> • <i>Wuchereria bancrofti</i> • <i>Fasciola hepatica</i>		Analytical skills Research skills
		Sericulture: silkworm species, silk worm rearing and management practices, pests and diseases of silkworm		Employable skills EMP SKD EDP
		Apiculture: honeybee species, bee keeping and management practices, bee products, pests and diseases of honey bees.		
		Prawn Fisheries: Types of Prawn fishery, Preservation and processing of Prawn		
		Pearl culture		

Books for Reference:

1. Barnes R.D. 1968. Invertebrate Zoology, 2nd Edn. Saunders Philadelphia.
2. Barrington, E.J.W. 1967. Invertebrate structure and function. Neelson, London.
3. Hymann, L.H. 1940-67. The Invertebrate, Vol. I-IV. Mc Graw- Hill, New York.
4. Marshall, A.J. and Williams, W.D. (Eds.). 1995. Text book of Zoology – Invertebrate VII Ed., Vol. I, A.I.T. B.S. Publishers.
5. Russell-Hunter, W.D. 1968. A biology of lower Invertebrates. Macmillan Company, New York.
6. Russell-Hunter, W.D. 1969. Biology of higher Invertebrate. Macmillan Company, New York.
7. Sedgewic Volumes
8. Parker and Haswel Vol. I
9. Kotpal Volumes Protozoa through Echinodermata
10. A manual of Zoology by Ekambarnath and Vishwanathan
11. Economic Zoology by Shukla and Upadaya
12. Economic Zoology by Reena and Mattur
13. Invertebrate Zoology by S.N. Prasad

S21ZO5.2: NON-CHORDATA (Practical)

Total teaching hours: 60

No. of hours/Week: 4

(2Credits)

Sl. No	Content	Hours
1.	Introduction to types of microscopes Protozoa: Study of permanent slides of <i>Amoeba</i> , <i>Euglena</i> , <i>Noctiluca</i> , <i>Paramecium</i> , <i>Vorticella</i> Porifera: <i>Sycon</i> , <i>Euplectella</i> , <i>Hyalonema</i> , and <i>Euspongia</i> . Permanent slides of spicules and gemmule. Coelenterata: <i>Hydra</i> , <i>Obelia</i> , <i>Physalia</i> , <i>Aurelia</i> <i>Preparation and observation of Obelia</i> Coelenterata : Corals– <i>Fungia</i> , <i>Corallium</i> , <i>Meandrina</i> , <i>Gorgonia</i> and <i>Pennatula</i>	20 hours EMP SKD EDP
2.	Helminthes: <i>Planaria</i> , <i>Liver fluke</i> and Tape worm. <i>Ascaris</i> – Male, female Annelida: Earthworm, <i>Nereis</i> and <i>Heteronereis</i> , <i>Arenicola</i> Arthropoda: Scorpion, Spider, <i>Limulus</i> , <i>Peripatus</i> , Millipede, Centipede <i>Mounting of pollen basket and sting of honey bee</i> <i>Mounting of head of Drosophila</i>	20 hours EMP SKD EDP
3.	Mollusca: <i>Mytilus</i> , <i>Chiton</i> , <i>Octopus</i> , <i>Sepia</i> , <i>Glochidium</i> larva Mollusca: Shell pattern- <i>Unio</i> , <i>Pila</i> , <i>Nautilus</i> , <i>Dentalium</i> , Cuttle bone Echinodermata: Sea star, Sea urchin, Sea cucumber, Sea lilly, <i>Pedicellaria</i> Hemichordata: <i>Balanoglossus</i>	20 hours

V Semester B.Sc.

Chordates and Comparative Anatomy

Course Code: S21ZO6.1

Total Hours: 60

Credits: 4

CObj	Course objective
CObj_1	To understand different categories of chordates and the general characters of chordates
CObj_2	To understand the level of organization in chordate subphylum and their origin and evolutionary relationship
CObj_3	To find differences and similarities between the body structure of species to predict whether they are related to a common ancestor or not.

CO	Course outcomes
	After completion of this module, students should be able to
CO1	Describe unique characters of chordates
CO2	Recognize the life functions of chordates.
CO3	Understand the ecological role of different groups of chordates.
CO4	Identify the major organs common in organisms
CO5	Compare and contrast the anatomical systems of different organisms

Course Content

Sl. No.	Unit/chapter title	Content	Number of hours	Skills developed
1	Unit 1: Protochordata	Basic Chordate characters and outline classification up to classes	15 hours	Cognitive skills
		Amphioxus - Morphology, feeding and circulatory system		
		Ascidian - Morphology, Ascidian tadpole and retrogressive metamorphosis.		
		General characters of Agnatha, differences between Myxine and Petromyzon		
		Ammocoete larva and its significance.		
	Pisces	Salient features and classification up to subclasses - Chondrichthyes and Osteichthyes		
		Morphology, digestive system, neuromast organs (Lateral line sensory system and Ampullae of Lorenzini) and urinogenital system.		
		Interesting features and their evolutionary significance.		
2	Unit 2: Amphibia	General characters and classification of living Amphibians up to orders, with suitable examples	15 hours	Cognitive Skills Critical thinking skills Analytical skills Logical skills EMP SKD EDP
		Origin of Amphibia: Transition from water to land, Threats and conservation		
	Reptilia	General characters and outline classification of modern reptiles with suitable examples		
		Adaptive radiation in extinct and extant reptiles with suitable examples		
		Temporal fossae in reptiles, Poisonous apparatus in snakes		
		Interesting features of Sphenodon & Iguana		
	Aves	General characters, differences between Ratite and Carinatae.		

		Interesting features of Archaeopteryx.		
		Flight adaptations in birds.		
3	Unit 3: Mammalia	General characters and classification up to subclasses (prototheria, metatheria and eutheria) with suitable examples.	15 hours	Cognitive Skills
		Interesting features of mammalian orders: Insectivora, Carnivora, Chiroptera, Cetacea, Proboscidea, Ungulata Perissodactyla, Artiodactyla, Primates (Platyrrhini and Catarrhini)		
4	Unit 4: Comparative Anatomy	Integument and its derivatives in fishes (cartilaginous and bony), amphibians, reptiles, birds and mammals.	15 hours	Analytical Logical skills
		Respiratory organs in fishes, amphibians, reptiles, birds and mammals		EMP
		Circulatory system - Evolutionary trends of vertebrate hearts. - Trends in the evolution of aortic arches in vertebrates		SKD
		Evolution of excretory structures in animals: pronephros, mesonephros and metanephros in different classes of vertebrates, Urinogenital System		EDP
		Evolutionary trends in the structure of Vertebrate brains: Shark, Frog, Lizard, Bird, Rabbit		

Books for Reference:

1. "A text book of Chordates" by N. Arumugam, A. Thangamani, S. Prasanna kumar, L.M. Narayanan
2. "Biology of Chordates" by B. N. Pandey and Vertica Mathur
3. "Chordate Zoology" by E. L. Jordan and P. S. Verma
4. "Biodiversity of Chordates" by. Ramesh Vitthalrao Shelke & Dr. D.V. Jamkar.
5. "Vertebrates" by R.L. Kotpal
6. "Comparative Anatomy Of Vertebrates" by Dr. Kishore R. Pawar, Dr. Ashok E. Desai, Dr. Dama L. B. Book
7. "Comparative Anatomy of Vertebrates", by. R.K. Saxena
8. "Vertebrates: Comparative Anatomy, Function, Evolution" by Kenneth Kardone
9. "Comparative Anatomy and Histology" by Piper Treuting
10. "Comparative anatomy of Vertebrates by R.K. Saxena and Sumithra Saxena

S21ZO6.2: CHORDATA (Practical)

Total teaching hours: 60

No. of hours/Week: 4

(2 Credits)

Sl. No.	Content	No. of hours
1.	Protochordata: Ascidian and Amphioxus, T.S. of Amphioxus through pharynx and intestine. Cyclostoma: Petromyzon, Ammocoete larva and Myxine Pisces: a. Cartilaginous Fishes – Narcine, Trygon, Pristis, Myxobatis (any two) -02 units b. Bony Fishes – Hippocampus, Muraena, Ostracion, Tetradon, Pleuronectes, Diodon and Echeneis (Any three) c. Accessory respiratory organs-Saccobranchus, Clarias and Anabas.	20 hours
2.	Amphibia: a. Frog, Bufo, Ambystoma, Axolotl larva, Necturus and Ichthyophis b. Endoskeleton of frog: Skull, lower jaw, vertebrae, pectoral and pelvic girdles. Reptilia: Turtle, Tortoise, Varanus, poisonous snakes – Cobra, Krait, Russell's viper and Hydrophis. Keys to identify poisonous & non-poisonous snakes Aves: a. Endoskeleton – Skull, heterocoelous vertebra, synsacrum, sternum, pectoral girdle, pelvic girdle. b. Beak and feet modifications	20 hours EMP SKD EDP
3.	Mammalia: a. Mongoose, Squirrel, Pangolin, b. Hedge Hog, Rabbit, Monkey and Loris (any four) b. Endoskeleton of human – Skull, mandible, vertebrae – first, second, typical cervical, thoracic, lumbar and sacrum with coccyx, girdles and limb bones (bones of wrist, hand, ankle and foot not required). Project report on a) Checklist of birds b) Identification of fish variety in market c) Types of bird feathers Dissection: Study of Morphometry of the given fish	20 hours EMP SKD EDP

S21ZO7.1: EVOLUTIONARY AND DEVELOPMENTAL BIOLOGY**Total Teaching Hours: 60****No. of Hours per Week: 4****(4 credits)**

CObj	Course objectives
CObj_1	To demonstrate understanding of ecological and evolutionary processes
CObj_2	To describe the theory of natural selection and to understand how species evolve
CObj_3	To understand the complete process of development in organisms

CO	Course outcomes After completion of this module, students should be able to
CO1	Describe evolutionary history of man.
CO2	Describe origin of species on earth.
CO3	List the types of characteristics that make an organism ideal for the study of developmental biology.
CO4	Recognize the events that lead to fertilization
CO5	Distinguish between evolutionary and developmental biology

CO-PO Mapping

	PO_1	PO_2	PO_3	PO_4	PO_5	PSO_1	PSO_2	PSO_3	PSO_4	PSO_5
CO_1	X					X				
CO_2	X						X			
CO_3	X	X				X		X	X	
CO_4	X		X	X						
CO_5	X				X					X

Sl. No.	Unit/chapter title	Content	Number of hours	Skills developed
Evolutionary Biology				
1	Unit 1/Chapter 1	Introduction, Darwinism: Contribution of Oparin, Haldane and Sydney Fox to be highlighted. Stanley Miller's experiment. a. Darwinism & Critical analysis of Darwinism b. Neo-Darwinism-Concept of Gene pool and Gene frequency, Hardy- Weinberg law	15 Hrs	Cognitive skills
	Chapter 2	Role of evolutionary forces in speciation: Sexual reproduction Mutation Genetic drift Natural Selection- Introduction, Stabilizing selection, Directional selection and Disruptive selection. Isolation: Isolating mechanisms – Introduction, Geographical and Reproductive isolation. Reproductive isolation: a. Prezygotic/Premating isolation b. Post zygotic/Post mating isolation Speciation: Introduction, Types: Allopatric and Sympatric speciation.		Cognitive and Analytical skills
2	Unit 2/ Chapter 3	Evidence of organic evolution: Fossils-Introduction, Fossil formation and types (Petrification, preservation, impressions, moulds and casts), Dating of fossils - Carbon method, Potassium - Argon method. Morphology and Comparative anatomy: Homologous structures, analogous structures, atavism	15 Hrs	Cognitive skills Research skills EMP SKD EDP
	Chapter 4	Evolution of man: Introduction, Salient features of important fossil stages of Human- Ramapithecus, Australopithecus, Homo erectus, Rhodesian man, Neanderthal man and Cro-Magnon man		Cognitive skills Research skills EMP SKD EDP

Developmental biology				
3	Unit 3/ Chapter 5	Introduction & Gametogenesis: Definition and scope, Historical review - Preformation theory, Epigenetic theory, Baer's	15 Hrs	Cognitive, Analytical skills EMP SKD EDP
		Law and Biogenetic law		
		Introduction, Spermatogenesis-formation of spermatids, spermiogenesis, Sertoli cells and their role in spermatogenesis.		
		Structure of a typical mammalian sperm, Oogenesis, Types of egg membranes with examples. Significance of egg membranes. Cleidoic egg (e.g., Hen's eggs) and its significance.		
	Chapter 6	Reproductive cycles, Patterns of development, Fertilization, Cleavage & Patterns of cleavage:		
		Estrous and Menstrual cycles and their regulation		
		Oviparity, ovoviviparity and viviparity with examples.		
		Introduction, Types, Mechanism of fertilization, monospermic and polyspermic fertilization (pathological and physiological polyspermy) with examples, a mechanism to block polyspermy in monospermic forms (fast block and slow block). Significance of fertilization		
		Cleavage: Characteristics of cleavage, planes of cleavage - meridional, vertical, equatorial and latitudinal bane.		
		Pattern of cleavage - radial type, biradial, spiral, bilateral, determinate and indeterminate cleavage with examples. Influence of yolk in cleavage.		
4	Unit 4/ Chapter 7	Blastulation, Fate maps, Cell lineage & Gastrulation: Blastulation: Comparative account with reference to Amphioxus, Frog and Chick	15 Hrs	Cognitive, Analytical skills EMP
		Fate maps and cell lineage: Methods of		

		Preparation of fate maps, Cell lineage in Nereis, Presumptive organ forming areas and fate maps in Frog, Gastrulation in Amphioxus, Frog and Chick. Neurulation, post-neurula development and metamorphosis in Frog.	SKD EDP
	Chapter 8	Organizers, Extra embryonic membranes and regeneration: Transplantation experiments of Spemann & Mangold, Chemistry of organizer, Foetal membranes in chick-formation, structure and function. Placenta-types, morphological and histological	
		Regeneration: Introduction -types & examples, Regeneration in planaria and amphibians	

Books for Reference:

1. "Developmental Biology (Developmental Biology Developmental Biology)" by Scott F Gilbert and Susan R Singer
2. "Developmental Biology: A Very Short Introduction (Very Short Introductions)" by Lewis Wolpert
3. "A Text Book of Embryology (Developmental Zoology)" by N Arumugam
4. "Developmental Biology" by Dr M A Subramanian
5. "Fundamental Concepts of Developmental Biology" by Das N
6. "The selfish gene" by Richard Dawkins
7. "The theory of Evolution" by William Berryman Scott
8. "Encyclopedia of Evolution" by Mark Pagel
9. "The theory of Evolution" by John Maynard Smith
10. "Evolutionary biology" by Dr. Tripurari Mishra

Web Resource:

1. <https://countryofpapers.com/search-journals/top-15-journals-developmental-biology>
2. <https://countryofpapers.com/search-journals/top-15-journals-developmental-biology>
3. <https://www.springer.com/journal/11692>

Journals:

1. Frontiers
2. Science Direct
3. Nature Ecology & Evolution

S21ZO7.2: EVOLUTIONARY & DEVELOPMENTAL BIOLOGY**(Practical)****Total teaching hours: 60****No. of hours/Week: 4****(2 Credits)**

Sl. No.	Unit/chapter title	Content	Number of hours	Skills developed
1	Unit 1	Developmental Biology • Early development of Frog: Cleavage, Blastula, Gastrula with yolk plug stage and Neurula. • Late development of Frog: Metamorphosis (Tadpole to young Frog) • Development of Chick: 18 hrs, 24 hrs, 36 hrs, 48 hrs and 72 hrs stages • Stages of Estrous cycle • Placenta: Histological types	15 Hrs	Cognitive skills EMP SKD EDP
2	Unit 2	Evolutionary biology • Study of Homologous organs: • Fore limb and Hind limb bones of terrestrial Vertebrates (Frog, Lizard, Bird, Rat or Rabbit or Human). • Mouth parts of Cockroach, House fly, Butterfly and Mosquito	15 Hrs	Cognitive skills,
3	Unit 3	• Study of Serial homology: Appendages of Prawn. • Study of Analogous organs: a. Vertebrate eye and Cephalopod Eye b. Wing of Insect and Bird • Study of Vestigial organs: Appendix, Coccyx, Molar tooth, Study of Fossil.	15 Hrs	Cognitive skills, Analytical skills
4	Unit 4	• Study of connecting links: Peripatus and Tornaria larva. • Evolution of Man: Study of Phylogeny using models	15 Hrs	Cognitive skills

Books for reference:

1. Keller, Laura R., Evans, John H., Thomas C.S. (1999). Experimental developmental biology: A laboratory manual.
2. Pahari, Dhrubajyothi. (2003). Evolutionary biology: Theory and Practicals. Kalyani Publication.

INDIAN ACADEMY
Degree College - Autonomous

**Department of Physical
Sciences
Chemistry**



MATRIX AND SYLLABUS

For the Programme B.Sc. (Chemistry/ Microbiology)

Chemistry

NEP Based Curriculum (2021 onwards)

PEO_ID	Programme Educational Objectives
PEO1	Students will be well prepared for successful careers in the profession at an industry and/or in government in one or more of discipline of chemistry.
PEO2	Students will be academically prepared to become licensed professional chemists in due course and will contribute effectively in serving the society.
PEO3	Students will be engaged in professional activities to enhance their own achievement and simultaneously contribute in service of humankind.
PEO4	Students will be successful in higher education in Chemistry
PEO5	Students will provide leadership quality to work in all kind of circumstances, diverse environment such as interdisciplinary and multidisciplinary learning systems.

PO_ID	Programme Outcomes
PO1	Create enthusiasm among students for chemistry and its application in various fields of life.
PO2	Provide students with broad and balanced knowledge and understanding of key concepts in chemistry.
PO3	Develop in students a range of practical skills so that they can understand and assess risks and work safely measures to be followed in the laboratory.
PO4	Develop in students the ability to apply standard methodology to the solution of problems in chemistry.
PO5	Provide students with knowledge and skill towards employment or higher education in chemistry or multi-disciplinary areas.

SO_ID	Programme Specific Outcomes
PSO1	Students have a firm foundation in the fundamentals and application of current chemical and scientific theories including those in Analytical, Inorganic, Organic and Physical branches of chemistry.
PSO2	Acquired the knowledge of terms, facts, concepts, processes techniques and principles of the subject.
PSO3	Carry out experiments and analysis in the area of organic analysis, estimation, separation, inorganic semi micro analysis, preparation.
PSO4	Apply appropriate techniques for the qualitative and quantitative analysis of chemicals in laboratories.
PSO5	Developed skills in the proper handling of apparatus and chemicals.



MATRIX AND SYLLABUS

For the Programme B.Sc. (Chemistry/ Microbiology)

Chemistry

NEP Based Curriculum (2021 onwards)

I Semester

I Semester							
Code	Course Code	Course	Teaching Hours	Course Components			Credits
				L	T	P	
AECC	S21KN 1.1/ S21HN 1.1/ S21AE 1.1	Language I (Kannada/Hindi/Additional English)	45	3	1	-	3
AECC	S21GE 1.1	Language II (Generic English)	60	3	1	-	3
DSC1	S21 MB1.1	General Microbiology	60		4	-	4
DSC 1	S21 MB 1.2	General Microbiology	45		-	4	2
DSC 1	S21 CH 1.1	Analytical & Organic Chemistry-I	60	-	4	-	4
DSC 1	S21 CH 1.2	Analytical & Organic Chemistry practicals-I	60	-	-	4	2
OE-1	S21OE/S21OE1.3	Microbial Technology for Human Welfare/Chemistry in Daily Life	45	2	1	-	3
SEC-SB	21SBC 1.1	Digital Fluency	30	1	-	2	2
SEC-VB	21VBC 1.1	Health and Well-being	30			2	1
SEC-VB	21VBC 1.2	Yoga	30			2	1
Total							25

AECC- Ability Enhancement Compulsory Course

DSC - Discipline-Specific Course

OE- Open elective (course offered by the department to students of other stream)

DSE – Discipline-Specific Elective

SEC - VB Skill Enhancement Course -Value Based

SEC - SB Skill Enhancement Course -Skill Based

B.Sc. (Chemistry & Microbiology) - Matrix for II Semester (w.e.f. 2021-22 onwards)

II Semester							
Code	Course Code	Course	Teaching Hours	Course Components			Credits
				L	T	P	
AECC	S21KN 2.1/ S21HN 2.1/ S21AE 2.1	Language I (Kannada/Hindi/Additional English)	45	3	1	-	3
AECC	S21GE 2.1	Language II (Generic English)	60	3	1	-	3
AECC	21SBC 2.1	Environmental Studies	45	2	1	-	3
DSC2	S21 CHE2.1	Inorganic & Physical Chemistry-I	60	4	-	-	4
DSC2	S21 CHE2.2	Inorganic & Physical Chemistry Practical-I	60	-	-	4	2
DSC2	S21 MB 2.1	Microbial Biochemistry and Physiology	60	4	-	-	4
DSC2	S21 MB 2.2	Microbial Biochemistry and Physiology - Practical	60	-	-	4	2
OE-2	S21OE-2.3	Environmental and health microbiology/Molecules of Life	45	2	1	-	3
SEC-VB	21VBC 2.1	NCC/NSS/Cultural	30	-	-	2	1
SEC-VB	21VBC 2.2	Sports	30	-	-	2	1
Total							26

AECC- Ability Enhancement Compulsory Course

DSC - Discipline-Specific Course

OE- Open elective (course offered by the department to students of other stream)

SEC - VB Skill Enhancement Course -Value Based

SEC - SB Skill Enhancement Course -Skill Based

B.Sc. (Chemistry & Microbiology) - Matrix for III Semester (w.e.f. 2021-22 onwards)

III Semester							
Code	Course Code	Course	Teaching Hours	Course Components			Credits
				L	T	P	
AECC	S21KN 3.1/ S21HN 3.1/ S21AE 1.1	Language I (Kannada/Hindi/Additional English)	45	3	1	-	3
AECC	S21GE 3.1	Language II (Generic English)	60	3	1	-	3
DSC3	S21 MB 3.1	Microbial diversity - Theory	60		4	-	4
DSC3	S21 MB 3.2	Microbial diversity – Practical	45		-	4	2
DSC3	S21 CH 3.1	Analytical & Organic Chemistry-II	60	-	4	-	4
DSC3	S21 CH 3.2	Analytical & Organic Chemistry Practicals-II	60	-	-	4	2
OE-3	S21OE 3.3	Cosmetic Microbiology/Atomic structure ,Bonding and concepts in Organic chemistry	45	2	1	-	3
SEC- SB	21SBC 3 .1	Digital fluency-II	30	1	-	2	2
SEC-VB	21VBC 3.1	NCC/NSS/Cultural	30	-	-	2	1
SEC-VB	21VBC 3.2	Sports	30	-	-	2	1
Total							25

Note 1:

AECC- Ability Enhancement Compulsory Course

DSC - Discipline-Specific Course

OE- Open elective (course offered by the department to students of other stream)

SEC - VB Skill Enhancement Course -Value Based

SEC - SB Skill Enhancement Course -Skill Based

B.Sc. (Chemistry & Microbiology) - Matrix for IV Semester (w.e.f. 2021-22 onwards)

IV Semester							
Code	Course Code	Course	Teaching Hours	Course Components			Credits
				L	T	P	
AECC	S21KN 4.1/ S21HN4.1/ S21AE 4.1	Language I (Kannada/Hindi/Additional English)	45	3	1	-	3
AECC	S21GE4.1	Language II (Generic English)	60	3	1	-	3
AECC	21SBC 4.1	Constitution of India	45	2	1	-	3
DSC4	S21 MB 4.1	Microbial Enzymology and Metabolism	60		4		4
DSC4	S21 MB 4.2	Microbial Enzymology and Metabolism practical	45			4	2
DSC4	S21 CH 4.1	Inorganic & Physical Chemistry-II	60	-	4	-	4
DSC4	S21 CH 4.2	Inorganic & Physical Chemistry Practicals-II	60	-	-	4	2
OE-4	S21OE4.3	Microbial Biotechnology/Electrochemistry, corrosion and Metallurgy	45	3	-	-	3
SEC-VB	21VBC 4.1	Sports	30	-	-	2	1
SEC-VB	21VBC 4.2	NCC/NSS/Cultural	30	-	-	2	1
Total							26

B.Sc. (Chemistry & Microbiology) - Matrix for V Semester (w.e.f. 2021-22 onwards)

V Semester							
Code	Course Code	Course	Teaching Hours	Course Components			Credits
				L	T	P	
DSC5	S21 CHE5.1	Selected topics in Inorganic Chemistry	60	4	-	-	4
DSC5	S21 CHE5.2	Inorganic Chemistry Practical	60	-	-	4	2
DSC6	S21 CHE6.1	Selected topics in Organic Chemistry	60	4	-	-	4
DSC6	S21 CHE6.2	Organic Chemistry Practical	60	-	-	4	2
DSC5	S21 MB 5.1	Microbial Genetics and Molecular Biology – Theory	60	4	-	-	4
DSC5	S21 MB 5.2	Microbial Genetics and Molecular Biology – Practical	60	-	-	4	2
DSC6	S21 MB 6.1	Immunology and Medical Microbiology – Theory	60	4	-	-	4
DSC6	S21 MB 6.2	Immunology and Medical Microbiology - Practical	60	-	-	4	2
SEC-SB	21SBC 5.1	R-Programming-A Practical Approach	45	1	-	2	2
Total							26

Note 1:

AECC- Ability Enhancement Compulsory Course

DSC - Discipline-Specific Course

OE- Open elective (course offered by the department to students of other stream)

SEC - VB Skill Enhancement Course -Value Based

SEC - SB Skill Enhancement Course -Skill Based

B.Sc. (Chemistry & Microbiology) - Matrix for VI Semester (w.e.f. 2021-22 onwards)

VI SEMESTER							
Code	Course Code	Course	Teaching hours	Course Components			Credits
				L	T	P	
DSC7	S21 CH 7.1	Selected topics in Physical Chemistry	60	4	-	-	4
DSC7	S21 CH 7.2	Physical Chemistry Practical	60	-	-	4	2
DSC8	S21 CH 8.1	Spectroscopy	60	4	-	-	4
DSC8	S21 CH 8.2	Analytical & Industrial Chemistry Practical	60	-	-	4	2
DSC7	S21 MB 7.1	Food and Dairy Microbiology-Theory	60	4	-	-	4
DSC7	S21 MB 7.2	Food and Dairy Microbiology-Practical	60	-	-	4	2
DSC8	S21 MB 8.1	Industrial Microbiology and Bioprocess Technology - Theory	60	4	-	-	4
DSC8	S21 MB 8.2	Industrial Microbiology and Bioprocess Technology - Practical	60	-	-	4	2
SEC- SB	21SBC 6.1	Professional & Business Communication	45	1	-	2	2
TOTAL							26

Note 1:

DSC - Discipline-Specific Course

OE- Open elective (course offered by the department to students of other stream)

DSE – Discipline-Specific Elective

SEC - SB Skill Enhancement Course -Skill Based

Exit Option with CERTIFICATE IN Chemistry (50 Credits)

AECC- Ability Enhancement Compulsory Courses

DSC- Discipline Specific Course

VBC- Value based Course

SEC- Skill Enhancement Course

DSE- Discipline Specific Elective

OE- Open Elective

**Continuous Internal Assessment – Scheme of Evaluation
For Theory Courses**
End Semester Examination: 60%
Continuous Internal Assessment: 40%

Activities (CIA: 40 Marks)	Proposed and Approved Scheme		Total Marks (40)
	IA-1	IA-2	
Session Test Maximum Marks	30	30	
1. Weightage (Marks)	10	10	20
2. Assignment (Marks)	20		20
i. Writing	10		
ii. Classwork	05		
iii. Classroom participation	05		
Total			40

**Continuous Internal Assessment – Scheme of Evaluation
For Practical Courses**
End-Semester Examination: 50%
Continuous Internal Assessment: 50%

CIA (25 marks) + End Semester Exam (25 marks)	
Maximum Marks (Internal Assessment)	25
1. Weightage (Marks)	15
2. Record work (Marks)	05
3. Viva	05
Total (Marks)	25

SEMESTER-I

S21CH1.1: Analytical and Organic Chemistry-I

Total Teaching Hours: 60 No. of Hours / Week: 4

CObj_ID	Course Objectives
CObj_1	The main objective is to provide to the students an in depth understanding of the basic concepts of chemical sciences.
CObj_2	To enable them with tools needed for the practice of chemistry, which remains a discipline with much stress on experimentation.
CObj_3	To provide a detailed knowledge of the terms, concepts, methods, principles and experimental techniques of chemistry.

CO_ID	Course Outcomes
CO_1	Learn the concepts of chemical analysis, accuracy, precision and statistical data treatment
CO_2	Prepare the solutions after calculating the required quantity of salts in preparing the reagents/solutions and dilution of stock solution.
CO_3	Know the concept of volumetric and gravimetric analysis and deducing the conversion factor for determination
CO_4	Handle toxic chemicals, concentrated acids and organic solvents and practice safety procedures.
CO_5	Understand the concepts of Organic reactions and techniques of writing the movement of electrons, bond breaking, bond forming

CO-PO Mapping

	PO_1	PO_2	PO_3	PO_4	PO_5	PSO_1	PSO_2	PSO_3	PSO_4	PSO_5
CO_1	X				X		X			
CO_2	X			X	X			X		
CO_3	X				X				X	
CO_4			X		X					X
CO_5	X	X			X	X				

Course Content-I Semester

S21CH1.1: Analytical and Organic Chemistry-I

S. No	Module title	Module Content	Number of Hours	Skills Developed
1	Unit -I	<u>Basic laboratory practices</u> Calibration of glassware (pipette, burette and volumetric flask), Sampling (solids and liquids), weighing, drying, dissolving, Acid treatment, Rules of work in analytical laboratory, General rule for performing quantitative determinations (volumetric and gravimetric), Safety in Chemical laboratory, Rules of fire prevention and accidents, First aid. Precautions to be taken while handling toxic chemicals, concentrated/fuming acids and organic solvents <u>Analytical chemistry:</u> Introduction, Role of analytical chemistry in the Sciences, Classification of Quantitative methods of analysis, steps in a typical quantitative analysis, selecting a method of analysis, sampling, preparing a laboratory sample, defining a replicate samples, preparing solutions of the samples, eliminating interferences, calibration and measurements, calculating results, evaluating results from estimating their reliability. <u>Errors in Chemical Analysis:</u> Definition of terms: Mean and Median, precision, accuracy, absolute error, relative error. Types of errors in experimental data: Systematic errors (source of systematic errors, instrument	15	Transferrable and Analytical Skills 1. EMP 2. SKD 3. EDP

		errors, method errors, personal errors). The effect of systematic errors: constant errors, proportional errors. Determination of systematic instrument and personal errors <u>Random errors in Analysis:</u> The nature of random errors, the statistically treatment of random errors(the sample and the population, properties of Gaussian curve, the sample standard deviation as a measure of precision, the reliability of S as a measure of precision, alternative terms for expressing the precision of samples of data) <u>The standard deviation of computed results:</u> The standard deviations of sums and differences, the standard deviation of products and quotients, the standard deviation in exponential calculations, the standard deviation of logarithms and antilogarithms. Numerical Problems		
2	Unit -2	<u>Acid-base titrimetry:</u> Titration curves for strong acid vs strong base, weak acid vs strong base and weak base vs strong acid titrations. Titration curves, Quantitative applications – selecting and standardizing a titrant, inorganic analysis - alkalinity, acidity. <u>Complexometric titrimetry:</u> Indicators for EDTA titrations - theory of metal ion indicators, titration methods employing EDTA - direct, back, displacement and indirect determinations, Application-determination of hardness of water. <u>Redox titrimetry:</u> Balancing redox equations, calculation of the equilibrium constant of redox reactions, titration curves, Theory of redox indicators, calculation of standard	15	Employable and Entrepreneurship Skills 1. EMP 2. SKD 3. EDP

		potentials using Nernst equation. Applications. Precipitation titrimetry: Titration curves, titrants and standards, indicators for precipitation titrations involving silver nitrate- Volhard's and Mohr's methods and their differences. Gravimetric Analysis: Requisites of precipitation, mechanism of precipitation, Factors influencing precipitation, Co-precipitation, post-precipitation, Advantages of organic reagents over inorganic reagents, reagents used in gravimetry (8-hydroxy quinoline (oxine) and dimethyl glyoxime (DMG)). Numerical problems on all the above aspects.		
3	Unit-3	Classification and nomenclature of organic compounds including bi functional, Hybridization, Shapes of organic molecules. Mechanisms of organic reactions: Breaking of a covalent bond, Homolytic fission and heterolytic fission, bond formation, difference between ionic and free radical reactions, reactions intermediates: free radicals, carbanions, carbonium ions. Classifications of reagents: electrophilic reagents (electrophiles), Nucleophilic reagents (Nucleophiles), comparison of electrophiles and nucleophiles. Types of organic reactions: substitution reactions, addition reactions, elimination reactions, rearrangements. Concept of activation energy and transition state. Reactions mechanism: concerted mechanism, non concerted mechanism.	15	Evaluation and Research Skills 1. EMP 2. SKD 3. EDP

		Mechanism of substitution reactions: Free radical substitution reactions, electrophilic substitution reactions, nucleophilic substitution reactions, unimolecular mechanism (SN1) bimolecular mechanism (SN2), comparison between SN1 and SN2 reactions. Mechanism of addition reactions: electrophilic addition reactions, nucleophilic addition reactions and free radical addition reactions. Mechanism of elimination reactions: α- elimination reactions, β-elimination. Bimolecular mechanism (E-2 reactions), Unimolecular mechanism (E-1 reactions) Aliphatic Hydrocarbons: Alkanes: Nomenclature of branched chain alkanes; Preparation: Corey-House synthesis, Wurtz reaction and Wurtz-Fittig reaction. Physical and chemical properties (Free radical substitution, Halogenation- relative reactivity and selectivity) and commercial importance. Difference between conformation and configuration. Conformations of ethane, propane and n-butane, explanation of stability based on Energy profile diagrams. Nomenclature of n-butane conformations using Klyne-Prelog terminology. Conformation and stability of 1,2-dichloroethane, ethylene glycol and acetaldehyde Cycloalkanes: Nomenclature, Method of formation. Explanation for stability based on heat of hydrogenation data. Baeyer's strain theory and stability of cyclopropane. Conformations of cyclohexane (Chair, twist boat, boat, half-chair and envelop forms and their stability). Geometrical isomerism with		

		examples. Cis and trans isomerism in 1,2-dimethylcyclopropane and 1,2-dimethylcyclohexane.		
4	Unit -4	Alkenes: Preparation of alkenes by dehydration of alcohols, dehydrohalogenation of alkyl halides, regio selectivity, Saytzeff rule and Hofmann eliminations. Reactions of alkenes: Addition of halides, hydrogen halides, water, markownikov's rule, antimarkownikov's addition(peroxide effect), oxymercuration, Hydroboration, oxidation with KMnO₄, Diels-Alder reaction. Alkynes: General methods of Preparation- dehydrohalogenation of vicinal and germinal dihalides and Higher alkynes from terminal alkynes. Reactions of alkynes: Electrophilic addition reactions, oxidation with KMnO₄, hydroboration-oxidation and hydrogenation and ozonolysis Arenes: Nomenclature: Mono, di and tri substituted benzenes, Aromaticity: Huckel's rule -application to benzenoid (benzene, naphthalene, anthracene and phenanthrene) and non-benzenoid (cyclopropenyl cation, cyclopentadienyl anion, tropylium cation) compounds, Anti-aromaticity, Homoaromaticity. Benzene: Molecular orbital picture and resonance energy. Preparation-from phenol, by decarboxylation, from acetylene, from benzene sulphonic acid. Mechanism of electrophilic substitution of benzene. Aromatic nucleophilic substitution via benzyne intermediate, Birch reduction, Side chain oxidation of toluene to benzaldehyde and benzoic acid. Polynuclear hydrocarbons: Naphthalene, Anthracene and phenanthrene- Preparations, resonance structures, oxidation of naphthalene,	15	Logical Skills/ creative thinking skills/ Analytical Skills 1. EMP 2. SKD 3. EDP

		anthracene and phenanthrene. Electrophilic and nucleophilic substitution reactions of Naphthalene and Anthracene. Diels-Alder reaction of anthracene with 1,2-dichloroethene. Alkenyl benzenes: Styrene, cis- and trans-stilbenes and their preparations. Biphenyl: Preparation-Ullmann reaction		

References

1. McMurry, J. E. *Fundamentals of Organic Chemistry*, 7th Ed. Cengage Learning India Edition, 2013
2. Morrison, R. N. & Boyd, R. N. *Organic Chemistry*, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education)
3. Organic Reaction mechanism by V. K. Ahluwalia and K. Parashar (Narosa Publishers).
4. Organic Chemistry by S. M. Mukherji, S. P. Singh and R. K. Kapoor. (Narosa Publishers).
5. Vogel's Textbook of Quantitative Chemical Analysis, J. Mendham, R.C. Denney, J.D.Barnes and M.J.K. Thomas, 6th edition, Third Indian Reprint, Pearson Education Pvt.Ltd.(2007).
6. Analytical Chemistry, G.D. Christian, 6th edition, Wiley-India (2007).

Course Content

SEMESTER-I

S21CH1.2: Analytical and Organic Practicals-1

Total Teaching Hours: 60 No. of Hours / Week: 4

CObj_ID	Course Objectives
CObj_1	To understand the uses of analytical methods in chemistry.
CObj_2	To establish an appreciation of the role of chemistry in qualitative and quantitative analysis.
CObj_3	To introduce different experiments to develop the skills and strategic approaches for organic synthesis and its purifications.

CO_ID	Course Outcomes
CO_1	Aware of methods of calibration of various glasswares.
CO_2	They will know the importance of purification of different chemicals
CO_3	Apply the organic synthetic strategies in multi-step synthesis
CO_4	Prepare organic compounds in an environmental friendly way
CO_5	Learn the qualitative and quantitative analysis of different chemicals

CO-PO Mapping

	PO_1	PO_2	PO_3	PO_4	PO_5	PSO_1	PSO_2	PSO_3	PSO_4	PSO_5
CO_1	X	X			X		X			X
CO_2	X	X		X	X			X		X
CO_3	X	X			X				X	X
CO_4		X	X		X					X
CO_5	X	X			X	X				X

S21CH1.2

Analytical and Organic Practicals-1

S. No	Module title	Module Content	Number of Hours	Skills Developed
I	PART-A Analytical Chemistry	1. Safety Practices in the Chemistry Laboratory, knowledge about common toxic chemicals and safety measures in their handling, cleaning and drying of glass wares. 2. Calibration of glassware, pipette, burette and volumetric flask. 3. Determination of sodium carbonate and sodium bicarbonate in a mixture. 4. Determination of alkali present in soaps/detergents 5. Determination of iron(II) using potassium dichromate 6. Determination of oxalic acid using potassium permanganate solution 7. Determination of Fe²⁺ as Fe₂O₃ Virtual Experiments 8. Standardization of EDTA solution and determination of hardness of water 9. Gravimetric estimation of Barium 10. Gravimetric estimation of Nickel	30	Analytical Skills 1. EMP 2. SKD 3. EDP

2	PART-B Organic Chemistry	11. Selection of suitable solvents for Purification/Crystallization of organic compounds. 12. Preparation of acetanilide from aniline using Zn/acetic acid (Green method). 13. Synthesis of p-nitro acetanilide from acetanilide using nitrating mixture. 14. Hydrolysis of methyl m-nitrobenzoate to m-nitrobenzoic acid (Conventional method) 15. Synthesis of diazoaminobenzene from aniline (conventional method). 16. Preparation of dibenzalacetone (Green method). 17. Diels Alder reaction between furan and maleic acid (Green method). 18. Virtual Experiments 19. Simple Distillation 20. Separation of Compounds by Column Chromatography 21. Detection of Functional Groups	30	Employability and Entrepreneurship Skills 1. EMP 2. SKD 3. EDP

Note: Questions from both sections should be given in each batch.

1. In the first 20 minutes the Teacher should discuss in detail the theory, principle, procedure and calculations
2. Instructions to be given for operating instruments, weighing chemicals and precautions while handling chemicals
3. The last 20 minutes the teacher is expected to solve related problems based on the experiments.

Text Books

1. Vogel's text book of Quantitative Chemical Analysis, 5th Edition, J. Bassett, G. H. Jeffery and J. Mendham, and R. C. Denny, Longman Scientific and Technical (1999).
2. Inorganic Semimicro Qualitative Analysis, V. V. Ramanujam; The National Pub. Co. (1974).
3. Practical Inorganic Chemistry, G. Marr and B. W. Rockett, Von Nostrand Reinhold Co., London (1972).
4. Laboratory manual of Organic Chemistry- B. B. Dey, M V Sitaraman and T R Govindachari, Allied Publishers, New Delhi, (1996).
5. Practical Organic Chemistry – Mann and Saunders, (1980).
6. Text Book of Practical Organic Chemistry- A. I. Vogel, (1996).
7. Test Book of Quantitative Organic Analysis- A. I. Vogel, (1996).

SEMESTER-I
S21OE1.3: CHEMISTRY IN DAILY LIFE

Total Teaching Hours: 45 No. of Hours / Week: 3

CObj_ID	Course Objectives
CObj_1	Visualize the importance of Chemistry in daily life.
CObj_2	Know about artificial sweetening agents and food preservatives.
CObj_3	Make students more aware of the chemical found in all aspects of daily life.

CO_ID	Course Outcomes
CO_1	Learn the constituents of milk and milk products and their analysis
CO_2	Students will learn about food adulterants and food additives and their analysis.
CO_3	Students will learn the concepts of manufacturing of soaps and detergents
CO_4	Students will learn the checking the purity of edible oils and will understand the importance of vitamins
CO_5	Students will learn about batteries and basic concepts of polymers

CO-PO Mapping

	PO_1	PO_2	PO_3	PO_4	PO_5	PSO_1	PSO_2	PSO_3	PSO_4	PSO_5
CO_1	X				X		X			X
CO_2	X		X	X	X			X		
CO_3	X				X	X			X	
CO_4			X		X		X			X
CO_5	X	X			X	X				

Course Content-I Semester

OE-1: S21OE1.3CHEMISTRY IN DAILY LIFE

S. No	Module title	Module Content	Number of Hours	Skills Developed
1	Unit -1	<u>Dairy Products:</u> Composition of milk and milk products. Analysis of fat content, minerals in milk and butter. Estimation of added water in milk. Beverages: Analysis of caffeine in coffee and tea, detection of chicory in coffee, chloral hydrate in toddy, determination of methyl alcohol in alcoholic beverages. <u>Food additives, adulterants, and contaminants-</u> Food preservatives like benzoates, propionates, sorbates, disulphites. Artificial sweeteners: Aspartame, saccharin, dulcin, sucralose, and sodium cyclamate. Flavors: Vanillin, alkyl esters (fruit flavors), and monosodium glutamate. <u>Artificial food colorants:</u> Coal tar dyes and non-permitted colors and metallic salts. Analysis of pesticide residues in food.	15	Employability and Entrepreneurship Skills 1. EMP 2. SKD 3. EDP
2	Unit -2	<u>Vitamins:</u> Classification and Nomenclature. Sources, deficiency diseases, and structures of Vitamin A1, Vitamin B1, Vitamin C, Vitamin D, Vitamin E & Vitamin K1. <u>Oils and fats:</u> Composition of edible oils, detection of purity, rancidity of fats and oil. Tests for adulterants like argemone oil and mineral oils. Halphen test. <u>Soaps & Detergents:</u> Definition, classification, manufacturing of soaps and detergents, composition and uses	15	Employability and Entrepreneurship Skills 1. EMP 2. SKD 3. EDP
3	Unit-3	<u>Chemical and Renewable Energy Sources:</u> Principles and applications of primary & secondary batteries and fuel cells. Basics	15	Employability and Entrepreneurship Skills

		of solar energy, future energy storer. Polymers: Basic concept of polymers, classification and characteristics of polymers. Applications of polymers as plastics in electronic, automobile components, medical fields, and aerospace materials. Problems of plastic waste management. Strategies for the development of environment-friendly polymers.		1. EMP 2. SKD 3. EDP

Text Books

1. B. K. Sharma: Introduction to Industrial Chemistry, Goel Publishing, Meerut (1998)
2. Medicinal Chemistry- Ashtoush Kar.
3. Analysis of Foods – H.E. Cox: 13.

References

1. Foods: Facts and Principles. N. Shakuntala Many and S. Swamy, 4thed. New Age International (1998)
2. Handbook on Fertilizer Technology by Swaminathan and Goswamy, 6th ed. 2001, FAI.

SEMESTER-II

S21CH2.1: Inorganic and Physical Chemistry-I

Total Teaching Hours: 60

No. of Hours / Week: 4

CO _{bj} _ID	Course Objectives
CO _{bj} _1	To understand the structure of the atom, shapes of different orbital's and properties of periodic table
CO _{bj} _2	To develop the ability to correlate the chemical and physical properties of elements and their compounds in the periodic table
CO _{bj} _3	An overview of close packing of metallic crystals, unit cell and crystal lattice, determination of surface tension, viscosity and refractive index of liquids. Colligative properties

CO_ID	Course Outcomes
CO_1	Students will learn the structure of an atom, electronic configuration. Schrodinger wave equation, Heisenberg's uncertainty principle, quantum numbers.
CO_2	Students will understand periodic properties of elements and their compounds.
CO_3	Students should be able to determine the difference between solids, liquids and gases.
CO_4	Students will be able to understand gas laws, theories and its application.
CO_5	Students will learn the physical properties of liquids and Colligative properties

CO-PO Mapping

	PO_1	PO_2	PO_3	PO_4	PO_5	PSO_1	PSO_2	PSO_3	PSO_4	PSO_5
CO_1	X				X		X			X
CO_2	X	X		X	X			X		
CO_3	X		X		X				X	
CO_4			X		X		X			X
CO_5	X	X			X	X			X	

Course Content-II Semester

S21CH2.1-Inorganic and Physical Chemistry-I

S. No	Module title	Module Content	Number of Hours	Skills Developed
1	Unit -1	<u>Atomic structure</u> Bohr's theory, its limitations and atomic spectrum of hydrogen atom. Wave mechanics: de Broglie equation, Heisenberg's Uncertainty Principle and its significance, Schrödinger's wave equation, significance of ψ and ψ^2. Quantum numbers and their significance. Normalized and orthogonal wave functions. Sign of wave functions. Radial and angular wave functions for hydrogen atom. Radial and angular distribution curves. Shapes of s, p, d and f orbitals. Contour boundary and probability diagrams. Pauli's Exclusion Principle, Hund's rule of maximum multiplicity, Aufbau's principle and its limitations- Electronic configurations of the elements (Z=1-30), effective nuclear charge, shielding/screening effect, Slater's rules. Variation of effective nuclear charge in Periodic Table.	15	Employability and Entrepreneurship Skills 1. EMP 2. SKD 3. EDP
2	Unit -2	<u>Periodic Table & Periodic Properties</u> s, p, d and f-block elements, the long form of periodic table. Detailed discussion of the following properties of the elements, with reference to s and p-block elements: (a) Atomic radii (van der Waals) (b) Ionic and crystal radii.	15	Employability and Entrepreneurship Skills 1. EMP 2. SKD 3. EDP

		(c) Covalent radii (d) Ionization enthalpy, successive ionization enthalpies and factors affecting ionization energy. Applications of ionization enthalpy. (e) Electron gain enthalpy, trends of electron gain enthalpy. (f) Electronegativity, Pauling's/ Mulliken's/ Allred Rachow's/ and Mulliken-Jaffé's electronegativity scales. Variation of electronegativity with bond order, partial charge, hybridization, group electronegativity. Trends in the chemistry of the compounds of groups 13 to 17 (hydrides, carbides, oxides and halides) are to be discussed		
3	Unit-3	Gaseous State Elementary aspects of kinetic theory of gases, Ideal and real gases. Boyle temperature (derivation not required), Molecular velocity, collision frequency, collision diameter, Collision cross section, collision number and mean free path and coefficient of viscosity, calculation of σ and η, variation of viscosity with temperature and pressure. Maxwell's Boltzmann distribution law of molecular velocities (Most probable, average and root mean square velocities). Relation between RMS, average and most probable velocity and average kinetic energies. (Mathematical derivation not required), law of equipartition of energy. Behaviour of real gases: Deviation from ideal gas behaviour.	15	Employability and Entrepreneurship Skills 1. EMP 2. SKD 3. EDP

		Compressibility factor (Z) and its variation with pressure for different gases. Causes of deviation from ideal behaviour, vander Waals equation of state (No derivation) and application in explaining real gas behaviour. Critical phenomena - Andrews isotherms of CO₂, critical constants and their calculation from van der Waals equation, Continuity of states, Law of corresponding states. Numerical problems. Liquid State Surface Tension: Definition and its determination using stalagmometer, effect of temperature and solute on surface tension Viscosity: Definition, Coefficient of viscosity. Determination of viscosity of a liquid using Oswald viscometer. Effect of temperature, size, weight, shape of molecules and intermolecular forces. Refraction: Specific and molar refraction- definition and advantages. Determination of refractive index by Abbe's Refractometer. Additive and constitutive properties. Parachor: Definition, Atomic and structure parachor, Elucidation of structure of benzene and benzoquinone. Viscosity and molecular structure. Molar refraction and chemical constitution. Numerical Problems.		
4	Unit -4	Dilute solutions- Review of colligative properties and concentration terms Determination of molecular mass of a solute by: (i) Berkeley-Hartley's method (Π); (ii) Beckmann's method (ΔT_f) and (iii) Landsberger's method. Numerical problems Distribution Law	15	Employability and Analytical Skills 1. EMP 2. SKD 3. EDP

		Nernst Distribution Law – Statement. Distribution constant, factors affecting distribution constant, validity of Distribution Law, Modification of distribution law when molecules undergo a) Association b) Dissociation. Application of Distribution Law in Solvent extraction. Nernst distribution law. Numerical Problems Solids Forms of solids: Unit cell and space lattice, anisotropy of crystals, size and shape of crystals, Laws of Crystallography: Law of constancy of interfacial angles, Law of rational indices, Law of symmetry (Symmetry elements), Crystal systems, Bravais lattice types and identification of lattice planes. Miller indices and its calculation, X-Ray diffraction by crystals: Bragg's law and derivation of Bragg's equation, Single crystal and powder diffraction methods. Defects in crystals, glasses and liquid crystals. Numerical problems.		

Text Books

1. Concise Inorganic Chemistry: J D Lee, 4th Edn, Wiley, (2021)
2. Atkins Physical Chemistry. 8th Edition. Peter Atkins & Julio De Paula Oxford University Press.
3. Principles of Physical Chemistry, Puri, Sharma & Pathania, Vishal Publishing Co.
4. Advanced Physical Chemistry, Gurdeep Raj, Goel Publishing House (2018)

References

1. Basic Inorganic Chemistry, F A Cotton, G Wilkinson and P. L. Gaus, 3rd Edition. Wiley. India
2. Physical Chemistry by Samuel Glasstone, ELBS (1982).
3. A Text Book of Physical Chemistry P.L.Soni , O.P. Dharmarhaand and U.N.Dash, Sultan Chand and Sons.

Course Content

SEMESTER-II S21CH2.2: Inorganic and Physical Practicals

Total Teaching Hours: 60

No. of Hours / Week: 4

CObj_ID	Course Objectives
CObj_1	To educate the methods of preparation of solutions different concentrations.
CObj_2	To measure different physical parameter like viscosity, surface tension.
CObj_3	To confidently make use of different apparatus in the laboratory

CO_ID	Course Outcomes
CO_1	Students will be confident in preparing various concentration of different solution.
CO_2	They will get expertise in analysis of real time samples.
CO_3	Students will understand acid- base, redox and precipitation reactions
CO_4	Students will be able to determine the molecular weight of unknown compounds by using walker –Lumsden and cryoscopic methods.
CO_5	Students will be aware of determining physical constants of different chemicals.

CO-PO Mapping

	PO_1	PO_2	PO_3	PO_4	PO_5	PSO_1	PSO_2	PSO_3	PSO_4	PSO_5
CO_1	X		X		X	X	X			X
CO_2	X			X	X	X		X		X
CO_3	X				X	X			X	X
CO_4			X		X	X				X
CO_5	X	X			X	X				X

S21CH2.2

Inorganic and Physical Practicals

S. No	Module title	Module Content	Number of Hours	Skills Developed
1	PART-A Inorganic Chemistry	TITRIMETRY 1. Determination of carbonate and hydroxide present in a mixture. 2. Determination of oxalic acid and sodium oxalate in a given mixture using standard $\text{KMnO}_4/\text{NaOH}$ solution 3. Standardization of potassium permanganate solution and determination of nitrite in a water sample 4. Determination of alkali content in antacids 5. Determination of chlorine in bleaching powder using iodometric method. 6. Virtual Experiments 7. Determination of concentration of Potassium Permanganate solution using Ferrous Ammonium sulphate 8. Standardization of silver nitrate and determination of chloride in a water sample 9. Soil Analysis-Determination of pH of soil.	30	Employability and Entrepreneurship Skills 1. EMP 2. SKD 3. EDP

2	PART-B Physical Chemistry	10. Determination of density using specific gravity bottle and viscosity of liquids using Ostwald's viscometer (Ethyl acetate, Toluene, Chloroform, Chlorobenzene or any other non-hazardous liquids) 11. Study of the variation of viscosity of sucrose solution with the concentration of a solute 12. Determination of the density using specific gravity bottle and surface tension of liquids using Stalagmometer (Ethyl acetate, Toluene, Chlorobenzene, any other non-hazardous liquids) 13. Study of variation of surface tension of detergent solution with concentration. 14. Determination of molar mass of non-electrolyte by Walker-Lumsden method 15. Determination of the composition of liquid mixture by refractometry. (Toluene & Alcohol, Water & Sucrose) 16. Determination of partition/distribution coefficient of Benzoic acid in water and toluene. Virtual Experiments 17. Determination of molar mass of a non-volatile solute by cryoscopic method 18. Determination of viscosity average molecular weight of a polymer 19. Determination of partition coefficient of Iodine between water and carbon tetrachloride	30	Employability and Entrepreneurship Skills 1. EMP 2. SKD 3. EDP

Note:

1. Questions from both sections should be given in each batch.
2. In the first 20 minutes the Teacher should discuss in detail the theory, principle, procedure and calculations
3. Instructions to be given for operating instruments, weighing chemicals and precautions while handling chemicals
4. The last 20 minutes the teacher is expected to solve related problems based on the experiments.

References

1. Findlays practical physical chemisty revised by P. B. Levitt, Longman's London (1966).
2. Experiments in Physical Chemistry by Shoemaker and Garland, McGraw Hill International Edn. (1966)
3. Advanced Practical Physical Chemistry by J. B. Yadav, Goel Publications Meerut (1988)
4. Senior Practical Physical Chemistry by B. C. Kosla, Simla Printers New Delhi (1987)
5. Experimental Physical Chemistry by Daniel et al., McGraw Hill, New York (1962).
6. Vogel's Text book of Qualitative Chemical Analysis, J. Bassett, G. H. Jeffery and J. Mendham, ELBS (1986).
7. Vogel's text book of Quantitative Chemical Analysis, 5th Edition, J. Bassett, G. H. Jeffery and J. Mendham, and R. C. Denny, Longman Scientific and Technical (1999).
8. Inorganic Semimicro Qualitative Analysis, V. V. Ramanujam; The National Pub. Co. (1974).
9. Practical Inorganic Chemistry, G. Marr and B. W. Rockett, Von Nostrand Reinhold Co., London (1972).

SEMESTER–II
S21OE2.3: Molecules of Life

Total Teaching Hours: 45 No. of Hours / Week: 3

CObj_ID	Course Objectives
CObj_1	Draw the basic structures and classification of biomolecules.
CObj_2	The physiological action of biomolecules in the body.
CObj_3	Concepts of bioenergetics

CO_ID	Course Outcomes
CO_1	The students will learn about the chemical structures of carbohydrate, and their structural and metabolic role in cellular system
CO_2	The students will learn about structure and function of lipids.
CO_3	They will also learn about primary, secondary, tertiary, quaternary structure of proteins, and composition, functions.
CO_4	The students will understand about the structure and function of nucleosides and nucleotides.
CO_5	They will also learn energy transformation in biological system.

CO-PO Mapping

	PO_1	PO_2	PO_3	PO_4	PO_5	PSO_1	PSO_2	PSO_3	PSO_4	PSO_5
CO_1	X				X		X			
CO_2	X			X	X			X		
CO_3	X				X	X	X	X	X	X
CO_4			X		X					X
CO_5	X	X			X	X				

Course Content-II Semester

S21OE2.3: Molecules of Life

S. No	Module title	Module Content	Number of Hours	Skills Developed
1	Unit -1	<u>Carbohydrates</u> Classification of carbohydrates, reducing and non-reducing sugars, General properties of glucose and fructose, their open chain structures. Epimers, mutarotation and anomers. Linkage between monosaccharides, structure of disaccharides (sucrose, maltose, lactose) and polysaccharides (starch and cellulose) excluding their structure elucidation. Carbohydrates as a source of energy <u>Amino Acids, Peptides and Proteins</u> Classification of amino acids, Zwitter ion structure and Isoelectric point. Peptides: structure and conformation, example and function of biologically important Peptides. Proteins: Classification based on composition, shape and function with examples. Overview of Primary, Secondary, Tertiary and Quaternary structure of proteins. Importance of primary structure by taking sickle cell anemia as example. Determination of primary structure of peptides. Denaturation of proteins;, Renaturation of proteins.	15	Employability Skills 1. EMP 2. SKD 3. EDP
2	Unit -2	Enzymes and correlation with drug action Brief Introduction, Nomenclature (E.C. No. upto 2nd digit) and	15	Employability and Entrepreneurship Skills 1. EMP

		classification of enzymes, Effect of pH and temperature. Enzyme specificity and theories-Lock and key model, induced fit theory. Active site and its characteristics, Mechanism of enzyme action, factors affecting enzyme action, Co-enzymes and cofactors and their role in biological reactions, Specificity of enzyme action (including stereo specificity), Enzyme inhibitors and their importance, phenomenon of inhibition (Competitive and Noncompetitive inhibition including allosteric inhibition). Drug action-receptor theory. Structure–activity relationships of drug molecules, binding role of –OH group, -NH₂ group, double bond and aromatic ring. Lipids Introduction to lipids, classification. Biological importance of triglycerides, phospholipids, glycolipids, and steroids (cholesterol).Oils and fats: Common fatty acids present in oils and fats, Omega fatty acids, Trans fats, Hydrogenation, Rancidity of oils. Triglycerides:: Biological importance of triglycerides. Saponification, saponification value and its significance, Unsaturation in acyl glycerols- iodine number and iodine number of different oils. Prostaglandins: definition and example, biological role of prostaglandins in general, Waxes: definition, types, biological importance. Lipoproteins: Types and functions, clinical significance.	2. SKD 3. EDP

3	Unit-3	<u>Nucleic Acids</u> Components of nucleic acids: Adenine, guanine, thymine and cytosine (Structure only), other components of nucleic acids, Nucleosides and nucleotides (nomenclature), Structure of polynucleotides; Structure of DNA (Watson-Crick model) and RNA (types of RNA), Genetic Code, -(general features and about Central dogma of Molecular biology) Biological roles of DNA and RNA: Replication, Transcription and Translation. Physico- chemical properties of nucleic acids - effect of alkali, acid and heat (denaturation and renaturation), Mutation Mutagens- chemical and physical, Molecular basis of mutation: spontaneous and induced mutations. Types of mutation <u>Concept of Energy in Bio systems</u> Calorific value of food. Standard caloric content of carbohydrates, proteins and fats. Oxidation of foodstuff (organic molecules) as a source of energy for cells. Introduction to Metabolism (catabolism, anabolism), ATP: the universal currency of cellular energy, ATP hydrolysis and free energy change. Conversion of food into energy. Outline of catabolic pathways of Carbohydrate- Glycolysis, Fermentation, and Krebs Cycle. Overview of catabolic pathways of Fats and Proteins. Interrelationships in the metabolic pathways of Proteins, Fats and Carbohydrates. Introduction to bioenergetics, stages of energy transformation- Photosynthesis respiration and utilization of energy. Exergonic and	15	Employability and Entrepreneurship Skills 1. EMP 2. SKD 3. EDP

		endergonic reactions. standard free energy change.		

References

1. Morrison, R. T. & Boyd, R. N. *Organic Chemistry*, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
2. A Text Book of Biochemistry, V. S. S. Rama Rao, UBSPD, 1998.
3. Concise Text Book of Biochemistry, T. N. Pattabhiraman, All India Publishers, 2000.
4. W. H. Freeman. Berg, J.M., Tymoczko, J.L. & Stryer, L. *Biochemistry*, 2002.

BSc Semester III –Chemistry (Hons)

S21CH3.1: Analytical and Organic Chemistry-II

Contact Hours: 60

Work load: 4 Hours/Week.

Credit Points :4

Evaluation: Continuous Internal Assesment-40 MarksSemester End

Examination -60 Marks

CObj_ID	Course Objectives
CObj_1	Interrelationship among frequency, wavelength and wave number and importanceof validation parameters of an instrumental method will be taught .
CObj_2	Principle, instrumentation and applications of spectrophotometry, nephelometryand turbidometry will be taught .
CObj_3	Fundamentals of separation methods and principles of paper, thin layer and columnchromatography will be taught
CO_ID	Course Outcomes
CO_1	Understand the importance of fundamental law and validation parameters inchemical analysis
CO_2	Know how different analytes in different matrices (water and real samples) can be determined by spectrophotometric, nephelometric and turbidimetric methods.
CO_3	Fundamentals of separation methods and principles of paper, thin layer and columnchromatography will be taught
CO_4	Principle and mechanism of ion-exchange, types of resins and domestic and industrial applications of ion-exchange chromatography will be taught
CO_5	Apply solvent extraction method for quantitative determination of metal ions indifferent samples

CO-PO Mapping

	PO_1	PO_2	PO_3	PO_4	PO_5	PSO_1	PSO_2	PSO_3	PSO_4	PSO_5
CO_1	X				X		X			
CO_2	X			X	X			X		
CO_3	X				X	X	X	X	X	X
CO_4			X		X					X
CO_5	X	X			X	X				

Semester III

S21CH3.1: Analytical and Organic Chemistry-II

Contact Hours: 60

Work load: 4 Hours/Week.

S. No	Module title	Module Content	Number of Hours	Skills Developed
1	Unit -1	Quantitative analysis-Instrumental methods Electromagnetic spectrum, absorption of electromagnetic radiation, Definition and units of frequency, wavelength, wave number, Beer's law, Beer-Lambert law derivation, deviations from Beer's law, limitations, construction of calibration graph (Plot of absorbance versus concentration), Evaluation Procedures- standard addition, Internal standard addition, validation parameters-detection limits, sensitivity, dynamic/linearity range, Instrumentation, single beam and double beam spectrophotometers, quantitative applications of colorimetry (determination of Fe, Mo, Cu, Ti and PO₄³⁻) and numerical problems on application of Beer's law. Nephelometry and Turbidimetry: Introduction, principle, instrumentations of nephelometry and turbidimetry; effects of concentration, particle size and wavelength on scattering; choice between nephelometry, applications of nephelometry and turbidimetry (determination of SO₄²⁻ and PO₄³⁻)	15	Employable Skills 1. EMP 2. SKD 3. EDP
2	Unit -2	Separation methods Fundamentals of	15	Employable Skills and analytical Skills

		chromatography: General description, definition, terms and parameters used in chromatography, classification of chromatographic methods, criteria for selection of stationary and mobile phase and nature of adsorbents. Principles of paper, thin layer, column chromatography. Column efficiency, factors affecting the column efficiency, van Deemter's equation and its modern version. Paper chromatography: Theory and applications Thin layer chromatography (TLC): Mechanism, R_f value, efficiency of TLC plates, methodology–selection of stationary and mobile phases, development, spray reagents, identification and detection, qualitative applications. 4 hrs Solvent Extraction: Types- batch, continuous, efficiency, selectivity, distribution coefficient, Nernst distribution law, derivation, factors affecting the partition, relationship between % extraction and volume fraction, Numerical problems on solvent extraction. Solvent extraction of iron and copper. 4 hrs Ion exchange chromatography: resins, types with examples- cation exchange and anion exchange resins, mechanism of cation and anion exchange process and applications of ion-exchange chromatography (softening of hard water, separation of lanthanides, industrial applications).		1. EMP 2. SKD 3. EDP

3	Unit-3	Reaction Intermediates: Generation, Stability and Reactions of, Carbocations: Dienone-phenol; and Pinacol-Pinacolone Rearrangement. Carbanions: Perkin Reaction, Aldol condensation, Claisen-Schmitt condensation. Free Radicals: Sandmeyer Reaction Carbenes and Nitrenes: Singlet and Triplet states, their relative stability and reactions Arynes: Formation, detection etc. 9 hrs Methods for Identifying Reaction Mechanism: analysis, Isolation and Identification of Intermediates, Stereochemical Evidences, Effect of Catalyst, Crossover experiments, Isotopic studies, Kinetic Studies. Product analysis, Isolation and Identification of Intermediates, Stereochemical Evidences, Effect of Catalyst, Crossover experiments, Isotopic studies, Kinetic Studies.	15	Employable Skills 1. EMP 2. SKD 3. EDP
4	Unit-4	Stereochemistry of Organic Compounds: Fischer projection, Newmann and Sawhorse projection formulae and their interconversions. Geometrical isomerism: Cis-trans and syn-anti isomerism, E/Z notations with C.I.P rules. Optical Isomerism: Optical activity, Specific rotation, Chirality/Asymmetry, Enantiomers, Molecules with two or more chiral centres, Diastereoisomers, meso structures, Racemic mixtures and Resolution,	15	Employable Skills 1. EMP 2. SKD 3. EDP

		Relative and absolute configuration, D/L and R/S designations		

References:

- 1) Fundamental of Analytical Chemistry, D.A. Skoog, D.M. West, Holler and Crouch, 8th edition, Saunders College Publishing, New York (2005).
- 2) Analytical Chemistry, G.D. Christian, 6th edition, Wiley-India (2007).
- 3) Vogel's Textbook of Quantitative Chemical Analysis, J. Mendham, R.C. Denney, J.D. Barnes and M.J.K. Thomas, 6th edition, Third Indian Reprint, Pearson Education Pvt. Ltd. (2007).
- 4) Organic Reaction Mechanism by V.K. Ahluwalia and R.K. Parashar (Narosa Publishers)
- 5) Organic Chemistry by S.M. Mukherji, S.P. Singh and R.K. Kapoor (Narosa Publishers)
- 6) Morrison R.N and Boyd R.N, Organic Chemistry, Darling Kindersley (India) Pvt. Ltd. (Pearson Education)
- 7) Finar I.L, Organic Chemistry (Volume I); Finar I.L (Volume II) Stereochemistry and the Chemistry of Natural Products., Dorling Kindersley (India) Pvt. Ltd. (Pearson Education)
- 8) Kalsi P.S. Stereochemistry, conformation and Mechanism, New age International
- 9) Eliel E.L and Wilen S.H, Stereochemistry of Organic Compounds, Wiley, (London)

B.Sc Semester III
S21CH3.2-Analytical & Organic Chemistry Practicals
Credit Points: 2 **Teaching Hours:4 hrs**

Course Objectives

CObj_ID	Course Objectives
CObj_1	To impart skills related to preparation of stock and working solutions and handling of instrumental methods.
CObj_2	To know the principle of colorimetric analysis and construction of calibration plot.
CObj_3	To understand the chemistry involved in colorimetric determination of metal ions and anion.

CO_ID	Course Outcomes
CO_1	Understand the importance of instrumental methods for quantitative applications.
CO_2	Apply colorimetric methods for accurate determination of metal ions and anions in water or real samples (real samples) can be determined by spectrophotometric, nephelometric and turbidimetric methods.
CO_3	Learn the importance of qualitative tests in identifying functional groups
CO_4	Learn how to prepare a derivative for particular functional groups and how to purify it'.
CO_5	Understand how functional groups in a compound are responsible for its characteristic property.

CO-PO Mapping

	PO_1	PO_2	PO_3	PO_4	PO_5	PSO_1	PSO_2	PSO_3	PSO_4	PSO_5
CO_1	X		X		X	X	X			X
CO_2	X			X	X	X		X		X
CO_3	X				X	X			X	X
CO_4			X		X	X				X
CO_5	X	X			X	X				X

B.Sc Semester III
S21CH3.2-Analytical & Organic Chemistry Practicals
Credit Points: 2 **Teaching Hours:4 hrs**

S. No	Module title	Module Content	Number of Hours	Skills Developed
I	PART-A Analytical Chemistry	Colorimetric determination of copper using ammonia solution Colorimetric determination of iron using thiocyanate solution Colorimetric determination of nickel using DMG solution Colorimetric determination of titanium using hydrogen peroxide Colorimetric determination of nitrite in a water sample (diazo coupling Reaction/Griess reagent) Colorimetric determination of phosphate as ammonium phosphomolybdate Determination of R_f values of two or three component systems by TLC Separation of different metal ions by paper chromatography/ Solvent extraction of iron using oxine solution (demonstration)	30	Analytical Skills 1. EMP 2. SKD 3. EDP

2	PART-B Physical Chemistry	PART-B (Organic Chemistry) Qualitative analysis of bifunctional Organic compounds such as 1) Salicylic acid, p-Nitro benzoic acid, Antranilic acid, p-Chloro benzoic acid 2) o-Cresol, p-Cresol, Resorcinol, o- Nitrophenol, p-nitrophenol 3) o-Nitro aniline, p-Nitroaniline, p-Toluidine, p-Chloroaniline, p-Bromoaniline, 4) Ethyl Salicylate, Salicylaldehyde, Acetophenone, p-Dichlorobenzene, p-Nitro toluene, Benzamide etc. (Atleast 6-8 compounds to be analysed in a semester)	30	Research Skills

References

- 1) Vogel's Textbook of Quantitative Chemical Analysis, J. Mendham, R.C. Denney, J.D. Barnes and M.J.K. Thomas, 6th edition, Third Indian Reprint, Pearson Education Pvt.Ltd.(2007)
- 2) Vogel's Text Book of Qualitative Chemical Analysis, ELBS

Semester III

Open Elective-3:S21OE3.3

Title of the Course :ATOMIC STRUCTURE, BONDING AND CONCEPTS IN ORGANIC CHEMISTRY

**Contact Hours: 45
week**

Workload: 3 hours per

Credit Points: 3

CObj_ID	Course Objectives
CObj_1	To develop an understanding of principles of atomic structure.
CObj_2	To know the importance of quantum numbers, writing of electronic configurations and representation of orbitals.
CObj_3	To develop an understanding of the periodic trends.

CO_ID	Course Outcomes
CO_1	The concept of atomic structure, significance of quantum numbers, filling of electrons of atoms/ions in various orbitals as per rules the trends in periodic properties .The formation of sigma and pi bonds and the bond strength.
CO_2	Tthe structures of ionic solids, applications of B-H cycle, solubility of compounds and consequences of polarization of ions.
CO_3	The construction of MO energy level diagrams and prediction of properties of molecules/ions like bond order, bond energies, bond lengths and magnetic properties.
CO_4	The shapes of molecules/ions based on VSEPR theory.
CO_5	To develop an understanding of the periodic trends.

S. No	Module title	Module Content	Number of Hours	Skills Developed
1	Unit -1	Atomic Structure and Pperiodic Properties History of an atom. Idea of de Broglie matter waves. Heisenberg uncertainty principle. Schrödinger wave equation, significance of wave functions, Bohr's model of hydrogen atom and its limitations. Quantum numbers and their importance, atomic orbitals and shapes of s, p, d orbitals, multi-electron atoms, Aufbau's and Pauli exclusion principle and Hund's multiplicity rule- Electronic configurations of the elements (atomic no. up to 30), effective nuclear charge and shielding Periodic Properties Atomic radius, Covalent, ionic and van der Waal radii-explanation with examples. Definition and periodicity of the following properties - ionic radii, ionization potential, electron affinity and electronegativity, methods of determination of electronegativity. Factors affecting the values of ionization energy.	15	Employable Skills 1. EMP 2. SKD 3. EDP
2	Unit -2	Ionic Solids– Ionic structures (NaCl, CsCl, TiO₂, ZnS), radius ratio rule and coordination number, limitation of radius	15	Employable Skills 1. EMP

		ratio rule, lattice energy and Born-Haber cycle, solvation energy and solubility of ionic solids, polarizing power and polarizability of ions, Fajan's rule and their consequences. Covalent Bond – Valence bond theory and its limitations, directional characteristics of covalent bond, various types of hybridization with examples and shapes of simple inorganic molecules and ions. Shapes of NH₃, I₃⁺, I₃⁻, SF₄, ClF₃, IF₅, ICl₂⁻ and H₂O using valence shell electron pair repulsion (VSEPR) theory, linear combination of atomic orbitals (LCAO), bonding, nonbonding and antibonding molecular orbitals, physical picture of bonding and antibonding wave functions. Applications of MO theory to explain the stability of homo dinuclear (He₂, N₂, O₂, F₂, C₂) and hetero binuclear (NO and CO) molecules. Comparison of M.O. and V.B. Models. Metallic bond-free electron, Band theory-electrical properties of metals, semiconductors and insulators. Weak interactions – Hydrogen bonding and its consequences, van der Waals forces.		2. SKD 3. EDP
3	Unit-3	Bonding and molecular structure and hydrocarbons Bonding and molecular structure: Introduction to organic chemistry, atomic	15	Employable Skills 1. EMP 2. SKD 3. EDP

		orbitals, sigma and pi bond formation-molecular orbital [MO] method, sp, sp² and sp³ hybridization, bond length, bond dissociation energies and bond angles (open chain and cyclic compounds). Electronegativity and polarity of the bonds. Classification and reactions of organic compounds (with examples). Aliphatic Hydrocarbons: Alkanes, Alkenes and Alkynes Definition, Nomenclature, preparations (any two methods) Reactions: Electrophilic, nucleophilic and free radical addition reactions Alicyclic compounds: Nomenclature, preparation and stability of cyclopropane, cyclobutane, Cyclopentane and cyclohexane.		

Reference Books:

1. J. D. Lee Concise Inorganic Chemistry, ELBS, 1996.
2. A. K. Das Fundamental Concepts of Inorganic Chemistry, CBS; 2nd edition (2019)
3. James E. Huheey, Ellen A. Keiter, Richard L. Keiter Inorganic Chemistry: Principles of Structure and Reactivity, Pearson Education India; 4th edition (2006)
4. Shriver, D.F. & Atkins, P.W =Inorganic Chemistry, Oxford University Press (2009)
5. Morrison and Boyd Organic Chemistry Sixth Edition by Pearson Education India; 7th edition (2010)
6. I.L. Finar Organic Chemistry Vol. 1 Pearson Education India; 6th edition (2002)

B.Sc-CHEMISTRY IV SEM

S21CH4.1-: Inorganic and Physical Chemistry-II

Contact Hours: 60

Work load: 4 Hours/Week.

Credit Points: 4

**Evaluation: Continuous Internal Assesment-40 Marks Semester End
Examination -60 Marks**

CObj_ID	Course Objectives
CObj_1	Different types of bonding in molecules/compounds/ions Properties of compounds based on bonding and structure
CObj_2	Electrochemistry dealing with electrolytes in solution.
CObj_3	Properties of compounds based on bonding and structure.

CO_ID	Course Outcomes
CO_1	Predict the nature of the bond formed between different elements
CO_2	Identify the possible type of arrangements of ions in ionic compounds
CO_3	Relate different energy parameters like, lattice energy, entropy, enthalpy and solvation energy in the dissolution of ionic solids
CO_4	Explain covalent nature in ionic compounds
CO_5	To develop an understanding of the periodic trends

CO-PO Mapping

	PO_1	PO_2	PO_3	PO_4	PO_5	PSO_1	PSO_2	PSO_3	PSO_4	PSO_5
CO_1	X		X		X	X	X			X
CO_2	X			X	X	X		X		X
CO_3	X				X	X			X	X
CO_4			X		X	X				X
CO_5	X	X			X	X				X

B.Sc-CHEMISTRY IV SEM**S21CH4.1:- Inorganic and Physical Chemistry-II**

S. No	Module title	Module Content	Number of Hours	Skills Developed
1	Unit -1	Structure and Bonding -I The ionic bond: Structures of ionic solids Radius ratio rules, Calculation of some limiting radius ratio values, Coordination number 3 (planar triangle), Coordination number 4 (tetrahedral and square planar), Coordination number 6 (octahedral), Close packing. Classification of ionic structures: Ionic compounds of the type AX (ZnS, NaCl, CsCl) Ionic compounds of the type AX₂ (Calcium fluoride (fluorite) and Rutile structure Layer structures CdI₂, Cadmium iodide structure Limitations of radius ratio concept. Lattice energy and Born-Haber cycle, Derivation of Born-Lande equation and its drawbacks, Kapustinskii equation, solvation energy and solubility of ionic solids, polarizing power and polarizability, Fajan's rules with applications. Numerical problems Covalent bond: Valence bond theory, The Lewis theory, The octet rule, Exceptions to the octet rule, Sidgwick- Powell theory. Valence shell electron pair repulsion (VSEPR)	15	Employable Skills 1. EMP 2. SKD 3. EDP

		theory, Effect of lone pairs, electronegativity, isoelectronic principle, Examples using VSEPR theory: BF_3 and BF_4^- , NH_3 and NH_4^+ , H_2O , PCl_5 , ClF_3 , SF_4 , I_3^- and I_3^+ , SF_6 , and IF_7 . Limitations of VSEPR		
2	Unit -3	Structure and Bonding -II Concept of resonance, resonance energy, hybridisation, types of hybridization, sp, sp^2, sp^3 dsp^2 dsp^3, d^2sp^3, sp^3d^2 with one example each, and energetics of hybridization. Bent's rule, Limitations of Valence Bond Theory. 4 hrs Molecular Orbital theory: LCAO concept: s-s, s-p, p-p, p-d and d-d combinations of orbitals, bonding, nonbonding and antibonding molecular orbitals, non-bonding combinations of orbitals, Rules for linear combination of atomic orbitals Examples of molecular orbital treatment for homonuclear diatomic molecules H_2 molecule, H^+ He_2 molecule, He^+ molecule ion, Li_2 molecule Be_2 molecule B_2 molecule, C_2 molecule, N_2 molecule, N_2^+, O_2 molecule O_2^- molecule, O_2^{2-} and O_2^--M.O. energy diagrams of heteronuclear diatomic molecules with examples (NO, NO^+ CO and HCl). Calculation of bond order, relationship between bond order,		Employable Skills 1. EMP 2. SKD 3. EDP

		bond energy and bond length, magnetic properties based on MOT. Metallic Bonding: General properties of metals: Conductivity, Lustre, Malleability and cohesive force Crystal structures of metals and Bond lengths Theories of bonding in metals: Free electron theory, Valence bond theory, Molecular orbital or band theory of solids Prediction of conducting properties of conductors, insulators and semiconductors, extrinsic and intrinsic semiconductors using M.O. theory		
3	Unit -3	First Law of Thermodynamics- Thermodynamic Processes, Reversible and Irreversible Processes, Nature of Heat and Work, Internal Energy, First Law of Thermodynamics, Enthalpy of a System, Work done in isothermal and adiabatic expansion of an ideal gas, Numerical problems, Joule -Thomson Expansion, Relation between Joule-Thomson coefficient and other thermodynamic parameters Second law of Thermodynamics Concept of entropy,	15	Employable Skills 1. EMP 2. SKD 3. EDP

		thermodynamic scale of temperature, Statements of the Second Law of Thermodynamics, molecular and statistical interpretation of entropy, Calculation of entropy change for reversible and irreversible processes, Free Energy Functions: Gibbs and Helmholtz energy, Variation of S, G, A with T, V and P, Numerical problems, Free energy change and spontaneity, Gibbs-Helmholtz equation. Third Law of Thermodynamics Statement of third law, concept of residual entropy, calculation of absolute entropy of molecules. Types of Catalysis and theories with examples (intermediate compound theory and adsorption theory), Theory of acid base catalysis, Michaelis-Menten mechanism. Catalysis Heterogeneous catalysis: surface reactions, unimolecular, bimolecular surface reactions. Autocatalysis with examples. Applications: Design process to removal of toxic compounds from industrial wastewater and treatment of portable water requirements		
4	Unit-4	Chemical Kinetics Differential and integrated form of rate expressions up to second order reactions, Derivation of expression of rate constant of second order reaction ($a=b$ and $a \neq b$), Problems on rate constant ($a=b$), Methods of determination of order of a	15	Employable Skills 1. EMP 2. SKD 3. EDP

		reaction, temperature dependence of reaction rates; Arrhenius equation, activation energy, Numerical problems on Arrhenius equation in calculating energy of activation and rate constants. Collision theory of reaction rates, Lindemann's mechanism, qualitative treatment of the theory of absolute reaction rates. Experimental determination of kinetics of (i) inversion of cane sugar by polarimetric method (ii) spectrophotometric method for the reaction between potassium persulphate and potassium iodide. Electrochemistry – I Arrhenius theory of electrolytic dissociation. Merits and Demerits, Conductance, Specific conductance, equivalent and molar conductivity and their variation with dilution. Molar conductivity at infinite dilution. Numerical problems. Kohlrausch's law of independent migration of ions and its applications, Debye-Hückel- Onsager equation. Ionic mobilities and their determinations, transference numbers and their relation to ionic mobility's, determination of transference numbers using Hittorf and Moving Boundary methods. Applications of conductance measurement: (i) degree of dissociation of weak electrolytes (ii) ionic product of water (iii) solubility and solubility product of sparingly soluble salts (iv) conductometric titrations (acid base titrations		

		only) and (v) Hydrolysis constants of salts. Numerical problems.		

Reference Books

1. Peter Atkins & Julio De Paula, Physical Chemistry, 9th Ed., Oxford University Press (2010)
2. G W Castellan, Physical Chemistry, 4th Ed., Narosa (2004)
3. R G Mortimer, Physical Chemistry 3rd Ed., Elsevier: Noida, UP (2009)
4. B R Puri, L R Sharma and M S Pathania, Principal of Physical Chemistry, Vishal Publishing Co.
5. B S Bahl, G D Tuli and Arun Bahl, Essentials of Physical chemistry, S Chand & Company Ltd.
6. A S Negi and S C Anand, A textbook of Physical Chemistry, New Age International Publishers.
7. B N Bajpai, Advanced Physical chemistry, S Chand and Company ltd.
8. R L Madan, Chemistry for Degree Students, Semester I, II, III and IV, S Chand and Company Ltd.
9. P L Soni, O P Dharmarha and U N Dash, Textbook of Physical Chemistry, Sultan Chand and Sons.

B.Sc-CHEMISTRY IV SEM

S21CH4.2: Inorganic and Physical Chemistry Practicals -II

Credit Points: 2

Teaching Hours: 4Hrs

Evaluation: Continuous Internal Assessment-20 marks Semester End

Examination: 30 marks

Course objectives:

CObj_ID	Course Objectives
CObj_1	Analytical skills in detecting the constituents present in unknown samples by systematically carrying out the qualitative analysis.
CObj_2	The methods of determining rates of chemical reactions.
CObj_3	Designing electrochemical cells and making measurements related to it.

CO_ID	Course Outcomes
CO_1	Understand the chemical reactions involved in the detection of cations and anions.
CO_2	Explain basic principles involved in classification of ions into groups in semi-microqualitative analysis of salt mixture
CO_3	Carryout the separation of cations into groups and understand the concept of commonion effect.
CO_4	Understand the choice of group reagents used in the analysis
CO_5	Analyse a simple inorganic salt mixture containing two anions and cations

CO-PO Mapping

	PO_1	PO_2	PO_3	PO_4	PO_5	PSO_1	PSO_2	PSO_3	PSO_4	PSO_5
CO_1	X		X		X	X	X			X
CO_2	X			X	X	X		X		X
CO_3	X				X	X			X	X
CO_4			X		X	X				X
CO_5	X	X			X	X				X

B.Sc-CHEMISTRY IV SEM**S21CH4.2: Inorganic and Physical Chemistry Practicals -II**

S. No	Module title	Module Content	Number of Hours	Skills Developed
I	PART-A Inorganic Chemistry Practicals	Qualitative semi-micro analysis of mixtures containing 2 anions and 2 cations. Emphasis should be given to the understanding of different reactions. The following cations and anions are suggested. Cations: NH_4^+, Pb^{2+}, Bi^{3+}, Cu^{2+}, Al^{3+}, Fe^{3+}, Co^{2+}, Cr^{3+}, Ni^{2+}, Zn^{2+}, Mn^{2+}, Ba^{2+}, Ca^{2+}, Sr^{2+}, Mg^{2+}, Na^+, K^+ and Li^+. Anions: CO_3^{2-}, CH_3COO^-, Cl^-, Br^-, I^-, NO_3^-, BO_3^{3-}, SO_4^{2-}, $\text{C}_2\text{O}_4^{2-}$ and PO_4^{3-}-Spot tests and flame tests to be carried out wherever possible.	30	Analytical skills 1. EMP 2. SKD 3. EDP

2	PART-B Physical Chemistry Practicals	1) Determination of the enthalpy of neutralization of a strong acid with strong base. 2) Verification of Freundlich and Langmuir isotherms for adsorption of acetic acid on activated charcoal. 3) The study of kinetics of potassium persulphate and potassium iodide volumetrically. 4) Determination of velocity constant for acid catalyzed hydrolysis of methyl acetate. 5) Determination of velocity constant for the saponification of ethyl acetate ($a = b$) volumetrically. 6) Determination of equivalent conductivity of strong electrolyte and verification of DHO equation. 7) Determination of dissociation constant of weak acid by conductivity method. 8) Conductometric titration of strong acid and strong base. 9) Conductometric titration of weak acid and strong base. 10) Determination of the hydrolysis constant of aniline hydrochloride conductometrically. 11) Determination of solubility product of sparingly soluble salt conductometrically	30	Analytical skills

References

1. Vogel's Qualitative analysis, Revised by G. Svehla, Pearson education, 2002
2. J B Yadav, Advanced Physical Chemistry, Krishna Prakashan Media (P) Ltd, Meerut.
3. Khosla, B. D.; Garg, V. C. & Gulati, A. Senior Practical Physical Chemistry, R. Chand & Co.: New Delhi (2011).
4. Garland, C. W.; Nibler, J. W. & Shoemaker, D. P. Experiments in Physical Chemistry 8th Ed.; McGraw-Hill: New York (2003).
5. Halpern, A. M. & Mc Bane, G. C. Experimental Physical Chemistry 3rd Ed.; W.H. Freeman & Co.: New York (2003).

B.Sc. Semester IV – B Sc / B. Sc. (Honors)

S21OE4.3: Electrochemistry, Corrosion and Metallurgy

Contact Hours: 42

Workload: 3 hours per week

Credit Points: 3

Evaluation: Continuous Internal Assessment

- 40 marks

Semester End Examination

- 60 marks

This course provides a broad introduction to the fundamental principles of Electrochemistry, Corrosion and Metallurgy. The student will gain an understanding of basic and practical applications in various fields of Electrochemistry, Corrosion and Metals and Alloy behaviour and manufacturing processes. This course is a valuable prerequisite for taking more technically challenging courses that will be required for career development

Course objective:

CObj_ID	Course Objectives
CObj_1	Types of conductance, concept of electrolytes, electrolysis, redox reactions and EMF
CObj_2	Concept of different types of electrochemical cells, Types of electrodes and electrodepotential. Application of electrochemical series.
CObj_3	Basic principles and applications of conductometric, potentiometric and pH titrations.

CO_ID	Course Outcomes
CO_1	Understand the concept of conductance in electrolytic solutions, electrolysis and redox reactions involved in electrode reactions.
CO_2	Learn the different types of electrochemical cells, their symbolical representation and application of electrochemical series.
CO_3	Apply conductometric, potentiometric and pH titrations.
CO_4	Know the principle, construction and working of batteries.
CO_5	Understand different types of corrosion and its prevention by different methods.

CO-PO Mapping

	PO_1	PO_2	PO_3	PO_4	PO_5	PSO_1	PSO_2	PSO_3	PSO_4	PSO_5
CO_1	X		X		X	X	X			X
CO_2	X			X	X	X		X		X
CO_3	X				X	X			X	X
CO_4			X		X	X				X
CO_5	X	X			X	X				X

B.Sc. Semester IV – B Sc / B. Sc. (Honors)

S21OE4.3: Electrochemistry, Corrosion and Metallurgy

S. No	Module title	Module Content	Number of Hours	Skills Developed
1	Unit -1	Electrochemistry Conductance, specific and molar conductance Types of Electrolytes, Conductivity in electrolytic solution, Electrolysis, Kohlrausch's law and its application, Equivalent Conductance of Weak electrolyte at Infinite dilution. Oxidation -reduction reactions, electrode potential, EMF of an electrochemical cell, cell reaction, Daniel cell, dry Cells - electrolytic and Galvanic cell, Representation of a cell. Standard electrode potential, Nernst equation (No derivation) and its application to chemical cell, Electrochemical series and its importance. Types of Electrodes. Basic Principles of (i) Conductometric titrations- HCl Vs NaOH, CH₃COOH Vs NaOH (ii) Potentiometric titrations: Acid-base titration HCl Vs NaOH, Redox titration (FAS Vs K₂Cr₂O₇) Determination of PH using glass	15	Employable Skills 1. EMP 2. SKD 3. EDP

		electrode. Batteries- Primary and Secondary batteries, Battery components and their role. Working of the following Batteries- Lead acid, Lithium Storage, Batteries, Fuel cell		
2	Unit -2	Corrosion: Introduction, definition, Types of Corrosion, Corrosion rate, Factors affecting corrosion rate, Metallic factor-purity, electrode potential of metal, hydrogen over voltage, nature of corrosion product. Environmental Factors- Temperature, pH of the medium, humidity, presence of impurities, electrical conductivity of the medium, velocity of the medium, concentration of the medium. Prevention of Corrosion: Material selection - Metals and alloys, metal purification, non-metallic, Alteration of environment - Changing media, inhibitors, Design-wall thickness, design rules, Coating-Metallic and other inorganic coatings, organic coating. Electroplating: Introduction, Electroplating of chromium (hard and decorative). Electro less plating: Introduction, distinction between electroplating and electrodes plating processes. Electroless plating of copper.	15	Employable Skills 1. EMP 2. SKD 3. EDP

3	Unit -3	Metallurgy Introduction: Ore, minerals, important ores of some common elements in India, General Principles of pyro metallurgy, roasting, Calcination, Gangue, Smelting, Flux, Gravity separation, Froth flotation process, leaching. Techniques employed for Purification of metal (Distillation process, Bessemerization, Electro-refining, Van Arkel and De Boer's Filaments. Extraction of metals: Extraction of Manganese (Pyrolusite), Titanium (Ilmanite) and Uranium. Alloys: Introduction, Classification of alloys, commercially important alloys, gold karats, Production of Ferro alloys; Ferrochrome, Ferro Manganese, Uses of alloys.	15	Employable Skills 1. EMP 2. SKD 3. EDP

Reference Books

1. Barrow. G.M, Physical Chemistry, Tata McGraw-Hill, (2007)
2. An introduction to electrochemistry, Samuel Glasstone, East-West edition New Delhi, (1942)
3. Text book of physical chemistry, Samuel Glasstone, 2ndEdition, Mac Millan India Ltd,(1991)
4. Principles and applications of Electrochemistry, D. R. Crow, 3rd edition, ChapmanhallLondon, (1988)
5. Fundamentals of electrochemical deposition, Milan Paunovic and Mordechay Schlesinger, Wiley Interscience Publications, New York, (1998)
6. Engineering Chemistry, V R Kulkarni and K Ramakrishna Reddy, New Age International,(2015)

7. Electrochemistry and Corrosion Science, Nestor Perez, Springer (India) Pvt. Ltd., (2004)
8. Principles and Prevention of Corrosion, D. A. Jones, Macmillan Publ. Co., (1996)
9. Essential of Materials Science and Engineering, Donald R. Askeland, Thomson Learning, 5th Edition, (2006)
10. Introduction to Engineering Materials, B. K. Agarwal, Tata McGraw Hill, 1st Edition (2013)
11. Material Science and Engineering, V. Raghavan, PHI Learning, 5th Edition (2004)
12. Engineering Materials and Metallurgy, R. K. Rajput, S. Chand - 1st Edition, (2011)

B.Sc V Semester

S21CH5.1- (Selected topics in Inorganic chemistry)

Total teaching hours: 45

No. of hours/Week: 3

CObj_ID	Course Objectives
CObj_1	To explore in depth specialized areas of chemistry of materials, including ores, metals, acids and bases and to understand how metals are extracted from their ores.
CObj_2	Understand the trends in properties and reactivity of the s, p-block elements and noble gases
CObj_3	To become familiar with some of the roles of inorganic polymer and its applications in day to day life.
CO_ID	Course Outcomes
CO_1	Analyze fundamental aspects of main group chemistry, including trends in oxidation states, periodic properties and complex formation tendency.
CO_2	The resulting knowledge primarily serves the success of students pursuing research in the field of chemical metallurgy.
CO_3	To familiar with a variety of different methods for synthesizing inorganic materials and principles of inorganic polymer synthesis.
CO_4	Deduce the shape (geometry) of molecules using radius ratio rules & VSEPR theory.
CO_5	Draw MO diagrams for a few homo- & hetero-nuclear diatomic molecules and to calculate the bond order

CO-PO Mapping

	PO_1	PO_2	PO_3	PO_4	PO_5	PSO_1	PSO_2	PSO_3	PSO_4	PSO_5
CO_1	X		X		X	X	X			X
CO_2	X			X	X	X		X		X
CO_3	X				X	X			X	X
CO_4			X		X	X				X
CO_5	X	X			X	X				X

B.Sc V Semester

S21 CHE5.1 (Selected topics in Inorganic chemistry)

No. of teaching hrs: 60

Credits: 4

Sl. No	Unit title	Course Content	Number of Hours	Skills Developed
1	UNIT-1	1. General Principles of Metallurgy Chief modes of occurrence of metals based on standard electrode potentials. Ellingham diagrams for reduction of metal oxides Carbon and carbon monoxide as reducing agent. Electrolytic Reduction, Hydrometallurgy. Methods of purification of metals: Electrolytic Kroll process, Parting process, van Arkel- de Boer process and Mond's process, Zone refining.	15 hrs	Employable Skills Analytical Skills 1. EMP 2. SKD 3. EDP
2	UNIT-2	2.Acids and Bases Brönsted-Lowry concept of acid-base reactions, solvated proton, relative strength of acids ,types of acid-base reactions, leveling solvents, Lewis acid-base concept, Classification of Lewis acids, Hard and Soft Acids and Bases (HSAB) Application of HSAB principle.	15hrs	Analytical Skills 1. EMP 2. SKD 3. EDP

3	UNIT-3	3.Chemistry of s and p Block Elements: Inert pair effect, Relative stability of different oxidation states, diagonal relationship and anomalous behaviour of first member of each group. Allotropy and catenation. Complex formation tendency of s and p block elements. Hydrides and their classification ionic, covalent and interstitial. Basic beryllium acetate and nitrate. Study of the following compounds with emphasis on structure, bonding, preparation, properties and uses. Boric acid and borates, boron nitrides, borohydrides (diborane) carboranes and graphitic compounds, silanes, Oxides and oxoacids of nitrogen, Phosphorus and chlorine. Peroxo acids of sulphur, interhalogen compounds, polyhalide ions, pseudo halogens and basic properties of halogens.	15hrs	Evaluation and Synthesis Research Skills 1. EMP 2. SKD 3. EDP
4	UNIT-4	4.Noble Gases: Occurrence and uses, rationalization of inertness of noble gases, Clathrates; preparation and properties of XeF₂, XeF₄ and XeF₆; Nature of bonding in noble gas compounds (Valence bond treatment and MO treatment for XeF₂). Molecular shapes of noble gas compounds (VSEPR theory). 5. Inorganic Polymers: Types of inorganic polymers, comparison with organic polymers, synthesis, structural aspects and applications of silicones and siloxanes. Borazines, silicates and phosphazenes, and polysulphates.	8hrs 7hrs	Evaluation and Synthesis Research Skills Evaluation and Synthesis Research Skills 1. EMP 2. SKD 3. EDP

Reference Books:

- 1.Lee, J.D. *Concise Inorganic Chemistry*, ELBS,
- 2.Douglas, B.E; Mc Daniel, D.H. & Alexander, J.J. *Concepts & Models of Inorganic Chemistry 3rd Ed.*, John Wiley Sons, N.Y. 1994.

- 3.Greenwood, N.N. & Earnshaw. *Chemistry of the Elements*, Butterworth-
- 4.Cotton, F.A. & Wilkinson, G. *Advanced Inorganic Chemistry*, Wiley, VCH, 1999.
- 5.Miessler, G. L. & Donald, A. Tarr. *Inorganic Chemistry 4th Ed.*, Pearson, 2010.
- 6.Shriver & Atkins, *Inorganic Chemistry 5th Ed.* Heinemann. 1997.

SEMESTER–V

S21 CHE.5.2 -Lab-5: Inorganic Chemistry practicals

Total teaching hours: 60

Credits :2

CObj_ID	Course Objectives
CObj_1	After completion of this course students will be able to analyze the inorganic sample qualitatively. This will help students to work in some laboratory and find the chemical composition of an unknown inorganic compound or mixture
CObj_2	This course teach student to separate the inorganic ions from a mixture and analyze them quantitatively. The basic principle of chromatographic separating techniques is provided in this course and student will learn how to separate metal ions by paper chromatography
CObj_3	To expose students on radical analysis in inorganic mixtures; Determination of surface tension and viscosity of liquids.
CO_ID	Course Outcomes
CO_1	After successfully completing this course, students will be able to prepare the exact solutions for quantitative analysis of metal ions.
CO_2	Apply the knowledge of quantitative analysis for the determination of metals from ores/alloys
CO_3	Synthesize Inorganic complexes and also find their purity.
CO_4	Understand Ion-exchange chromatography for separation.
CO_5	Understand the principle and working of different instruments like colorimeter, conduct meter, spectrophotometer, etc

CO-PO Mapping

	PO_ 1	PO_ _2	PO_ 3	PO_ 4	PO_ 5	PSO_ 1	PSO_ 2	PSO_ 3	PSO_ 4	PSO_ 5
CO_1	X		X					X		
CO_2	X					X				
CO_3			X			X		X		
CO_4	X			X		X				X
CO_5		X		X			X			

V Semester

S21 CHE.5.2 -Lab-5: Inorganic Chemistry practicals

Total teaching hours: 60

No. of hours/Week: 4

S. No	Unit title	Course Content	Number of Hours	Skills Developed
1	PART-A Iodo / Iodimetric titrations	(i) Estimation of Cu(II) and $K_2Cr_2O_7$ using sodium thiosulphate solution (ii) Estimation of (i) arsenite and (ii) antimony in tartar-emetic iodimetrically (iii). Estimation of available chlorine in bleaching powder iodometrically.	30hrs	Employable Skills 1. EMP 2. SKD 3. EDP
2.	PART-B Inorganic preparations	(i) Cuprous Chloride, Cu_2Cl_2 (ii) Preparation of Manganese(III) phosphate, $MnPO_4 \cdot H_2O$ (iii) Preparation of Aluminium potassium sulphate $KAl(SO_4)_2 \cdot 12H_2O$ (Potash alum) or Chrome alum.		Employable Skills

Reference Books:

1. Vogel, A.I. A Textbook of Quantitative Inorganic Analysis, ELBS. 1978

B.Sc-V semester

S21 CHE.6.1- (Selected topics in Organic Chemistry)

Total teaching hours: 60 hrs

No. of hours/Week: 4

Credits : 4

CObj_ID	Course Objectives
CObj_1	Differentiate chiral and achiral molecules.
CObj_2	Identify the stereo centers in a molecule and assign the configuration as R or S
CObj_3	Know about the most important simple heterocyclic ring systems containing heteroatom and their systems of nomenclature and numbering.

CO_ID	Course Outcomes
CO_1	Elucidate structure of organic compounds with specific examples of terpenes and alkaloids by practical approach.
CO_2	Understand the applications of these compounds including their medicinal applications through their reaction chemistry.
CO_3	Learn about basic principles of UV, IR and NMR spectroscopic techniques to interpret the spectra to determine structure and stereochemistry of known and unknown compounds
CO_4	Develop a sound understanding of the fundamental concepts of stereochemistry
CO_5	Understand thoroughly the chemistry of compounds having nitrogen containing functional groups, heterocyclic, polynuclear hydrocarbons, alkaloids and terpenes which includes various methods for synthesis .

CO-PO mapping

	PO_1	PO_2	PO_3	PO_4	PO_5	PSO_1	PSO_2	PSO_3	PSO_4	PSO_5
CO_1		x				x				
CO_2	X					x			x	
CO_3				x				x		
CO_4		x					x			
CO_5		x		x		x		x		

B.Sc V Semester

S21 CHE.6.1 (Selected topics in Organic Chemistry)

Total teaching hours: 60hrs
Credits : 4

No. of hours/Week: 4

S. No	Unit title	Course Content	Number of Hours	Skills Developed
1	UNIT-1	Stereochemistry 12hours Elements of symmetry in chiral and achiral molecules, chirality, stereogenic centre. Fischer projection formulae. Enantiomers: Optical activity; use of +/-, d/l and D/L notations. Properties of enantiomers, chiral and achiral molecules with two stereogenic centers. Meso compounds. Cahn-Ingold-Prelog sequence rules: R, S system of nomenclature. Diastereomers: Threo and Erythro isomers. Racemisation and resolution. Optical isomerism due to restricted rotation about single bonds-diphenyl systems. Geometric isomerism: Determination of configuration of geometric isomers. Cis & trans, E, Z system of nomenclature. Alicyclic compounds: Conformations of four to eight membered cycloalkanes and disubstituted cyclohexanes. Bicyclic systems: Nomenclature; conformations of decalins.	15hrs	Employable Skills 1. EMP 2. SKD 3. EDP
2	UNIT-2	Amines 5hours Classification. Preparation of alkyl and aryl amines-reductive amination of carbonyl compounds, Gabriel phthalimide synthesis. Basicity of amines in aqueous solution: Inductive, resonance, steric and solvation effects on the basicity of amines. Reaction of amines as nucleophiles – Methylation, quaternary salts, Hoffmann elimination with mechanism. Distinguishing reactions of 10, 20 and 30 amines. Diazotization and synthetic applications of diazonium salts.Sandmeyer's reaction. hydrolysis, reduction (to phenyl hydrazine and aniline), coupling reactions to give azo dyes (p-hydroxyazobenzene and 1-phenylazo-2-naphthol).	25hrs	Analytical Skills 1. EMP 2. SKD 3. EDP

		Heterocyclic compounds 5hours Introduction, classification, structures, resonance and aromatic character of furan, pyrrole, thiophene and pyridine. Methods of preparation and reactions of pyrrole, furan, thiophene, pyridine. Mechanism of electrophilic substitution reactions. Comparison of basicity of pyrrole, pyridine and piperidine. Chemistry of Natural Products 13hours Carbohydrates: Introduction and classification. Monosaccharides: Aldoses, structures of all the D-aldohehexoses. Elucidation of open chain structure of D-glucose.Mechanism of mutarotation and anomeric effect.Elucidation of ring structure of D- glucose in detail.Ketoses: Fructose, interconversion of glucose and fructose. Disaccharides: Glycosidic bond. Structures of maltose, lactose and sucrose-Haworth and conformational structures. Terpenes and terpenoids: Occurrence, classification and isoprene rule. Elucidation of structure and synthesis of citral and zingiberene. Structures and uses of limonene, menthol, Alkaloids: Introduction, classification and general characteristics. Structural elucidation of nicotine. and synthesis Structures and uses of ephedrine, caffeine, cocaine, atropine, quinine and morphine.		
3	UNI T-3	UV-Visible spectroscopy: Introduction. Chromophores and auxochormes; blue shift and red shift. Graphical representation of spectra of 1,3-butadiene, benzene and lycopene. Influence of conjugation on UV absorption-Comparison of UV spectra of acetone and methyl vinyl ketone. IR spectroscopy: Introduction. Stretching frequencies of –OH (free and H-bonded), alkyl –C–H, C≡C, C=C, C–C, C=O and C–O groups (by taking suitable examples).	20hrs	Research Skills 1. EMP 2. SKD 3. EDP

		NMR spectroscopy: Basic principles of proton magnetic resonance: Nuclear magnetic spin quantum number I, influence of the magnetic field on the spin of nuclei, Nuclear magnetic resonance, chemical shift (δ values), uses of TMS as reference. Nuclear shielding and deshielding effects. Equivalent and non-equivalent protons. Effect of electronegativity of adjacent atoms on chemical shift values. Spin-spin splitting and spin-spin coupling (qualitative treatment only). Applications of NMR spectroscopy including identification of simple organic molecules. Examples: Shielding and deshielding effects for (i) methane (ii) $\text{CH}_3\text{-Cl}$ (iii) CH_2Cl_2 (iv) CHCl_3. Spin-spin coupling in (i) Cl_2CHCHO (ii) 1,1,2-trichloroethane (iii) $\text{CH}_3\text{CH}_2\text{Cl}$.		

Reference books:

1. Advanced Organic Chemistry S. Bahl and A. Bahl., S. Chand & Co. 1995
2. Advanced Organic Chemistry March, John Wiley & Sons, 2008.
3. Understanding Organic Reaction Mechanisms Jacobs, Cambridge Univ Press, 1998.
4. Organic Chemistry K. Jain, Nagin & Co., 1987
5. A Guide to Mechanism in Organic Chemistry Sykes, Orient Longman, 2005.

B.Sc V Semester

S21 CHE.6.2: Organic Chemistry practicals

Total teaching hours: 60

No. of hours/Week: 4

Credits : 2

CObj_ID	Course Objectives
CObj_1	To understand the mechanisms of important organic rearrangements.
CObj_2	To demonstrate the basic laboratory techniques and application oriented physical constants.
CObj_3	To identify the functional groups of unknown organic compounds.

O_ID	Course Outcomes
CO_1	The students will develop skills in distillation, solvent extraction, TLC and column chromatography.
CO_2	Learn Oxidation and reduction of organic compounds using variety of reagents.
CO_3	Summarize the purification technique, separation and identification technique i.e. Recrystallization, distillation fractional distillation, chromatography and solvent extraction are used for all types of organic compound.
CO_4	Preparation of organic compounds and derivatives, their purifications and run TLC
CO_5	Determination of physical constant: Melting point, Boiling point.

CO-PO mapping

	PO_1	PO_2	PO_3	PO_4	PO_5	PSO_1	PSO_2	PSO_3	PSO_4	PSO_5
CO_1		x				x				
CO_2	X					x			x	
CO_3				x				x		
CO_4		x					x			
CO_5		x		x		x		x		

B.Sc V Semester

S21 CHE.6.2 : Organic Chemistry practicals

Total teaching hours: 60

No. of hours/Week: 4

S. No	Unit title	Course Content	Number of Hours	Skills Developed
1	PART-A	Preparation and purification of organic compounds 1. Recrystallisation and determination of melting point of solids (mixed melting point determination and its importance may be mentioned). 2. Simple distillation and determination of boiling point of liquids. 3. Purification of solids by sublimation.	20hrs	Employable Skills/Analytical Skills 1. EMP 2. SKD 3. EDP
2.	PART-B	Two stage preparations 4. Preparation of p-bromoaniline from acetanilide. 5. Preparation of p-nitroaniline from acetanilide. 6. Preparation of m-nitrobenzoic acid from methyl benzoate. 7. Preparation of methyl orange/methyl red by diazotization and coupling	20hrs	Analytical Skills/ Employable Skills
3	PART-C	Chromatography 8. Paper chromatography: Extraction of spinach (using 1 : 1 alcohol and Whatmann filter paper) 9. Thin layer chromatography:		

		Separation of green leaf pigments/separation of a mixture of two organic compounds. 10. Column chromatography: Separation of a mixture of two organic compounds.	20hrs	

Reference Books:

1. Harris, D. C. *Quantitative Chemical Analysis*. 6th Ed., Freeman (2007) Chapters 3-5.
2. Levie, R. de, *How to use Excel in analytical chemistry and in general scientific data analysis*, Cambridge Univ. Press (2001) 487 pages.

VI-Semester

S21CHE7.1 (Selected topics in Physical Chemistry)

No. of hrs : 60

Credits : 4

CObj_ID	Course Objectives
CObj_1	To understand the importance of Chemical Thermodynamics.
CObj_2	Understand the concept of Chemical Equilibrium.
CObj_3	To become familiar with Solutions and Colligative Properties

CO_ID	Course Outcomes
CO_1	The students will develop skills in distillation, solvent extraction, TLC and column chromatography.
CO_2	They should know different chemical equilibriums and relationship between them.
CO_3	They should be able to know why there is lowering in vapour pressure, Raoult's law, Henry's law and their applications
CO_4	They should have a general idea about elevation in boiling point and depression in freezing point, their conditions of occurrence and effects.
CO_5	They will know how to determine basicity / proticity of a polyprotic acid by the thermochemical method.

CO-PO mapping

	PO_1	PO_2	PO_3	PO_4	PO_5	PSO_1	PSO_2	PSO_3	PSO_4	PSO_5
CO_1		x				x				
CO_2	X					x			x	
CO_3				x				x		
CO_4		x					x			
CO_5		x		x		x		x		

VI-Semester

S21CHE7.1 (Selected topics in Physical Chemistry)

Total teaching hours: 60

No. of hours/Week: 4

Credits : 4

S. No	Unit title	Course Content	Number of Hours	Skills Developed
1	UNIT-1	Chemical Thermodynamics: Intensive and extensive variables; state and path functions; isolated, closed and open systems; zeroth law of thermodynamics. First law: Concept of heat, q, work, w, internal energy, U, and statement of first law; enthalpy, H, relation between heat capacities, calculations of q, w, U and H for reversible, irreversible and free expansion of gases (ideal and van der Waals) under isothermal and adiabatic conditions. Second Law: Concept of entropy; thermodynamic scale of temperature, statement of the second law of thermodynamics; molecular and statistical interpretation of entropy. Calculation of entropy change for reversible and irreversible processes. Third Law: Statement of third law, concept of residual entropy, calculation of absolute entropy of molecules. Free Energy Functions: Gibbs and Helmholtz energy; variation of S, G, A with T, V, P; Free energy change and spontaneity. Relation between Joule-Thomson coefficient and other thermodynamic parameters; inversion temperature; Gibbs-Helmholtz equation; Maxwell relations; thermodynamic equation of state. Chemical potential, Gibbs-Duhem equation.	25hrs	Employable skills/Analytical Skills/Research Skills EMP SKD EDP
2	UNIT-2	Chemical Equilibrium: Criteria of thermodynamic equilibrium, degree of advancement of reaction, chemical equilibria in ideal gases, concept of fugacity. Thermodynamic derivation of relation between Gibbs free energy of reaction and reaction quotient. Coupling of exoergic and endoergic reactions. Equilibrium constants and their quantitative dependence on temperature, pressure and concentration. Free energy of mixing and spontaneity; thermodynamic derivation of	20hrs	Employable skills EMP SKD

		relations between the various equilibrium constants K_p , K_c and K_x . Le Chatelier principle (quantitative treatment); equilibrium between ideal gases and a pure condensed phase.		3. EDP
3	UNIT-3	Solutions and Colligative Properties: Dilute solutions; lowering of vapour pressure, Raoult's and Henry's Laws and their applications. Excess thermodynamic functions. Thermodynamic derivation using chemical potential to derive relations between the four colligative properties [(i) relative lowering of vapour pressure, (ii) elevation of boiling point, (iii) Depression of freezing point, (iv) osmotic pressure] and amount of solute. Applications in calculating molar masses of normal, dissociated and associated solutes in solution.	15hrs	Employable skills 1. EMP 2. SKD 3. EDP

VI-Semester

S21CHE7.2 (Physical Chemistry practicals)

Total teaching hours: 60

No. of hours/Week: 4

Credits : 2

CObj_ID	Course Objectives
CObj_1	To expose students to instrumental methods of analysis.
CObj_2	To teach students the titrimetric and instrumental methods for analytical studies.
CObj_3	To study classical methods of analysis

CO_ID	Course Outcomes
CO_1	Study kinetics of reaction between acetone and iodine and the hydrolysis acetates
CO_2	Separate binary organic mixture and identification of its components.
CO_3	Learners will be able to study chemical kinetics to find the rate constant and determine molecular weight of polymers by viscosity measurements.
CO_4	Students will learn commercial analysis, ion exchange methods and also get hands on training in use of spectrophotometry, potentiometry and pH metry
CO_5	Students will be able independently use potentiometry, conductometry and colorimetry for quantitative determinations.

VI-Semester

S21CHE7.2 (Physical Chemistry practicals)

Total teaching hours: 60

No. of hours/Week: 4

Credits : 2

S. No	Unit title	Course Content	Number of Hours	Skills Developed
1	PART-A	1.Determination of velocity constant for acid catalysed hydrolysis of methyl acetate and determination of energy of activation. 2.Determination of velocity constant for the saponification of ethyl acetate (a = b). 3.Determination of equivalent conductivity of 0.1 N sodium chloride and verification of DHO equation. 4.Determination of dissociation constant of monochloroacetic acid by conductivity method.	30hrs	Analytical Skills 1. EMP 2. SKD 3. EDP
2.	PART-B	1.Conductometric titration of hydrochloric acid with sodium hydroxide. 2.Potentiometric titration of potassium dichromate with ferrous ammonium sulphate. 3.To construct the phase diagram of two component system (Ex. diphenylamine-benzophenone) by cooling curve method. 4.Determination of percentage of sodium chloride by miscibility temperature method.	30hrs	Analytical Skills

		5. Estimation of copper (Cu^{2+}) colorimetrically and verification of Beer-Lambert's law.		

References:

1. V. Venkateswaran, R. Veerasamy and A. R. Kulandaivelu, Basic Principles of Practical Chemistry, Sultan Chand & Sons, ISBN: 9788180547768, 8180547760, Edition: 2012
2. J.P. Yadav, Advanced Practical Physical Chemistry.
3. S. Oolvi, Practical Physical Chemistry.

B.Sc VI Semester

S21 CHE8.1 (Spectroscopy)

Total teaching hours: 60

No. of hours/Week: 4

Credits : 4

CObj_ID	Course Objectives
CObj_1	To impart the knowledge of electronic, rotation, vibration. NMR, FTIR, ESR, spectroscopy and their applications.
CObj_2	The course will provide and introduction to modern optical spectroscopic and imaging techniques and their applications to biology and chemistry.
CObj_3	To understand the role of symmetry in electronic spectroscopy,

CO_ID	Course Outcomes
CO_1	Recognize spectroscopy in microwave, Rotational spectra of rigid diatomic molecules, selection rules, interaction of spectral lines
CO_2	Learn Electronic spectra of diatomic molecules Born-oppenheimer approximation
CO_3	Make Students aware of the fine structure of ESR absorption, Hyperfine structure, Double resonance in ESR, Techniques of ESR spectroscopy.
CO_4	Understand Principles and Applications of Mossbauer spectroscopy
CO_5	Make Students aware of the fine structure of ESR absorption, Hyperfine structure, Double resonance in ESR, Techniques of ESR spectroscopy.

CO-PO mapping

	PO_1	PO_2	PO_3	PO_4	PO_5	PSO_1	PSO_2	PSO_3	PSO_4	PSO_5
CO_1		x				x				
CO_2	X					x			x	
CO_3				x				x		
CO_4		x					x			
CO_5		x		x		x		x		

VI Semester

S21 CH 8.1 (Spectroscopy)

Total teaching hours: 60

No. of hours/Week: 4

Credits: 4

S. No	Unit title	Course Content	Number of Hours	Skills Developed
1	UNIT-1	1. Unifying Principles: Electromagnetic radiation, Interaction of electromagnetic radiation with matter, Line width, Selection rules, Intensity of spectral lines, Born-Oppenheimer approximation, Rotational, Vibrational and Electronic energy levels. 5hrs 2. Microwave Spectroscopy: Classification of molecules, Rigid rotor model, Effect of isotopic substitution on the transition frequencies, Intensities, Non-rigid rotor, Stark effect, Applications. 5hrs 3. Vibrational Spectroscopy: Infrared Spectroscopy– Simple harmonic oscillator, Vibrational energies of diatomic molecules, Anharmonicity, Vibration-rotation spectroscopy, P, Q, R branches, Vibrations of polyatomic molecules, Group frequencies, Overtones, Hot bands, 5hrs	20hrs	Employable skills/Analytical Skills 1. EMP 2. SKD 3. EDP

2	UNIT-2	4. Raman Spectroscopy - Classical and quantum theories of Raman effect, Pure rotational, Vibrational and Vibrational-Rotational Raman spectra, Mutual exclusion principle, Coherent anti Stokes Raman spectroscopy. 5hrs 5. Electronic Spectroscopy: Energies of atomic and molecular orbitals, UV-Visible spectra, Spectra of hydrogen atom and alkali metal atoms, Applications, Franck-Condon principle, Electronic spectra of polyatomic molecules. 5hrs	20hrs	Employable skills 1. EMP 2. SKD 3. EDP
3	UNIT-3	6. Magnetic Resonance Spectroscopy: Nuclear Magnetic Resonance Spectroscopy – Proton NMR, Shielding and Deshielding, of magnetic nuclei, Chemical shift, Spin-spin interactions and coupling constant 'J', Spin decoupling, Instrumentals, NMR studies of ^{13}C, ^{19}F and ^{31}P nuclei, NMR in chemical analysis and medical diagnostics. 7. Electron Spin Resonance Spectroscopy - Basic principles, Zero field splitting and Kramer's degeneracy, Factors affecting the 'g' value, hyperfine coupling constants, Instrumentation and Applications.	20hrs	Employable skills/ analytical Skills 1. EMP 2. SKD 3. EDP

Reference Books:

- 1) Fundamentals of molecular spectroscopy, C.N.Banwell and E.McCasj, Tata McGraw Hill (1994)

2. Hollas, J.M., Modern Spectroscopy, John Wiley (1996) 3rd ed.
3. Windawi, H., and Floyd, F.L.H., Applied Electron Spectroscopy for Chemical Analysis
(Chemical Analysis Vol. 63), John Wiley (1982).
4. Parish, R.V., NMR, NQR, EPR and Mossbauer Spectroscopy in Inorganic Chemistry,
Ellis Harwood (1991).
5. Chang, R., Basic Principles of Spectroscopy, McGraw-Hill (1971).
6. Ghosh, P.K., Introduction to Photoelectron Spectroscopy, John Wiley & Sons,
New York (1983).
7. Carrington, A., and MacLachlan, A.D., Introduction to Magnetic Resonance,
Harper and Row, New York, USA (1967).

B.Sc VI Semester

S21CHE8.2 (Analytical & Industrial Chemistry practicals)

Total teaching hours: 60

No. of hours/Week: 4

Credits: 2

CObj_ID	Course Objectives
CObj_1	To develop an understanding of the range and uses of analytical methods in chemistry.
CObj_2	To provide an understanding of chemical methods employed for elemental and compound analysis.
CObj_3	To develop some understanding of the professional and safety responsibilities residing in working on chemical analysis.

CO_ID	Course Outcomes
CO_1	Describe and compare a range of analytical chemistry methods and explain the underlying theoretical principles;
CO_2	Employ a variety of analytical methods to prepare, separate and characterize samples from various matrices;
CO_3	As part of a team or individually, conduct, analyse and interpret results of a chemical analysis and effectively communicate these in written reports and other formats;
CO_4	Explain the broad role of analysts in quality control and assessment of experimental measurements from various application context
CO_5	To establish an appreciation of the role of chemistry in quantitative analysis

B.Sc VI Semester

S21CHE8.2 (Analytical & Industrial Chemistry practicals)

Total teaching hours: 60

No. of hours/Week: 4

Credits: 2

S. No	Unit title	Course Content	Number of Hours	Skills Developed
1	PART-A	1. Paper chromatographic separation of Fe^{3+}, Al^{3+}, and Cr^{3+}. 2. Separation and identification of the monosaccharides present in the given mixture (glucose & fructose) by paper chromatography. Reporting the R_f values. 3. To separate a mixture of Ni^{2+} & Fe^{2+} by complexation with DMG and extracting the Ni^{2+}-DMG complex in chloroform, and determine its concentration by spectrophotometry. 4. Determine the pH of the given aerated drinks, fruit juices, shampoos and soaps.	30hrs	Analytical Skills 1. EMP 2. SKD 3. EDP
2.	PART-B	5. Analysis of soil: (i) Determination of pH of soil. (ii) Total soluble salt (iii) Estimation of calcium, magnesium, phosphate, nitrate. 6. Separation of amino acids from organic acids by ion exchange chromatography.	30hrs	Analytical Skills

		7.Determination of dissolved oxygen in water. 8.Determination of chemical oxygen demand (COD). 9.Determination of Biological oxygen demand (BOD)		Research Skills

Reference Books:

1. Vogel, Arthur I: A Test book of Quantitative Inorganic Analysis (Rev. by G.H. Jeffery and others) 5th Ed.
2. Willard, Hobert H. et al.: Instrumental Methods of Analysis, 7th Ed. Wardsworth Publishing Company, Belmont, California, USA, 1988.
3. Christian, Gary D; Analytical Chemistry, 6th Ed. John Wiley & Sons, New York, 2004.
4. Harris, Daniel C: Exploring Chemical Analysis, Ed. New York, W.H. Freeman, 2001.
5. Khopkar, S.M. Basic Concepts of Analytical Chemistry. New Age, International Publisher, 2009.
6. Skoog, D.A. Holler F.J. and Nieman, T.A. Principles of Instrumental Analysis, Thomson Asia Pvt. Ltd. Singapore.
7. Mikes, O. & Chalmes, R.A. Laboratory Hand Book of Chromatographic & Allied Methods
, Elles Harwood Ltd. London. 45
8. Ditts, R.V. Analytical Chemistry – Methods of separation.

DEPARTMENT OF CHEMISTRY

M.Sc CHEMISTRY REVISED SYLLABUS (WEF 2019-22)

&

**REVISED PAPERS OF MCH-205 (GREEN CHEMISTRY
to BIOLOGICAL CHEMISTRY) FROM 2024 TO 25
BATCH STUDENTS)**

Programme Educational Objectives

PEO_ID	Programme Educational Objectives
PEO_1	Students will be well prepared for successful careers in the profession at an industry and/or in government in one or more of discipline of chemistry.
PEO_2	Students will be academically prepared to become licensed professional chemists in due course and will contribute effectively in serving the society.
PEO_3	Students will be engaged in professional activities to enhance their own achievement and simultaneously contribute in service of humankind.
PEO_4	Students will be successful in higher education in Chemistry
PEO_5	Students will provide leadership quality to work in all kind of circumstances, diverse environment such as interdisciplinary and multidisciplinary learning systems.

Programme Specific Outcomes

PSO_ID	Programme Specific Outcomes
PSO_1	Academic competence: (i) Understand fundamental principles and advanced concepts of organic, inorganic and physical chemistry. (ii) Demonstrate understanding of various types of reactions, reaction mechanisms, stereochemistry, photochemistry, rearrangements, heterocyclic and medicinal chemistry, and reactions involving use of metals. (iii) Interpret analytical data for structure elucidation obtained using NMR, IR, UV and Mass spectroscopy.
PSO_2	Personal and Professional Competence: (i) Carry out experiments which include various chemical techniques and also setting of dry reactions, handling of hazardous reagents, assembling of apparatus, isolation of natural products, purification by column chromatography. (ii) Evaluate results obtained, observations and conclusion of experiments. Documentation of results. (iii) Formulate ideas, scientific writing and authentic reporting, effective presentation and communication skills.
PSO_3	Research Competence: (i) Outline research problem related to research area of interest and planning of methodology for execution. (ii) Review scientific literature and findings in systematic manner and processing of information obtained to understand scope for novelty. (iii) Design novel synthetic routes using a retrosynthetic approach for development of elegant, economic and eco-friendly schemes.
PSO_4	Entrepreneurial and Social competence: (i) Demonstrate importance of industrial applications of organic chemistry in various fields. (ii) Devise chemical processes with Green approach having advantage in safe operations.
PSO_5	To propose/develop:

	Cost effective and novel methods of synthesis of bioactive compounds/nanomaterials and in turn to design target oriented drugs to treat different diseases.

PROGRAMME OUTCOMES

PO_ID	PROGRAMME OUTCOMES
PO_1	Master of Science in Chemistry basically aims at the training of students with a detailed knowledge base in Chemistry of potential utility in academia as well as Industry through advanced course work and laboratory work in the department and a project work in industries or premier institutions
PO_2	To qualify NET/GATE/SET/Civil Services and other competitive examinations.
PO_3	For exploring global level research opportunities for doctoral and post-doctoral studies
PO_4	For professional employment in different domains such as academics, industries, analytical laboratories, scientific organizations, entrepreneurship, administrative positions etc.
PO_5	For enhancing the connectivity between academic and industrial institutions.

Continuous Internal Assessment – Scheme of Evaluation For PG Theory Courses

Activities (CIA: 30 Marks)	Proposed and Approved Scheme		Total Marks (30)
	IA-1	IA-2	
Session Test Maximum Marks	35	70	
1. Weightage (Marks)	05	10	15
2. Assignment -I	05		05
3. Assignment-II	05		05
4. Classroom participation	05		05
Total			30

PG CIA Components Practical paper (30 MARKS & 15 MARKS)

Activities (CIA: 30 Marks)	Total Marks (30)	Total Marks (15)
Session Test Maximum Marks		
1.Lab Performance	15	05
2.Obervation	05	05
3. Mock Test	10	05
Total	30	15

CIA Components Project Work (30 MARKS)

Activities(CIA: 30Marks)	Total Marks (30)
Session Test Maximum Marks	

1.Project Performance/Participation	15
2.Thesis Preparation	10
3. Class participation/Attendance	05
Total	30

M.Sc I SEMESTER-CHEMISTRY
MCH-101: INORGANIC CHEMISTRY-I

COURSE	DETAILS
CODE	MCH-101
TITLE	INORGANIC CHEMISTRY-I
PROGRAMME	M.Sc ORGANIC CHEMISTRY
YEAR/SEMESTER	FIRST/FIRST
TYPE	HARD-CORE
TOTAL CREDITS	4
TOTAL CONTACT HOURS	52
COTACT HOURS PER WEEK	4
EXAMINATION DURATION	3
MAXIMUM MARKS	30(IA) + 70 = 100

TOTAL MODULES	4
PEDAGOGY	Lecture with practical problems being worked out, Chalk and talk PPT presentations, Seminars and presentations.
EVALUATION METHOD	Two internal assessments, one mid-term examination, one end Semester examination, Class participation.

COURSE OBJECTIVES

This course aims to impart to the student, knowledge of:

CObj_ID	Course Objectives
CObj_1	Advanced principles of bonding in inorganic compounds. The structure and applications of isopoly and heteropoly anions of vanadium, molybdenum and tungsten and metal carbonyl clusters.
CObj_2	The structure of important silicon containing compounds and the correlation between their structure and application. The various principles and applications of solvent system, hard-soft acid base (HSAB), theories of acids and bases and concept of super acids.
CObj_3	The chemistry of non-metal containing compounds such as boranes, borazines, sulphurnitrogen compounds and phosphorus-nitrogen compounds.

COURSE OUTCOMES

Upon the completion of this course, the students will be able to:

CO_ID	COURSE OUTCOMES
CO_1	Appreciate the different theories of chemical bonding and be able to apply these theories to solve structures
CO_2	Correctly write the structures of heteropoly, isopoly anions and metal

			carbonyl clusters and relate the structure to chemical reactivity.									
	CO_3		Understand the three dimensional structure of silicates and catalytically important molecules such as aluminosilicates (zeolites) and apply their knowledge towards selectivity based on structure.									
	CO_4	PO_1	PO_2	PO_3	PO_4	PO_5	PSO_1	PSO_2	PSO_3	PSO_4	PSO_5	
			Write the structure of norm based on STYX.									
	CO_5	X							X			
	CO_2			X			X					

MCH-101: INORGANIC CHEMISTRY-I

CO-PO Mapping:

CO_3		X							X	
CO_4	X						X			
CO_5			X			X				

M.Sc I SEMESTER-CHEMISTRY
MCH-101: INORGANIC CHEMISTRY- I

52hrs

S. No	Module title	Module Content	Number of Hours	Skills Developed

1	UNIT-I	Chemical Bonding- VSEPR model, shapes of molecules-ClF_3, ICl_4^-, TeF_5^-, I_3, TeCl_6^{2-}, XeF_6, SbCl_6^{3-}, IF_7, ReF_7, XeF_8^{2-}, TaF_8^{3-}; Bent rules and energetics of hybridization; electronegativity and partial ionic character; Bonds-Multicenter, Synergic and Agostic bonding. Lattice energy: Born-Lande equation, Kapustinskii equation; polarizability and partial covalent character, radius-ratio rules, structures of simple solids, Zintl-isoelectronic relationship in solids. Molecular orbital theory: LCAO and MO diagrams of heteronuclear diatomic (CO, NO, HF, ICl) and triatomic molecules (CO_2 and NO_2^-).	13hrs	Employable Skills 1. EMP 2. SKD 3. EDP
2	UNIT-II	Chemistry of main group elements- Structure and bonding in boranes, carboranes, metallocarboranes, Wade's rules, borazines, phosphazenes, S, N-compounds. Silicates - Classification, structures, isomorphous replacement, pyroxenes, layered and vitreous silicates, zeolites and molecular sieves.	13hrs	Employable Skills and analytical Skills 1. EMP 2. SKD 3. EDP
3	UNIT-III	HSAB concept: Basis of HSAB concept, acid-base strength, hardness and softness, symbiosis, applications of HSAB concept; Acid- base concept in non-aqueous media, reactions in BrF_3, N_2O_4, anhydrous H_2SO_4, CH_3COOH. Isopoly and heteropoly acids of W, Mo and V, preparations, properties, structure and applications. Stereoisomerism- Chirality, optical activity- CD, ORD, Cotton effect, absolute configuration of metal complexes, magnetic circular dichroism.	13hrs	1. EMP 2. SKD 3. EDP

4	UNIT-IV	A. M-M bond and metal atom clusters, halide clusters, bonding in $[\text{ReCl}_8]^{2-}$. Metal carbonyl clusters- LNCC's and HNCC's. Electron counting in carbonyl clusters, Wades-Mingos and Lauher rules. B. Nuclear Chemistry-The atomic nucleus-elementary particles, quarks, classification of nuclides based on Z and N values, nuclear stability, nuclear potential, binding energy. Nuclear Models: Shell model-salient features, forms of the nuclear potential, filling of orbitals, nuclear configuration, Liquid drop model, Fermi gas model, Collective model and Optical model. Radioactivity, radioactive decay kinetics, Parent-daughter decay-growth relationship-secular and transient equilibria, theories of α, β^-, β^+ and γ-decay, internal conversion, Auger effect.	13hrs	1. EMP 2. SKD 3. EDP

REFERENCE BOOKS:

1. Basic Inorganic Chemistry- F. A. Cotton, G. Wilkinson and P. L. Gaus; John Wiley and sons. Inc, 6th edition (1999).
2. Advanced Inorganic Chemistry, 6th edition; F. A. Cotton and G. Wilkinson.
3. Inorganic Chemistry IV edition; J. E. Huheey, E. A. Keiter and R. L. Keiter, Addison; Wesley (1993).
4. Inorganic Chemistry, II edition, D. F. Shriver, P. W. Atkins and C. H. Langford ELBS; Oxford University Press, 1994.
5. Chemistry of elements; N. N. Greenwood and A. E. Earnshaw, Butterworth Heinemann (1997).

M.Sc I SEMESTER-CHEMISTRY

MCH-102: ORGANIC CHEMISTRY-I

52hrs

COURSE	DETAILS
CODE	MCH-102
TITLE	ORGANIC CHEMISTRY-I
PROGRAMME	M.Sc ORGANIC CHEMISTRY
YEAR/SEMESTER	FIRST/FIRST
TYPE	HARD-CORE
TOTAL CREDITS	4
TOTAL CONTACT HOURS	52
COTACT HOURS PER WEEK	4
EXAMINATION DURATION	3
MAXIMUM MARKS	30(IA) + 70 = 100
TOTAL MODULES	4
PEDAGOGY	Lecture with practical problems being Worked out, Chalk and talk PPT presentations, Seminars and presentations.
EVALUATION METHOD	Two internal assessments, one mid-term examination, one end Semester examination, Class participation.

COURSE OBJECTIVES

This course aims to impart to the student, knowledge of:

CObj_ID	Course Objectives
CObj_1	Basic concepts of bonding, structures, resonance, aromaticity, hyperconjugation and tautomerism in organic molecules.
CObj_2	Generation, structure, stability and reactivity of reactive intermediates. Conformation and stability of substituted cyclic systems, nomenclature and conformations of fused rings and bridged ring systems.
CObj_3	Stereochemistry of organic compounds, isomerism, different projection formulae with nomenclature and prochirality. Use of various oxidizing and reducing agents and their applications in the synthesis of industrially and pharmaceutically important compounds. Synthetic molecular receptors, their significance and functions.

COURSE OUTCOMES

Upon the completion of this course, the students will be able to:

CO_ID	COURSE OUTCOMES
CO_1	Predict the products, identify reaction intermediates and propose suitable mechanism for organic reactions. Identify stereogenic centres, recognize enantiomers, diastereomers, meso compounds, draw stereochemical structures, and provide R/S designations of stereocenters.
CO_2	Apply the concepts of bonding, resonance, aromaticity, hyperconjugation and tautomerism to higher organic compounds.
CO_3	Draw stable conformations for substituted cyclic compounds, fused and bridged rings.
CO_4	Use of various oxidizing and reducing reagents for application in organic transformations of industrially and pharmaceutically important organic compounds.
CO_5	Understand the host-guest interactions in molecular receptors.

CO-PO Mapping:

	PO_1	PO_2	PO_3	PO_4	PO_5	PSO_1	PSO_2	PSO_3	PSO_4	PSO_5
CO_1	X						X			
CO_2		X							X	
CO_3			X			X				
CO_4		X								X
CO_5	X					X				

MCH-102: ORGANIC CHEMISTRY- I

52hrs

S. No	Module title	Module Content	Number of Hours	Skills Developed
1	Unit -1	Nature of Bonding in Organic Molecules Delocalized chemical bonding: Conjugation, cross conjugation, resonance. Aromaticity. Huckel's rule of aromaticity. Aromatic systems with electron numbers other than six (including azulene, tropone, tropolone and annulenes). Antiaromaticity. Aromaticity in benzenoids, meso-ionic compounds. Homo-aromaticity. Alternant and nonalternant hydrocarbons, Energy levels in odd and even-alternant hydrocarbons. Hyperconjugation. Tautomerism. Reaction Mechanisms-I Generation, structure, stability and reactivity of carbocations, carbanions, carbon free radicals, carbenes and nitrenes. Classification of reactions and mechanisms. Kinetic and thermodynamic control, Hammond postulate, Curtin-Hammett principle. Potential energy diagrams, transition states and intermediates. <u>Methods of determining mechanisms:</u> Based on the structure of products, determination of the presence of intermediates, isotopic labeling, and isotope effects. <u>Acids and bases.</u> Effect of structure on the strengths of acids and bases.	13hrs	Employable Skills 4. EMP 5. SKD 6. EDP
2	Unit -2	Reaction Mechanisms-II <u>Effect of structure on reactivity:</u> - Resonance and field effects; steric effects. The Hammett equation and linear free energy relationship, substituent and reaction constants. Taft	13hrs	Employable Skills and analytical Skills

		equation. <u>Nucleophilic substitution reaction at a saturated carbon</u>: SN1, SN2, and SET mechanisms. Effect of substrate structure, attacking nucleophile, leaving group. Ambident nucleophiles and substrates. Stereochemistry-I Fischer, Newman, Sawhorse and flying wedge projections and their interconversions. <u>Optical isomerism</u>: Elements of symmetry and chirality. D-L conventions. CIP rules, R-S and M-P conventions. Chirality in compounds with a stereogenic centre, and in allenes, alkylidene cycloalkanes and spiranes (with a stereogenic axis). Cram's and Prelog's rules. <u>Conformational analysis</u>: Conformational analysis of cycloalkanes: cyclobutane, cyclopentane, cyclohexanes (monosubstituted e.g., methyl, <i>iso</i>-propyl, <i>tert</i>-butyl and disubstituted cyclohexanes e.g., dialkyl, dihalo, diols), and cycloheptane.		1. EMP 2. SKD 3. EDP
3	Unit-3	Nomenclature and conformations of fused rings and bridged ring systems. <u>Prochirality</u>: Enantiotopic and diastereotopic atoms, groups and faces. Carbohydrates Introduction. Kiliani-Fischer synthesis, Determination of configuration of the monosaccharides, conformational analysis of monosaccharides. Synthesis of amino sugars-(N-acetylmuramic acid (NAMA), N-acetyl neuraminic acid NANA). Synthesis of aldonic, uronic, aldaric acids and alditols. Structure elucidation of sucrose and maltose. Structures of lactose, gentiobiose, and meliobiose.	13hrs	Employable Skills 1. EMP 2. SKD 3. EDP

4	Unit-4	Heterocyclic compounds Nomenclature of heterocyclic compounds. Structure, reactivity, synthesis and reactions of pyrazole, imidazole, oxazole, isoxazole, thiazole, isothiazole, pyrimidine, purine and indole. Preparation and reactions of coumarins, acridines, cinnolenes and quinoxalines. <u>Synthetic Molecular Receptors:</u> Definition and Significance. Structure and function of receptors with molecular clefts, molecular tweezers, Receptors with multiple hydrogen bonding sites, Crown ether, Cryptates; Cyclodextrins, Cyclophanes, Calixarenes, ionophores, and micelles.	13hrs	Employable Skills 1. EMP 2. SKD 3. EDP

REFERENCE BOOKS:

1. Advanced Organic Chemistry – Reactions, Mechanism and Structure, Jerry March, John Wiley (2008).
2. Advanced Organic Chemistry, F A Carey and R J Sundberg Plenum, (1990).
3. A Guide Book to Mechanism in Organic Chemistry, Peter Sykes, Longman, (2000).
4. Structure and mechanism of Organic Chemistry, C K Ingold, Cornell University Press (1999).
5. Organic Chemistry, R T Morrison and R N Boyd, Prentice-Hall, (1998).
6. Stereochemistry of Organic Compounds, D Nasipuri, New-Age International, (1999).
7. Organic Synthesis, Jagadamba Singh and L. D. S. Yadav, Seventh Edition, 2011.
8. Organic Reaction Mechanisms, V. K. Alhuwalia and Rakesh Kumar Parashar, 4th Edition, 2012.
9. Understanding organic reaction mechanisms, A. Jacob, Cambridge, University Press, 1997.

M.Sc I SEMESTER-CHEMISTRY
MCH-103: PHYSICAL CHEMISTRY-I

52hrs

COURSE	DETAILS
CODE	MCH-103
TITLE	PHYSICAL CHEMISTRY-I
PROGRAMME	M.Sc ORGANIC CHEMISTRY
YEAR/SEMESTER	FIRST/FIRST
TYPE	HARD-CORE
TOTAL CREDITS	4
TOTAL CONTACT HOURS	52
COTACT HOURS PER WEEK	4
EXAMINATION DURATION	3
MAXIMUM MARKS	30(IA) + 70 = 100
TOTAL MODULES	4
PEDAGOGY	Lecture with practical problems being Worked out, Chalk and talk PPT presentations, Seminars and presentations.
EVALUATION METHOD	Two internal assessments, one mid-term

	examination, one end Semester examination, Class participation.

COURSE OBJECTIVES

This course aims to impart to the student, knowledge of:

CObj_ID	Course Objectives
CObj_1	Time dependent and time independent Schrödinger equations with solutions in simple systems. Apply variational method, time independent perturbation theory and time dependent perturbation theory to solve simple problems.
CObj_2	Matrix representation of quantum mechanics is discussed together with approximate methods.
CObj_3	The collision model of chemical reactions and how various factors such as temperature and catalyst can affect reaction rate and mechanism of thermal and photochemical hydrogen halogen reactions. The kinetics and thermodynamics of electrochemical reactions

COURSE OUTCOMES

Upon the completion of this course, the students will be able to:

CO_ID	COURSE OUTCOMES
CO_1	Show an understanding of wave mechanics in three dimensions.
CO_2	Describe the structure of the hydrogen atom and show an understanding of quantization of angular momentum.
CO_3	Recall and explain why certain factors such as concentration, temperature, medium and the presence of a catalyst will affect the speed of a chemical reaction.
CO_4	Understand the concept of activation energy and its calculation from kinetic data

CO_5	Define and explain surface and interfacial phenomenon.

MCH-103: PHYSICAL CHEMISTRY-I

CO-PO Mapping:

	PO_1	PO_2	PO_3	PO_4	PO_5	PSO_1	PSO_2	PSO_3	PSO_4	PSO_5
CO_1		X					X			
CO_2				X					X	
CO_3	X								X	
CO_4	X					X				
CO_5			X					X		

M.Sc I SEMESTER-CHEMISTRY
MCH-103: PHYSICAL CHEMISTRY- I

52 hours

S. No	Module title	Module Content	Number of Hours	Skills Developed

1	Unit -1	<u>Quantum Mechanics-I</u> Introduction to quantum mechanics. Schrödinger wave equation. Time-independent and time-dependent Schrödinger wave equations and the relation between their solutions. Eigen functions and Eigenvalues. Physical Interpretation of wave function. Concepts of Operators: Laplacian, Hamiltonian, Linear and Hermitian operators. Angular Momentum operators and their properties. Commutation of operators. Normalization, orthogonality and orthonormality of wave functions. Average (expectation) values. Postulates of quantum mechanics. Solutions of Schrödinger wave equation for a free particle, particle in a ring, particle in a three dimensional box. Quantum mechanical degeneracy, tunneling (no derivation). Application of Schrödinger equation to harmonic oscillator, rigid rotator. Eigen functions and eigenvalues of angular momentum. Ladder operator method for angular momentum.	13hrs	Employable Skills EMP SKD EDP
2	Unit -2	<u>Quantum Mechanics-II</u> Schrödinger equation to hydrogen atom in spherical polar co-ordinates. Solution of Φ, Θ, equation and statements of solution of R equation. Total wave functions of hydrogen atom. Quantum numbers and their characteristics. List of wave functions for few initial states of hydrogen like atoms. Diagrams of radial and angular wave functions. Radial and angular distribution function and their significance. Electron spin (Stern-Gerlach experiment), spin-orbital, anti-symmetry and Pauli-exclusion principle, Slater determinants. Coupling of Angular momenta. Russell-Saunders and JJ-coupling, Term symbols. Spin-orbital interaction and explanation of term multiplicities (Na-D doublet). Zeeman effect. Approximate methods: Need for approximate methods. Perturbation method. Rayleigh Schrödinger perturbation theory for time-independent non-degenerate system. Application to electron in a box under the influence of an electric	13hrs	Employable Skills and analytical Skills 1. EMP 2. SKD 3. EDP

		field. Application to He atom. Variation theory-statement and proof. Application of variation method to particle in a one-dimensional box and He atom.		
3	Unit-3	Chemical Dynamics-I A. Macroscopic and microscopic kinetics, Review of theories of reaction rate-Collision theory and Transition state theory, Comparison of collision theory with transition state theory, Arrhenius equation- characteristics, Significance of energy of activation, Temperature coefficient and its evaluation. Thermodynamical formulation of reaction rates (Wyne-jones and Eyring treatment), Reaction between ions in solutions – Influence of ionic strength on reaction rates (primary and secondary salt effects). B. Concept of Steady state kinetics, Chain reactions – chain length and chain inhibition, comparison of photochemical and thermal reactions, Mechanisms of thermal and photochemical reactions between hydrogen-bromine and hydrogen-chlorine. Comparative study of thermal and photochemical hydrogen-halogen reactions. Pyrolysis of acetaldehyde, Decomposition of ethane. C. Kinetics of fast reactions- Introduction, Study of reactions by relaxation method (Temperature and pressure jump), flow method (Plug flow method and Stopped flow method), Flash photolysis and Shock tube method.	13hrs	Employable Skills EMP SKD EDP
4	Unit-4	Chemical Dynamics-II D. Kinetics of homogeneous catalysis-kinetics of auto catalytic reactions, kinetics of acid-base catalysed reactions. Comparison of enzyme catalysed and chemical catalysed reactions, Mechanism (Lock and Key theory), Kinetics of enzyme catalyzed reactions – Henri-Michaelis-Menten mechanism, Significance of Michaelis-Menten constant, Lineweaver-Burk plot. Effects of enzyme concentration, pH, Temperature, Activators and Inhibitors on enzyme activity.	13hrs	Employable Skills EMP SKD EDP

		E. Theories of unimolecular reactions: Perrin theory, Lindemann theory, and Hinshelwood theory. F. Surface chemistry- Types of adsorption isotherms, Effect of temperature on adsorption, Mechanical adsorption, Estimation of surface area using BET equation, Gibbs adsorption isotherm and its significance, Surface tension and surface energy, Pressure difference across curved surface (Laplace equation), Vapour pressure of droplets (Kelvin equation), Surface film on liquids (electro-kinetic phenomena), Catalytic activity of surfaces.		

REFERENCE BOOKS:

1. Glasstone S., Thermodynamics for Chemists, Affiliated East-West Press Pvt. Ltd., (1960)
2. Mc. Quarrie D.A., Simon J.D., Molecular Thermodynamics, University Science Books, (1999).
3. Gupta M.C. Statistical Thermodynamics, Wiley Eastern Ltd., (1993).
4. Laidler K.J., Chemical Kinetics 3rd Edition, Pearson Publ., (2013).
5. House J.E., Principles of Chemical Kinetics, Wm C Brown Publisher, Boston (1997).
6. Glasstone S., Text Book of Physical Chemistry, 2nd Edition, Macmillan India Ltd., (1991).
7. Atkins P.W., de Paula J., Physical Chemistry, 7th Edition, Oxford Publ., (2002).
8. Puri B.R, Sharma L.R, Pathannia M.S., Principles of Physical Chemistry, 47th Edition. Shoban Lal Nagin Chand Co., (2017).

M.Sc I SEMESTER-CHEMISTRY MCH-104: ANALYTICAL CHEMISTRY-I

52hrs

COURSE	DETAILS
CODE	MCH-104
TITLE	ANALYTICAL CHEMISTRY-I
PROGRAMME	M.Sc ORGANIC CHEMISTRY
YEAR/SEMESTER	FIRST/FIRST
TYPE	HARD-CORE
TOTAL CREDITS	4
TOTAL CONTACT HOURS	52
COTACT HOURS PER WEEK	4
EXAMINATION DURATION	3
MAXIMUM MARKS	30(IA) + 70 = 100
TOTAL MODULES	4
PEDAGOGY	Lecture with practical problems being Worked out, Chalk and talk PPT presentations, Seminars and presentations.
EVALUATION METHOD	Two internal assessments, one mid-term examination, one end Semester examination, Class participation.

COURSE OBJECTIVE

This course aims to impart to the student, knowledge of:

CObj_ID	Course Objectives
CObj_1	Different analytical techniques.
CObj_2	Precision and accuracy can be calculated.
CObj_3	Calibration methods are used to calibrate the equipments.

COURSE OUTCOMES

Upon the completion of this course, the students will be able to:

CO_ID	COURSE OUTCOMES
CO_1	Outline and recall basic knowledge of fundamentals and application of organic and physical chemistry through chemical and scientific theories. Students learn the basic principles and applications of the theory of indicators.
CO_2	Students can be familiarizing with Separation techniques. Use of safety responsibilities residing in working with chemicals.
CO_3	The students also trained in the field of Ion exchange Chromatography, Thin-layer Chromatography.
CO_4	Students also expertise in handling of various electro analytical techniques. Standardize/calibrate the apparatus and instrument. Carry out purification techniques.
CO_5	Write the experimental results and interpret it. Overall students can solve the problems related to spectroscopy.

MCH-104: ANALYTICAL CHEMISTRY-I

CO-PO Mapping:

	PO_1	PO_2	PO_3	PO_4	PO_5	PSO_1	PSO_2	PSO_3	PSO_4	PSO_5
CO_1			X				X			
CO_2		X							X	
CO_3	X							X		
CO_4				X		X				
CO_5		X				X				

MCH - 104 ANALYTICAL CHEMISTRY

52hrs

S. No	Module title	Module Content	Number of Hours	Skills Developed
1	Unit -1	Acid – Base Titrations: Basic principles, Titration curves for mono functional acids and bases, pH calculations, theory of indicators, fractions of phosphoric acid species as a function of pH. Titration curves for polyfunctional acids [H₃PO₄]. Redox Titrations: Nernst equation, Standard & formal potentials. Titration curves, end point signals, Indicators, criteria for the selection of indicators. Feasibility of redox titration. Titration of multicomponent system. Adjustment of analyte's oxidation state. Applications: Ce (IV), bromate, Iodates. Kinetic methods of analysis: Rate laws, psuedo first order kinetics, types of kinetic methods, fixed time methods. Applications of catalytic and non-catalytic kinetic methods.	13hrs	Employable Skills EMP SKD EDP
2	Unit -2	Precipitation titrations: Solubility product. Theoretical principles: Titration curves, end point signals, Mohr, Volhard and adsorption indicators. Applications: Estimation of F⁻, K⁺, CO₃²⁻, C₂O₄²⁻, acetylenes and mixture of halides Complexometric titrations:	13hrs	Employable Skills and analytical Skills EMP SKD

		Complexometric titrations with particular reference to EDTA titrations, suitability of polydentate ligands as titrants, expressions for the different forms of EDTA in solution as a function of pH, conditional stability constants, derivation of titration curve, effect of pH and second complexing agent on the conditional stability constant and titration curve. Selectivity by pH control, masking and demasking, metal ion indicators, types of EDTA titrations, titrations involving monodentat.		EDP
3	Unit-3	Karl-Fischer titrations: Stoichiometry of the reaction, preparation of the reagent, titration method, standardization of the reagent using water-in-methanol, determination of water in samples, interference and their elimination, application to quantitative analysis of some organic compounds- alcohols, carboxylic acids, acid anhydrides and carbonyl compounds. Non-Aqueous titration :Acid –base titrations in non-aqueous solvents- classification of solvents, leveling and differentiating solvents, acidic and basic titrants, methods of titration. Titrations in glacial acetic acid and ethylene diamine, applications of non-aqueous titrations. Gravimetric analysis: Formation and treatment of precipitates, co-precipitation, homogeneous precipitation, important precipitating agents and their significance in inorganic analysis.	13hrs	Employable Skills EMP SKD EDP

4	Unit-4	Separation Techniques: Solvent Extraction- Types – batch, Continuous, efficiency, selectivity, Distribution coefficient, Nernst distribution law, derivation, applications and numerical problems. Chromatography- Types, Terminology, Principles of paper, thin layer, column chromatography. Electro analytical techniques Membrane indicator electrodes- Classification of membranes, properties of ion-selective membranes, the glass electrode for PH measurements, glass electrodes for other cations, crystalline membrane electrodes, liquid membrane electrodes. Ion-selective field-defect transistors (ISFETs): Mechanism of ISFET ion-selective behavior, application of ISFETs. Molecular selective electrode systems: Gas-sensing probes, biocatalytic membrane electrodes, disposable multiplayer p-ion systems.	13hrs	Employable Skills EMP SKD EDP

REFERENCE BOOKS:

1. Fundamentals of Analytical Chemistry-Skoog, West and Holler 9th Edition; Mary Finch. (2014)
2. Modern Analytical Chemistry David Harvey; McGraw Hill Higher Education Publishers, (2010)
3. Vogel's Textbook of Quantitative Chemical Analysis, 6th edition; Pearson Education limited, (2007)
4. Analytical Chemistry-Gary .D. Christian (6th edition) John Wiley & sons (2010).
5. Analytical Chemistry Principles- John H Kennedy, 2nd edition, published by Cengage Delmar Learning India Pvt (2011).

M.Sc I SEMESTER-CHEMISTRY
MCH-105: MATHEMATICS FOR CHEMISTS

COURSE	DETAILS
CODE	MCH-105
TITLE	MATHEMATICS FOR CHEMISTS
PROGRAMME	M.Sc ORGANIC CHEMISTRY
YEAR/SEMESTER	FIRST/FIRST
TYPE	SOFT-CORE
TOTAL CREDITS	3
TOTAL CONTACT HOURS	36
COTACT HOURS PER WEEK	3
EXAMINATION DURATION	3
MAXIMUM MARKS	30(IA) + 70 = 100
TOTAL MODULES	3
PEDAGOGY	Lecture with practical problems being Worked out, Chalk and talk PPT presentations, Seminars and presentations.
EVALUATION METHOD	Two internal assessments, one mid-term examination, one end Semester examination, Class participation.

COURSE OBJECTIVES

This course aims to impart to the student, knowledge of:

CObj_ID	Course Objectives
CObj_1	To enable the students to acquire the basic knowledge on mathematics.
CObj_2	Mathematical concepts like vectors, matrices, calculus (differentiation, integration and differential equations), Fourier transform and probability.
CObj_3	Use of these concepts in physical chemistry, spectroscopy, crystallography, analytical chemistry, nature of bonding etc.

COURSE OUTCOMES

Upon the completion of this course, the students will be able to:

CO_ID	COURSE OUTCOMES
CO_1	Students learn the basic principles and applications of Vectors and matrix algebra. Apply the concepts of calculus in understanding the derivations of thermodynamics and quantum mechanics.
CO_2	Discuss the applications of matrices in HMO concept and group theory.
CO_3	Understand the advantages in image resolution of infrared spectra using Fourier transform.
CO_4	Understand the complex motion of electrons and electronic wave functions which are based on probability.

CO_5	Apply matrix and vector methods in understanding diffraction patterns from crystal structures

MCH-105: MATHEMATICS FOR CHEMISTS

CO-PO MAPPING:

	PO_1	PO_2	PO_3	PO_4	PO_5	PSO_1	PSO_2	PSO_3	PSO_4	PSO_5
CO_1	X						X			
CO_2			X			X				
CO_3		X						X		
CO_4				X					X	
CO_5		X				X				

MCH-105: SOFT CORE: MATHEMATICS FOR CHEMISTS

36 hours

S. No	Module title	Module Content	Number of Hours	Skills Developed
1	Unit -1	Vectors: vectors, dot and cross products; scalar and vector triple products and their applications. Tensors and their applications Matrix Algebra: Review of different types of matrices (including Hermetian and skew Hermetian); matrix addition and multiplication; determinant of a square matrix, transpose, adjoint and inverse of a square matrix. Solution to system of linear equation (a) by matrix method and (b) by Cramer's Rule. Characteristic equation of a square matrix, eigenvalues and eigenvectors	12hrs	Employable Skills EMP SKD EDP

2	Unit -2	Calculus: Rule for differentiation; Chain rule (for $f(x)=U^n$, $\sin u$, $\log u$ etc). Implicit differentiation and parametric differentiation and successive differentiation of order 2 (for explicit functions only). Applications of differentiation: Derivative as a slope of the tangent, derivative as a rate measure-velocity and acceleration. Increasing and decreasing functions-Maxima and minima-second derivative test-point of inflections-problems restricted to polynomial.	12hrs	Employable Skills and analytical Skills EMP SKD EDP
3	Unit-3	Integrations: Basic rules-simple substitution-Method of partial fractions-Integration by parts. Define integral and application to areas of plane curves. Functions of several variables: partial derivatives; co-ordinate transformation from cartesian co-ordinates to spherical and cylindrical coordinates and vice-versa. Elementary differential equation: Variable separable, exact first order equations, linear and homogeneous equation. Second order homogeneous differential equation with constant coefficients $f(D)$, $y=0$. Solution of differential equation by power series method. Fourier series: Simple problems. Probability: Review of permutations and combinations. Probability and addition theorem for mutually exclusive events and multiplication theorem for independent events. Curve fitting-Method of least squares.	12 hrs	Employable Skills EMP SKD EDP

REFERENCE BOOKS:

1. Mathematical Preparation for physical chemistry, F. Daniells, M.Graw Hill Inc., US, 1959.
2. Mathematics for chemists, D. M. Hirst, Chemical Publishing Company Incorporated, New York, 1979.
3. Mathematics for chemists, P. G. Francis, Springer, 2011.
4. Basic Mathematics for chemists, P. Tebutt, Wiley-Blackwell, 1994.
5. Calculus and analytic geometry, 9th edition, G. B. Thomas, R.L. Finney, Addison-Wesley Publishing Company, Inc. 1996.
6. Short Course in differential equations, Rainvilles and Bedient, IBH publishers, 1968.
7. Mathematics for chemistry, G. Doggett and B. T. Sutcliffe Longmann Publishers, 1995.

M.Sc I SEMESTER-CHEMISTRY

MCH-106: INORGANIC CHEMISTRY PRACTICALS –I

COURSE	DETAILS
CODE	MCH-106
TITLE	INORGANIC CHEMISTRY PRACTICALS -I
PROGRAMME	M.Sc ORGANIC CHEMISTRY
YEAR/SEMESTER	FIRST/FIRST
TYPE	HARD-CORE
TOTAL CREDITS	2
TOTAL CONTACT HOURS	60
COTACT HOURS PER WEEK	4
EXAMINATION DURATION	4
MAXIMUM MARKS	15(IA) + 35 = 50

TOTAL MODULES	10 Experiments
PEDAGOGY	Lecture with practical training will be given to students.
EVALUATION METHOD	Lab performance, Observation and Mock tests will be given.

COURSE OBJECTIVES

This course aims to impart to the student, knowledge of:

CObj_ID	Course Objectives
CObj_1	Reagents required for qualitative analysis inorganic salts and how to prepare them.
CObj_2	The principles of qualitative analysis of a mixture of inorganic salts containing rare elements and the skills required for the analysis.
CObj_3	The principles of spot analysis also explained.

COURSE OUTCOMES

Upon the completion of this course, the students will be able to:

CO_ID	COURSE OUTCOMES
CO_1	Prepare reagents required for analysis.

CO_2	Carry out qualitative tests and identify inorganic radicals in a salt mixture.										
CO_3	Identify the separation of rare elements present in the given mixture.										
CO_4	Communicate the results of the experiment in a written and oral form.										
PO_1	PO_2	PO_3	PO_4	PO_5	PSO_1	PSO_2	PSO_3	PSO_4	PSO_5		
Understand the separation technique											

MCH-106: INORGANIC CHEMISTRY PRACTICALS –I

CO-PO MAPPING:

CO_1	X					X				
CO_2			X					X		
CO_3		X				X				
CO_4				X					X	
CO_5		X					X			

MCH-106 Inorganic Chemistry Practical-I

60hrs

S. No	Module title	Module Content	Number of Hours	Skills Developed

1	Unit -1	Semi micro qualitative analysis of mixtures containing two anions, two common cations and one less familiar elements: W, Mo, Ce, Th, Zr, V, U and Li	30hrs	Employable Skills EMP SKD EDP
2	Unit -2	Semi micro qualitative analysis of mixtures containing rare elements: W, Mo, Ce, Th, Zr, V, U and Li.	30hrs	Employable Skills and analytical Skills EMP SKD EDP

REFERENCE BOOKS:

1. Vogel's Text book of Qualitative Chemical Analysis, J. Bassett, G. H. Jeffery and J. Mendham, ELBS (1986).
2. Vogel's text book of Quantitative Chemical Analysis, 5th Edition, J. Bassett, G. H. Jeffery and J. Mendham, and R. C. Denny, Longman Scientific and Technical (1999).
3. Inorganic Semimicro Qualitative Analysis, V. V. Ramanujam; The National Pub. Co. (1974).
4. Practical Inorganic Chemistry, G. Marr and B. W. Rockett, Von Nostrand Reinhold Co., London (1972).

M.Sc I SEMESTER-CHEMISTRY MCH-107: INORGANIC CHEMISTRY PRACTICALS –II

COURSE	DETAILS

CODE	MCH-107
TITLE	INORGANIC CHEMISTRY PRACTICALS –II
PROGRAMME	M.Sc ORGANIC CHEMISTRY
YEAR/SEMESTER	FIRST/FIRST
TYPE	HARD-CORE
TOTAL CREDITS	2
TOTAL CONTACT HOURS	60
COTACT HOURS PER WEEK	4
EXAMINATION DURATION	4
MAXIMUM MARKS	15(IA) + 35 = 50
TOTAL MODULES	10 Experiments
PEDAGOGY	Lecture with practical training will be given to students.
EVALUATION METHOD	Lab performance, Observation and Mock tests will be given.

COURSE OBJECTIVES

This course aims to impart to the student, knowledge of:

CObj_ID	Course Objectives

CObj_1	Preparation of solutions required for an experiment.
CObj_2	The principles of preparation of coordination compounds explained.
CObj_3	The various techniques involved in the preparation of coordination compounds.

COURSE OUTCOMES

Upon the completion of this course, the students will be able to:

CO_ID	COURSE OUTCOMES
CO_1	Prepare reagents required for the synthesis of coordination compounds.
CO_2	Design a scheme for synthesis of coordination compound and execute it based on the principles learned.
CO_3	Solve problems encountered during a synthesis.
CO_4	Communicate the results of the experiment in a written and oral form.
CO_5	Understand the different techniques used for the synthesis in the laboratory.

MCH-107: INORGANIC CHEMISTRY PRACTICALS –II

CO-PO Mapping:

	PO_1	PO_2	PO_3	PO_4	PO_5	PSO_1	PSO_2	PSO_3	PSO_4	PSO_5
CO_1	X							X		
CO_2		X				X				
CO_3		X				X				
CO_4	X						X			
CO_5				X			X			

MCH-107: INORGANIC CHEMISTRY PRACTICALS –II

60hrs

S. No	Module title	Module Content	Number of Hours	Skills Developed
1	Unit -1	Preparation of inorganic complexes: 1. Cis- and trans- potassium dioxalatodiaquachromium(III) complex [analysis of oxalate and chromium] 2. Hexamminecobalt(III)chloride [analysis of cobalt] 3. Mercurytrithiocyanatocobaltate. 4. Preparation of pentamminechloro cobalt(III)chloride	30hrs	Employable Skills EMP SKD EDP
2	Unit -2	Quantitative analysis of inorganic complexes: 1. Cis- and trans- potassium dioxalatodiaquachromium(III) complex [analysis of oxalate and chromium] 2. Hexamminecobalt(III)chloride [analysis of cobalt] 3. Mercurytrithiocyanatocobaltate. 4. Preparation of pentammine chloro cobalt(III)chloride.	30hrs	Employable Skills and analytical Skills EMP SKD EDP

REFERENCE BOOKS:

1. Vogel's Text book of Qualitative Chemical Analysis, J. Bassett, G. H. Jeffery and J. Mendham, ELBS (1986).
2. Vogel's text book of Quantitative Chemical Analysis, 5th Edition, J. Bassett, G. H. Jeffery and J. Mendham, and R. C. Denny, Longman Scientific and Technical (1999).
3. Inorganic Semimicro Qualitative Analysis, V. V. Ramanujam; The National Pub. Co. (1974).
4. Practical Inorganic Chemistry, G. Marr and B. W. Rockett, Von Nostrand Reinhold Co., London (1972).

M.Sc I SEMESTER-CHEMISTRY
MCH-108: PHYSICAL CHEMISTRY PRACTICALS –III

COURSE	DETAILS
CODE	MCH-108
TITLE	PHYSICAL CHEMISTRY PRACTICALS –III
PROGRAMME	M.Sc ORGANIC CHEMISTRY
YEAR/SEMESTER	FIRST/FIRST
TYPE	HARD-CORE
TOTAL CREDITS	2
TOTAL CONTACT HOURS	60
CONTACT HOURS PER WEEK	4
EXAMINATION DURATION	4
MAXIMUM MARKS	15(IA) + 35 = 50
TOTAL MODULES	10 Experiments
PEDAGOGY	Lecture with practical training will be given to students.
EVALUATION METHOD	Lab performance, Observation and Mock tests will be given.

COURSE OBJECTIVES

This course aims to impart to the student, knowledge of:

CObj_ID	Course Objectives
CObj_1	Preparation and standardization of solutions. Preparation and standardization of solutions required for an experiment.
CObj_2	Use of a colorimeter for titrations. Use of a colorimeter in the estimation of mixtures. Determination of partial molal volume of solutions
CObj_3	Use of a colorimeter in the study of the kinetics of a reaction. Verify Beer's law of different ions.

COURSE OUTCOMES

Upon the completion of this course, the students will be able to:

CO_ID	COURSE OUTCOMES
CO_1	Devise and carry out an experiment to study the kinetics of a reaction.
CO_2	Interpret the experimental data in terms of a rate equation.
CO_3	Identify wavelength of maximum absorbance
CO_4	To plot phase diagram of two/three component systems and interpret them.
CO_5	Use colorimeter/spectrophotometer for colorimetric estimations, titrations and kinetic studies.

MCH-108: PHYSICAL CHEMISTRY PRACTICALS –III

CO-PO Mapping:

	PO_1	PO_2	PO_3	PO_4	PO_5	PSO_1	PSO_2	PSO_3	PSO_4	PSO_5
CO_1		X					X			
CO_2	X					X				
CO_3		X					X			
CO_4	X					X				
CO_5			X				X			

MCH-108 Physical Chemistry Practical –I

60hrs

S. No	Module title	Module Content	Number of Hours	Skills Developed
1	Unit -1	Acid hydrolysis of methyl acetate at lab temperature. 1. Velocity constant for the saponification of ethyl acetate. 2. Verification of Beer's Law for Cu^{2+} ions 3. Verification of Beer's Law for Fe^{2+} ions.	26hs	Employable Skills EMP SKD EDP
2	Unit -2	4. Estimation of Fe^{2+} ions concentration in the given solution by titration of FAS versus KMnO_4 through colorimetric method. 5. Estimation of Fe^{2+} ions concentration using EDTA through colorimetric method 6. Phase diagram of two component systems and determination of E_C, E_T and the determination of the composition of given unknown. 7. Determination of partial molar volume of solute – H_2O system by apparent molar volume method. 8. Determination of the viscosity of a mixture by apparent molar volume method.	34hrs	Employable Skills and analytical Skills EMP SKD EDP

REFERENCE BOOKS:

1. Findlays practical physical chemisty revised by P. B. Levitt, Longman's London (1966).
2. Experiments in Physical Chemistry by Shoemaker and Garland, McGraw Hill International Edn. (1966)
3. Advanced Practical Physical Chemistry by J. B. Yadav, Goel Publications Meerut (1988)
4. Senior Practical Physical Chemistry by B. C. Kosla, Simla Printers New Delhi (1987)

M.Sc I SEMESTER-CHEMISTRY
MCH-109: PHYSICAL CHEMISTRY PRACTICALS –IV

COURSE	DETAILS
CODE	MCH-109
TITLE	PHYSICAL CHEMISTRY PRACTICALS –IV
PROGRAMME	M.Sc ORGANIC CHEMISTRY
YEAR/SEMESTER	FIRST/FIRST
TYPE	HARD-CORE
TOTAL CREDITS	2
TOTAL CONTACT HOURS	60
COTACT HOURS PER WEEK	4
EXAMINATION DURATION	4
MAXIMUM MARKS	15(IA) + 35 = 50
TOTAL MODULES	10 Experiments
PEDAGOGY	Lecture with practical training will be given to students.
EVALUATION METHOD	Lab performance, Observation and Mock tests will be given.

COURSE OBJECTIVES

This course aims to impart to the student, knowledge of:

CObj_ID	Course Objectives
CObj_1	The use of a conductivity meter for determination of specific conductance and solubility of electrolytes.
CObj_2	The use of Potentiometer meter for titrations (acid base, redox, precipitation)
CObj_3	Plotting of data in two dimensions and identifying the end point of the titration.

COURSE OUTCOMES

Upon the completion of this course, the students will be able to:

CO_ID	COURSE OUTCOMES
CO_1	Use the conductivity meter as a tool for quantitative analysis. Report the results of the experiment in written and verbal form.
CO_2	Use conductivity measurements to distinguish between electrolytes (strong and weak).
CO_3	Use colorimeter/spectrophotometer for colorimetric estimations, titrations and kinetic studies.
CO_4	Carry out an electrochemistry experiments to determine the single electrode potentials of different systems.
CO_5	Report the results of the experiment in written and verbal form.

MCH-109: PHYSICAL CHEMISTRY PRACTICALS –IV

CO-PO Mapping:

	PO_1	PO_2	PO_3	PO_4	PO_5	PSO_1	PSO_2	PSO_3	PSO_4	PSO_5
CO_1		X					X			
CO_2	X					X				
CO_3		X					X			
CO_4	X					X				
CO_5			X				X			

MCH-109 Physical Chemistry Practical –II

60hrs

S. No	Module title	Module Content	Number of Hours	Skills Developed
1	Unit -1	<u>Conductometric Experiments</u> 1. Precipitation titration: conductometric titration of lithium sulphate versus BaCl ₂ 2. Conductometric titration of weak acid versus weak base. 3. Dissociation constant of weak acid (CH ₃ COOH) by conductometric method. 4. Determination of Equivalent conductance of a given strong electrolyte. Conductometric titration of strong acid versus strong base.	30hrs	Employable Skills EMP SKD EDP
2	Unit -2	<u>Potentiometric Experiments</u> 6. Determination of single electrode potential of Cu ²⁺ /Cu and estimate the given unknown concentration. 7. Determination of single electrode potential of Zn ²⁺ /Zn and estimate the given unknown concentration. 8. Titration of weak acid against a strong base using quinhydrone electrode and calculation of pKa and Ka values of the weak acid. 9. Determination of pH of a buffer	30hrs	Employable Skills and analytical Skills EMP SKD EDP

		by using quinhydrone electrode and comparison of the pH values obtained with glass electrode.		

REFERENCE BOOKS:

1. Experimental Physical Chemistry by Daniel et al., McGraw Hill, New York (1962).
2. Practical Physical Chemistry by A.M James and P. E. Pritchard, Longman's Group Ltd (1968)
3. Experimental Physical Chemistry by Wilson, Newcombe & others, Pergamon Press, New York (1962)
4. Experimental Physical Chemistry by R. C. Behra and B Behra, Tata McGraw, New Delhi (1983)
5. Experimental Physical Chemistry by V. D. Atavale and Parul Mathur, New Age International, New York (2001)
6. Physical Chemistry Laboratory Principles and Experiments by H. W. Salberg J. I. Morrow, S. R. Cohen and M. E. Green Macmillan publishing Co .new York.
7. Practical's in physical chemistry A. Modern Approach by P.S Sindhu, Mac. Millan Publishers Delhi (2006).

M.Sc II SEMESTER-CHEMISTRY

MCH-201: INORGANIC CHEMISTRY-II

COURSE	DETAILS
CODE	MCH-201
TITLE	INORGANIC CHEMISTRY-II
PROGRAMME	M.Sc ORGANIC CHEMISTRY
YEAR/SEMESTER	FIRST/SECOND
TYPE	HARD-CORE
TOTAL CREDITS	4
TOTAL CONTACT HOURS	52
COTACT HOURS PER WEEK	4
EXAMINATION DURATION	3
MAXIMUM MARKS	30(IA) + 70 = 100
TOTAL MODULES	4
PEDAGOGY	Lecture with practical problems being Worked out, Chalk and talk PPT presentations, Seminars and presentations.

EVALUATION METHOD	Two internal assessments, one mid-term examination, one end Semester examination, Class participation.

COURSE OBJECTIVES

This course aims to impart to the student, knowledge of:

CObj_ID	Course Objectives
CObj_1	Kinetic and thermodynamic parameters as a measure of stability of coordination compounds. . Electronic spectroscopy and magnetic properties of coordination compounds.
CObj_2	Advanced theories of bonding in complexes along with their stereochemistry.
CObj_3	Mechanisms of inorganic redox reactions involving coordination compounds.

COURSE OUTCOMES

Upon the completion of this course, the students will be able to:

CO_ID	COURSE OUTCOMES
CO_1	Understand and apply the principles of stability of complexes in synthesis of new molecules.
CO_2	Relate the structure of complexes to their properties.
CO_3	Use electronic spectroscopy as an analytical tool in the structural elucidation of complexes.

CO_4		Interpret the magnetic properties of transition metal complexes based on magnetic measurements									
CO_5		Study the mechanisms of inorganic oxidation and reduction reactions involving coordination compounds									
		PO_1	PO_2	PO_3	PO_4	PO_5	PSO_1	PSO_2	PSO_3	PSO_4	PSO_5
CO_1			X					X			
CO_2	X						X				
CO_3			X					X			
CO_4	X						X				

CO-PO MAPPING:

CO_5			X				X			

SECOND SEMESTER

MCH-201: INORGANIC CHEMISTRY- II

52 Hours

S. No	Module title	Module Content	Number of Hours	Skills Developed

1	Unit -1	Metal-Ligand equilibria in solution- Step-wise and overall formation constant and their relationship, trends in step-wise constant, kinetic and thermodynamic stability of metal complexes, factors affecting the stability of metal complexes with reference to the nature of the metal ion and ligand, chelate effect, macrocyclic effect and their thermodynamic origin. Determination of binary formation constant by pH metry, spectrophotometry, polarography and ion exchange methods. Structure and bonding- Structure and bonding in hydride, dihydrogen, dioxygen, isocyanide, CO, NO, N₂ and tertiary phosphine complexes of transition metals.	13hrs	Employable Skills EMP SKD EDP
2	Unit -2	Metal- ligand bonding- Stereoisomerism- coordination numbers 3 to 8. Crystal field theory, salient features, spectrochemical series, splitting of d-orbitals in tetragonal, square planar, trigonal bipyramidal and square-pyramidal geometry, applications of CFT- colours of transition metal complexes, magnetic properties of octahedral complex, distortion of octahedral complex, CFSE and their uses, factors affecting CFSE, limitations of CFT, experimental evidence for metal-ligand covalent bonding in complexes, nephelauxetic effect, Ligand Field Theory, MO theory: tetrahedral and octahedral Stereochemical non-rigidity, self assembly in supramolecular chemistry. Chemistry.complexes (including π-bonding), angular overlap model.	13hrs	Employable Skills and analytical Skills EMP SKD EDP
3	Unit-3	Electronic spectra of coordination compounds- Spectroscopic ground states, selection rules, term symbols for dⁿ ions, Racah parameters, Orgel, Correlation and Tanabe-Sugano diagrams, spectra of 3d metal-aqua complexes of trivalent V, Cr, divalent Mn, Co and Ni, CoCl₄²⁻, calculation of Dq, B and β parameters, CT spectra. Spectral properties of Lanthanide and Actinide metal complexes.	13hrs	Employable Skills EMP SKD EDP

4	Unit-4	Magnetic properties of coordination compounds- Types of magnetic behavior, magnetic susceptibility and its determination- Gouy, Faraday, VSM method. Diamagnetic correction, orbital contribution, spin-orbital coupling, ferro- and antiferromagnetic coupling, spin-crossover. Magnetic properties of Lanthanide and Actinide metal complexes. Photochemical reactions of transition metals complexes: Basic photochemical processes, Kasha's rule, quantum yield, Jabolnskii diagrams, photo substitution reactions, photo-redox reactions, ligand photoreactions, photoreactions and solar energy conversion.	13hrs	Employable Skills EMP SKD EDP

REFERENCE BOOKS:

1. Basic Inorganic Chemistry- F. A. Cotton, G. Wilkinson and P. L. Gaus; John Wiley and sons. Inc, 6th edition (1999).
2. Chemistry of elements- N. N. Greenwood and A. E. Earnshaw, Butterworth Heinemann (1997).
3. Inorganic Chemistry IV edition; J. E. Huheey, E. A. Keiter and R. L. Keiter, Addison; Wesley (1993).
4. Inorganic Chemistry, II edition, D. F. Shriver, P. W. Atkins and C. H. Langford, ELBS; Oxford University Press, 1994.
5. Inorganic Electronic spectroscopy, A. B. P. Lever, Elsevier. (1968).
6. Magnetochemistry, R.L. Carlin, Springer Verlag.

M.Sc II SEMESTER-CHEMISTRY

MCH-202: ORGANIC CHEMISTRY-II

COURSE	DETAILS
CODE	MCH-202
TITLE	ORGANIC CHEMISTRY-II
PROGRAMME	M.Sc ORGANIC CHEMISTRY
YEAR/SEMESTER	FIRST/SECOND
TYPE	HARD-CORE
TOTAL CREDITS	4
TOTAL CONTACT HOURS	52
COTACT HOURS PER WEEK	4
EXAMINATION DURATION	3
MAXIMUM MARKS	30(IA) + 70 = 100
TOTAL MODULES	4
PEDAGOGY	Lecture with practical problems being Worked out, Chalk and talk PPT presentations, Seminars and presentations.
EVALUATION METHOD	Two internal assessments, one mid-term examination, one end Semester examination, Class participation.

COURSE OBJECTIVES

This course aims to impart to the student, knowledge of:

CObj_ID	Course Objectives
CObj_1	Mechanisms and evidences for aromatic electrophilic and nucleophilic substitutions, addition reactions, elimination reactions and rearrangements.
CObj_2	Effect of substrate structure, leaving group and attacking species in the above reactions.
CObj_3	The orientation and stereochemistry of the product formed.

COURSE OUTCOMES

Upon the completion of this course, the students will be able to:

CO_ID	COURSE OUTCOMES
CO_1	Explain the mechanistic pathway for aromatic substitutions, addition reactions, elimination reactions and rearrangements.
CO_2	Predict the stereochemistry of the products formed.
CO_3	Design reactions with the help of name reactions and rearrangements and use of suitable reagents.
CO_4	Know the uses of name reactions and rearrangements for the synthesis of industrially and pharmaceutically important compounds.
CO_5	Know the Synthesis and applications of selected reagents used for various organic transformations.

CO-PO MAPPING

	PO_1	PO_2	PO_3	PO_4	PO_5	PSO_1	PSO_2	PSO_3	PSO_4	PSO_5
CO_1		X					X			
CO_2	X					X				
CO_3		X					X			
CO_4	X					X				
CO_5			X				X			

52 Hours

S. No	Module title	Module Content	Number of Hours	Skills Developed
1	Unit -1	Aromatic Substitution Reactions <u>Electrophilic Substitution Reactions:</u> The arenium ion mechanism. Orientation and reactivity. Energy profile diagrams. The <i>ortho/para</i> ratio, <i>ipso</i> attack, orientation in other ring systems. Quantitative treatment of reactivity in substrates and electrophiles. Effect of leaving group. Amination, sulfonylation reactions; Diazonium coupling, Vilsmeier-Haack reaction, Gatterman reaction, Gatterman-Koch reaction and Hoesch reaction. <u>Nucleophilic substitution reactions:</u> The S_NAr, S_N1, benzyne and S_{RN}1 mechanisms. Reactivity: effect of substrate structure, leaving group and attacking nucleophile. Goldberg reaction, Bucherer reaction, Schiemann reaction, von Richter reaction, Sommelet-Hauser and Smiles rearrangements.	13hrs	Employable Skills EMP SKD EDP
2	Unit -2	Addition Reactions <u>Addition to carbon-carbon multiple bonds:</u> mechanistic and stereochemical aspects of addition reactions involving electrophiles, nucleophiles and free radicals. Regio, stereo- and chemoselectivities. Orientation and reactivity. Addition to cyclopropane ring. Hydrogenation of double and triple bonds, hydrogenation of aromatic rings. Addition of alkenes and/or alkynes to alkenes and/or alkynes. Ene synthesis. Michael reaction. <u>Addition to carbon-heteroatom multiple bonds:</u> Mechanism of metal hydride reduction (LiAlH₄, NaBH₄) of saturated and unsaturated carbonyl compounds, acids, esters and nitriles.	13hrs	Employable Skills and analytical Skills EMP SKD EDP

		Addition of Grignard reagents and organolithium reagents to carbonyl compounds and unsaturated carbonyl compounds. Conversion of aldehydes to nitriles. Hydrolysis of nitriles and addition of amines to isocyanates. Formation of xanthates. Wittig, Mannich and Stobbe reactions		
3	Unit-3	Elimination Reactions The E2, E1 and E1cB mechanisms. Orientation of the double bond. Reactivity-effects of substrate structure, attacking base, the leaving group and the medium. Mechanism and orientation in pyrolytic elimination reactions (including Chugaev reaction). Rearrangements Wagner-Meerwein, Pinacol-Pinacolone, Fries, Beckmann, Hofmann, Curtius, Lossen and Schmidt rearrangements. Benzil-benzilic acid rearrangement, Arndt-Eistert reaction, Tiffeneau-Demjanov reaction, Fritsch-Buttenberg-Wiechell rearrangement. Stevens, and Favorskii rearrangements, Dienone-phenol, Baeyer-Villiger oxidation. Neber rearrangement. Benzidine rearrangement,	13hrs	Employable Skills EMP SKD EDP
4	Unit-4	Amino acids and Peptides Synthesis of amino acids Classification and nomenclature of peptides. Sanger and Edman methods of sequencing. Cleavage of peptide bond by chemical methods. Peptide synthesis- Protection of amino group (Boc-, Z- and Fmoc-) and carboxyl group as alkyl and aryl esters. Use of DCC, EEDQ, HOBt in peptide bond formation reactions. Deprotection and racemization in peptide synthesis. solid phase techniques. Synthesis of oxytocin, gramicidin. Vitamins Biological importance and synthesis of Vitamins A, Vitamin B ₁ (thiamine), Vitamin B ₆ (pyridoxine), folic acid, pantothenic acid, riboflavin, Vitamin C, Vitamin E (α -tocopherol), Vitamin H (biotin), Vitamins K ₁ and K ₂ .	13hrs	Employable Skills EMP SKD EDP

REFERENCE BOOKS:

1. Advanced Organic Chemistry – Reactions, Mechanism and Structure, Jerry March, John Wiley (2008).
2. Advanced Organic Chemistry, F. A. Carey and R. J. Sundberg, Plenum (1990).
3. A Guide Book to Mechanism of Organic Chemistry, Peter Sykes, Longman (2000).
4. Structure and Mechanism of Organic Chemistry, C. K. Ingold, Cornell University Press.
5. Organic Chemistry, R. T. Morrison and R. N. Boyd, Prentice-Hall (1998).
6. Modern Organic Reactions, H. O. House, Benjamin (1972).
7. Principles of Organic Synthesis, R.C. Norman and J. M. Coxon, Blackie Academic and Professional (1996).
8. Stereochemistry of Organic Compounds, D. Nasipuri, New-Age International (1999).
9. Stereochemistry of Carbon Compounds, E. L. Eliel, S. H. Wilen and L. N. Mander, John Wiley (1994).
10. Organic Chemistry, Volumes I and II, I L Finar, Longman. (1999).
11. Medicinal Chemistry, A Kar, Wiley (2000).
12. Peptides Chemistry: A practical text book, M. Bodansky, Springer-Verlag NY, 1988.
13. Solid-phase peptide synthesis: A practical approach-E. Artherton & R.C. Sheppard, I R L, Oxford Univ. Press, 1989.
14. Peptides: Chemistry and Biology, N Selwad and H.-D. Jakubke, Wiley-VCH, 2002.

M.Sc II SEMESTER-CHEMISTRY

MCH-203: PHYSICAL CHEMISTRY-II

COURSE	DETAILS
CODE	MCH-203
TITLE	PHYSICAL CHEMISTRY-II
PROGRAMME	M.Sc ORGANIC CHEMISTRY
YEAR/SEMESTER	FIRST/SECOND
TYPE	HARD-CORE
TOTAL CREDITS	4
TOTAL CONTACT HOURS	52
COTACT HOURS PER WEEK	4
EXAMINATION DURATION	3
MAXIMUM MARKS	30(IA) + 70 = 100
TOTAL MODULES	4
PEDAGOGY	Lecture with practical problems being Worked out, Chalk and talk PPT presentations, Seminars and presentations.
EVALUATION METHOD	Two internal assessments, one mid-term

	examination, one end Semester examination, Class participation.

COURSE OBJECTIVES

This course aims to impart to the student, knowledge of:

CObj_ID	Course Objectives
CObj_1	The advanced theories explaining the behavior of electrolytes such as Debye-Huckel theory and Bjerrum theory of ion association.
CObj_2	Structural models of electrified interface.
CObj_3	The kinetics and thermodynamics of electrochemical reactions.

COURSE OUTCOMES

Upon the completion of this course, the students will be able to:

CO_ID	COURSE OUTCOMES
CO_1	Explain fundamental aspects of electrochemical reaction in terms of thermodynamics, kinetics and mass transport.
CO_2	Explain the structure of electric double layer at the interface and its role on electrode reactions.
CO_3	Account for the physical interpretation of distribution functions and discuss and show how these can be used in calculations of basic thermodynamic properties.
CO_4	Know the Concepts in classical laws of thermodynamics and their application, postulates of statistical mechanics, statistical interpretation of thermodynamics, ensembles.

CO_5	Understand the Mathematical framework for thermodynamics of system.

	PO_1	PO_2	PO_3	PO_4	PO_5	PSO_1	PSO_2	PSO_3	PSO_4	PSO_5
CO_1		X					X			
CO_2	X					X				
CO_3		X					X			
CO_4	X					X				
CO_5			X				X			

CO-PO Mapping

MCH-203: PHYSICAL CHEMISTRY- II

52 Hours

S. No	Module title	Module Content	Number of Hours	Skills Developed
1	Unit -1	<u>Thermodynamics-I</u> Thermodynamics: Concepts of partial molar properties – partial molar free energy, chemical potential, partial molar volume and its significance. Gibbs-Duhem equation, Gibbs-Duhem-Margulus equation. Determination of partial molar volume: Graphical method, intercept method and Apparent molar volume method. Concept of fugacity; Determination of fugacity by graphical method and compressibility factor method. Activity and activity coefficient: Determination of activity coefficient by EMF and solubility method. Thermodynamics of	13hrs	Employable Skills EMP SKD EDP

		non-ideal system-Excess thermodynamic function, G^E, SE, H^E etc. Phase Rule: Derivation of phase rule from the concept of chemical potential. Application of Phase Rule to three components system: Principle of triangular diagram: Plots for a mixture of three liquids consisting of one, two and three pairs of partially miscible liquids. Statistical Thermodynamics: Objectives of statistical thermodynamics, Concept of distributions, Types of ensembles. Thermodynamic probability, most probable distribution Law Partition Function, (Definition and significance): Molar and molecular partitions-translational, rotational, vibrational and electronic partition functions- Relation between thermodynamic functions (E, H, S, G and C_V) and the partition functions.		
2	Unit -2	<u>Thermodynamics-II</u> Sackur-Tetrode equation for entropy of translation function. Relation between equilibrium constant and partition function. Different Distribution Laws: Types of Statistics Maxwell – Boltzmann , Bose-Einstein and Fermi-Dirac statistics. Derivation of ations for above three distribution Laws. Comparison of Bose-Einstein and Fermi-Dirac statistics with Maxwell – Boltzmann statistics. Problems and their Solutions. Non-equilibrium Thermodynamics : Thermodynamic criteria for non-equilibrium states-Phenomenological Laws and Onsager's reciprocity relations, Coupled and Non-coupled reactions, Entropy production and entropy flow. Electro kinetic Phenomenon. Postulates and methodologies: Uncompensated heat and thermodynamics function production. de-Donder's inequality. Rate of entropy production. Transformations of the generalized fluxes and forces : eg., Chemical reaction, heat flow, Diffusion or material flow, flow of	13hrs	Employable Skills and analytical Skills EMP SKD EDP

		electric current		
3	Unit-3	<u>Electrochemistry-I</u> Electrochemistry of solutions: Ionic atmosphere, Debye-Huckel theory for the problem of activity coefficient, Debye-Huckel limiting Law, Debye-Huckel equation for appreciable concentration, Debye-Huckel Onsagar interactions Conductance equation and its extension to ion solvent. Thermodynamics of electrified interface, derivation of electro capillary Lipmann's equation, surface excess, thermodynamic aspects of surface excess. The method of determination and measurement of interfacial tension as a function of applied potential difference across the interface.	13hrs	Employable Skills EMP SKD EDP
4	Unit-4	<u>Electrochemistry-II</u> Structure of electrified interface: Helmholtz theory Guoy- Chapman theory, Stern model. Overpotential: Concentration overpotential and volmer equation. Electrocatalysis: Definition and Influence of various parameters. Quantum aspects of charge transfer at electrode solution interface, quantization of charge transfer, tunneling of electrons for hydrogen evolution with reference to electrocatalysis. Polarography: Ilkovic equation, half wave potential and its significance, qualitative and quantitative estimation of metal ions. Semiconductor- solution interface: Theory of double layers at semiconductor- electrolyte interface.	13hrs	Employable Skills EMP SKD EDP

REFERENCE BOOKS:

1. Molecular thermodynamics, Donald A. Mc Quarrie, John D. Simon University Science Books California, (1999).
2. Thermodynamics for Chemists, by S. Glasstone, East-West Press, New Delhi, (1960).
3. Thermodynamics, by Rajaraman and Kuriacose, East-West Press, (1986).
4. Statistical Thermodynamics, M. C. Gupta (Wiley Eastern Ltd.) 1993.

5. Elementary Statistical Thermodynamics, N. D. Smith, Plenum Press, NY, (1982).
6. Elements of Classical and Statistical Thermodynamics, L. K. Nash, Addison-Wiley (1979).
7. Thermodynamics, Statistical Thermodynamics and Kinetics by Thomas Engel & Philip Reid, Pearson Education inc. (2007)
8. Modern Electrochemistry Vol-1 and 2 J. O. M Bockris and A. K. N. Raddy, Plenum NewYork (1978)
9. An introduction to electrochemistry- Samuel Glastone East-West edition New Delhi (1942)
10. Text book of physical chemistry Samuel Glastone , 2nd edition, Mac Millan India Ltd (1991)
11. Electrochemistry, Principles and applications, Edmund, C. Potter, Cleaver-Hume press London (1961).
12. Principles and applications of Electrochemistry- D. R. Crow 3rd edition Chapmanhall London (1988)

M.Sc II SEMESTER-CHEMISTRY

MCH-204: SPECTROSCOPY-I

COURSE	DETAILS
CODE	MCH-204
TITLE	SPECTROSCOPY-I
PROGRAMME	M.Sc ORGANIC CHEMISTRY
YEAR/SEMESTER	FIRST/SECOND
TYPE	HARD-CORE
TOTAL CREDITS	4
TOTAL CONTACT HOURS	52
COTACT HOURS PER WEEK	4

EXAMINATION DURATION	3
MAXIMUM MARKS	30(IA) + 70 = 100
TOTAL MODULES	4
PEDAGOGY	Lecture with practical problems being Worked out, Chalk and talk PPT presentations, Seminars and presentations.
EVALUATION METHOD	Two internal assessments, one mid-term examination, one end Semester examination, Class participation.

COURSE OBJECTIVES

This course aims to impart to the student, knowledge of:

CObj_ID	Course Objectives
CObj_1	Qualitatively predict which signals are to be observed in the rotational, vibrational or electronic spectrum of various materials ranging from single atoms (atomic spectroscopy) to molecules (IR, Raman, and UV-Vis Spectroscopy).
CObj_2	Basic concepts of group theory and its applications, fundamental aspects of classifying molecules based on various symmetry elements, point groups and constructing character table.
CObj_3	Principles and instrumentation of different molecular spectroscopic methods

COURSE OUTCOMES

Upon the completion of this course, the students will be able to:

CO_ID	COURSE OUTCOMES

CO_1		Recognize symmetry elements, identify point groups of molecules, construct and explain character table for simple molecules.									
CO_2		Categorize molecules based on their symmetry properties and predict									
			their molecular properties.								
		PO_1	PO_2	PO_3	PO_4	PO_5	PSO_1	PSO_2	PSO_3	PSO_4	PSO_5
	CO_3		Combine, evaluate and								
CO_1			spectroscopic techniques in								
		X						X			
	CO_4		Understand the significance								
CO_2											
	X						X				
	CO_5		Know the conceptual featur								
CO_3											
		X						X			
CO_4											

CO-PO MAPPING:

	X					X				
CO_5			X				X			

MCH-204: SPECTROSCOPY-I

S. No	Module title	Module Content	Number of Hours	Skills Developed

1	Unit -1	Symmetry and Group Theory in Chemistry Definition of groups, subgroups, cyclic groups, conjugate relationships, classes, simple theorems in group theory. Symmetry elements and symmetry operations, point groups, Schönflies notations, representations of groups by matrices, reducible and irreducible representations, characters of representations, Great Orthogonality Theorem (without proof) and its applications, character tables and their uses (representations for the C_n, C_{nv}, C_{nh}, D_{nh} etc groups to be worked out explicitly) Mulliken symbols for irreducible representations Direct products, Applications of group theory to quantum mechanics- identifying non-zero matrix elements, derivation of the orthonormalization conditions Unifying principles Interaction of electromagnetic radiation with matter- time-dependent perturbation theory, transition moment integral, selection rules- symmetry and spin forbidden transitions	13hrs	Employable Skills EMP SKD EDP
2	Unit -2	Microwave Spectroscopy Rotations of molecules, rigid diatomic molecule-rotational energy expression, energy level diagram, rotational wave functions and their symmetry, selection rules, expression for the energies of spectral lines, computation of intensities, effect of isotopic substitution, centrifugal distortion and the spectrum of a non-rigid rotor. Rotational spectra of polyatomic molecules- linear, symmetric top and asymmetric top molecules Stark effect, techniques and instrumentation Infrared Spectroscopy-I Vibrations of molecules, harmonic and anharmonic oscillators- vibrational energy expression, energy level diagram, vibrational	13hrs	Employable Skills and analytical Skills EMP SKD EDP

		wave functions and their symmetry, selection rules, expression for the energies of spectral lines, computation of intensities, hot bands, effect of isotopic substitution Diatomic vibrating rotor, Born-Oppenheimer approximation, vibrational-rotational spectra of diatomic molecules, P, Q and R branches, breakdown of the Born-Oppenheimer approximation.		
3	Unit-3	Infrared Spectroscopy-II Vibrations of polyatomic molecules: Normal coordinates, translations, vibrations and rotations, vibrational energy levels and wave functions, fundamentals, overtones and combinations Vibration-rotation spectra of polyatomic molecules- parallel and perpendicular vibrations of linear and symmetric top molecules, Techniques and instrumentation FTIR. Raman Spectroscopy Classical theory of the Raman effect, polarizability as a tensor, polarizability ellipsoids, quantum theory of the Raman effect, Pure rotational Raman spectra of linear and asymmetric top molecules, vibrational Raman spectra, Raman activity of vibrations, rule of mutual exclusion, rotational fine structure- O and S branches, Polarization of Raman scattered photons Structure determination from Raman and IR spectroscopy-AB₂ and AB₃ molecules Techniques and instrument	13hrs	Employable Skills EMP SKD EDP
4	Unit-4	Electronic Spectroscopy Born-Oppenheimer approximation, vibrational coarse structure, intensities by Franck-Condon principle, Dissociation energy, rotational fine structure, Fortrat diagram, pre-dissociation. Electronic structure of diatomic molecules- basic results of MO theory, classification of states by electronic angular momentum-σ, π, δ, and ϕ molecular orbitals, selection rules, spectrum of singlet and triplet molecular hydrogen	13hrs	Employable Skills EMP SKD EDP

		Electronic spectra of polyatomic molecules-localized MOs, spectrum of HCHO, change of shape on excitation		
		Decay of excited states- radiative (fluorescence and phosphorescence) and non-radiative decay, internal conversion		

REFERENCE BOOKS:

1. Chemical Applications of Group Theory, F. A. Cotton, Wiley Eastern (1976).
2. Molecular Symmetry, D. S. Schonland, Van Nostrand (1965).
3. Introduction to Molecular Spectroscopy, C. N. Banwell, TMH Edition (1994).
4. Introduction to Molecular Spectroscopy, G. M. Barrow, McGraw Hill (Int. Students Edition) (1988).
5. Molecular Spectroscopy, J. D. Graybeal, McGraw Hill (Int. Students Edition) (1990).
6. Spectroscopy, Vols. 1-3, B. P. Straughan and W. Walker, Chapman Hall (1976).

(UPTO 2019 to 2024)

COURSE	DETAILS
CODE	MCH-205
TITLE	GREEN SYNTHESIS (SOFT-CORE)
PROGRAMME	M.Sc ORGANIC CHEMISTRY
YEAR/SEMESTER	FIRST/SECOND
TYPE	SOFT-CORE
TOTAL CREDITS	3
TOTAL CONTACT HOURS	36
COTACT HOURS PER WEEK	4
EXAMINATION DURATION	3
MAXIMUM MARKS	30(IA) + 70 = 100
TOTAL MODULES	4
PEDAGOGY	Lecture with practical problems being Worked out, Chalk and talk PPT presentations, Seminars and presentations.
EVALUATION METHOD	Two internal assessments, one mid-term examination, one end Semester examination, Class participation.

COURSE OBJECTIVES

This course aims to impart to the student, knowledge of:

CObj_ID	Course Objectives
CObj_1	Understand Ultrasound, microwave, ionic liquids, phase transfer catalysts, polymer supports in organic synthesis.
CObj_2	Multi-component reactions as a tool for efficient atom economical reactions.
CObj_3	Sonochemical reactions

COURSE OUTCOMES

Upon the completion of this course, the students will be able to:

CO_ID	COURSE OUTCOMES
CO_1	Use ultrasound, microwave, ionic liquids, phase transfer catalysts, polymer supports and multi-component reactions for various organic transformations.
CO_2	Understand the uses of Ionic liquids in Organic synthesis.
CO_3	Design the mechanism for phase transfer catalysis.
CO_4	Know the synthetic applications of superoxide ions.
CO_5	Understand the use of polymer supported reagents in Organic synthesis.

CO-PO MAPPING:

	PO_1	PO_2	PO_3	PO_4	PO_5	PSO_1	PSO_2	PSO_3	PSO_4	PSO_5
CO_1		X					X			
CO_2	X					X				
CO_3		X					X			
CO_4	X					X				
CO_5			X				X			

M.SC II SEMESTER- CHEMISTRY

MCH-205: GREEN SYNTHESIS (SOFT-CORE) (UPTO 2019-24)

36hrs

S. No	Module title	Module Content	Number of Hours	Skills Developed
1	Unit -1	Use of ultrasound and Microwaves in Organic Synthesis <u>Use of ultrasound</u>: Introduction, Sonochemical esterification, substitution, addition, alkylation, oxidation, reduction and coupling reactions. <u>Use of Microwaves</u>: Introduction, concept, reaction vessel/medium, atom efficiency (% atom utilization), advantages and limitations. N-alkylation and alkylation of active methylene compounds, condensation of active methylene compounds with aldehydes and amines. Diels-Alder reaction. Deprotection of esters and silyl ethers.	7hrs	Employable Skills EMP SKD EDP
2	Unit -2	Ionic-liquids: Introduction, structure, synthesis and applications of some important ionic liquids in organic synthesis. . Polymer supported reagents in organic synthesis Introduction- properties of polymer support, advantages of polymer supported reagents and choice of polymers. <u>Applications: Substrate covalently bound to the support</u>: Synthesis of oligosachcharides, Dieckmann cyclisation. Preparation of polymer bound aldehyde and application in aldol and Wittig reactions. Synthesis of polystyryl boronic acid and use in diol protection reaction. <u>Reagent linked to a polymeric material</u>: Preparation of sulfonazide polymer and application in diazotransfer reaction. Synthesis of polymer bound per acid and its applications. <u>Polymer supported catalytic reactions</u>: Preparation of polymer supported AlCl₃ and application in etherification and acetal formation reactions.	12hrs	Employable Skills and analytical Skills EMP SKD EDP

3	Unit-3	Phase transfer catalysis and Crown ethers <u>Phase transfer catalysis</u>: Introduction, definition, mechanism of phase transfer catalysis. Types of phase transfer catalysts and reactions and their Advantages. Preparation of catalysts and their application in substitution, elimination, addition, alkylation, oxidation and reduction reactions. <u>Crown ethers</u>: Introduction, nomenclature, nature of donor site. General synthesis of Crown ethers. <u>Synthetic applications</u>: Alkylation, generation of carbenes, aromatic substitution and displacement reactions. Generation and application of superoxide anions. Cation deactivation reaction.	8hrs	Employable Skills EMP SKD EDP
4	Unit-4	Multi-component Reactions Use of the following reactions in organic synthesis: Passerini-Ugi; Hantsch; Biginelli; Doebner-Miller; Ritter; Jacobson; Betti; Robinson-Schopf; Barbier; Baylis-Hillmann; Ivanov and Suzuki coupling reaction.	9hrs	Employable Skills EMP SKD EDP

REFERENCE BOOKS:

1. Stereochemistry of carbon compounds, E. L. Eliel, S. H. Wilen and L. N. Mander, John Wiley & Sons, 1994.
2. Stereochemistry, Potapov, MIR, Moscow, 1984.
3. Stereochemistry, Nasipuri, D, New Age, 1999.
4. Advanced organic chemistry, J. March, 4th Edn. John Wiley, 2008.
5. Organic Chemistry, R. E. Ireland Prentice-Hall India, New Delhi, 1975.
6. Some modern methods of Organic Synthesis, W. Caruthers, Cambridge Uni. Press London, 2nd Edn. 1998.
7. Green Chemistry, environment friendly alternatives, R. Sanghi and M M Srivastava, Narosa, New Delhi, 2003
8. Green Chemistry-an introduction text, Royal Society of Chemistry, UK, 2002.
9. Organic chemistry Vol. 2, 6th Edn., I. L. Finar, Longman, 1992
10. Crownethers & cryptands, G. W. Gokel, Monograph, The Royal Society of Chemistry, 1991.

M.Sc II SEMESTER-CHEMISTRY
MCH-205: BIOLOGICAL CHEMISTRY (SOFT-CORE)
(FROM 2024-25 ONWARDS)

COURSE	DETAILS
CODE	MCH-205
TITLE	BIOLOGICAL CHEMISTRY (SOFT-CORE)
PROGRAMME	M.Sc ORGANIC CHEMISTRY
YEAR/SEMESTER	FIRST/SECOND
TYPE	SOFT-CORE
TOTAL CREDITS	3
TOTAL CONTACT HOURS	36
COTACT HOURS PER WEEK	4
EXAMINATION DURATION	3
MAXIMUM MARKS	30(IA) + 70 = 100
TOTAL MODULES	4
PEDAGOGY	Lecture with practical problems being Worked out, Chalk and talk PPT presentations, Seminars and presentations.
EVALUATION METHOD	Two internal assessments, one mid-term examination, one end Semester examination, Class participation.

COURSE OBJECTIVES

This course aims to impart to the student, knowledge of:

CObj_ID	Course Objectives
CObj_1	Understanding the importance of metabolism of substrates.
CObj_2	Qualitative and quantitative estimation of the biological macromolecules.
CObj_3	Interpreting of data emanating from a Clinical Test Lab.

COURSE OUTCOMES

Upon the completion of this course, the students will be able to:

CO_ID	COURSE OUTCOMES
CO_1	Acquire chemistry and biological importance of biological macromolecules.
CO_2	To know how physiological conditions influence the structures and re-activities of biomolecules.
CO_3	To understand the basic principles of protein and polysaccharide structure
CO_4	Design the structures of proteins.
CO_5	Understand the use of polymer supported reagents in Organic synthesis.

CO-PO MAPPING:

	PO_1	PO_2	PO_3	PO_4	PO_5	PSO_1	PSO_2	PSO_3	PSO_4	PSO_5
CO_1		X					X			
CO_2	X					X				
CO_3		X					X			
CO_4	X					X				
CO_5			X				X			

MCH-205 BIOLOGICAL CHEMISTRY (SOFT CORE)

(FROM 2024-25 ONWARDS)

36hrs

S. No	Module title	Module Content	Number of Hours	Skills Developed
1	Unit -1	Biochemical Thermodynamics : Introduction-stages of energy transformation. Energy reactions, exergonic and endergonic reactions. Thermodynamic interpretation of energy reactions. Relationship between free energy and equilibrium constant. Concept of entropy and free energy. Energy phosphates: Definition, examples, structural features of ATP. Energy coupling in biological reactions (explain the concept with suitable examples). Biological oxidation: comparison of oxidation with combustion using glucose as an example. Redox potentials of some biologically important half reactions. Calculation of energy yield from biological redox reaction (oxidation of NADH by oxygen, reduction of acetaldehyde by NADH). Mitochondrial electron transport chain, oxidative phosphorylation. Substrate level phosphorylation.	3hrs 9hrs	Employable Skills EMP SKD EDP
2	Unit -2	Enzymes & Mechanism of Enzyme action : Introduction and historical perspective, chemical and biological catalysis, remarkable properties of enzymes like catalytic power, specificity and regulation. Nomenclature and classification, extraction and purification. Fischer's lock and key and Koshland's induced fit hypothesis, concept and identification of active site by the use of inhibitors, affinity labeling and enzyme modification by site-directed, mutagenesis. Enzyme kinetics, Michaelis-Menten and Lineweaver-Burk plots, reversible and	9hrs	Employable Skills and analytical Skills EMP SKD EDP

		irreversible inhibition. Transition state theory, acid-base catalysis, covalent catalysis, strain or distortion. Examples of some typical enzyme mechanisms for chymotrypsin, ribonuclease, lysozyme and carboxypeptidase A. Co-Enzyme Chemistry: Cofactors as derived from vitamins, coenzymes, prosthetic groups, apoenzymes. Structure and biological functions of coenzyme A, thiamine pyrophosphate, pyridoxal phosphate, NAD⁺, NADP⁺, FMN, FAD, lipoic acid, vitamin B12. Mechanisms of reactions catalysed by the above cofactors.	3hrs	
3	Unit-3	Essential and trace elements in biological systems: with reference to Na⁺, K⁺, Ca²⁺, Fe²⁺, P, Cu, V and Ni. Metallo-porphyrins with special reference to haemoglobin, myoglobin and chlorophyll. Role of cobalamin (vitamin-B₁₂coenzyme) in living systems. NUCLEIC ACIDS Types–Components of nucleic acids, bases, nucleosides and nucleotides with structures. Partial structure of polynucleotide. Chargoff's rule of base equivalence, Semi conservative model, DNA replication, Structure of DNA (Watson-Crick model) and RNA. Biological roles of DNA and RNAs. Genetic code, characteristics of genetic codes, Central dogma in molecular biology.	3hrs 9hrs	Employable Skills EMP SKD EDP

REFERENCE BOOKS:

1. Biochemistry, G. Zubey, Macmillan, NY, 1998.
2. Biochemistry, D. Voet and J. G. Voet, John Wiley & Sons, 1998.
3. Principles of Biochemistry, A. L. Lehninger, D. L. Nelson & M. M. Cox, 2nd Edn. Worth Publishers, NY, 2005.

M.Sc I SEMESTER-CHEMISTRY
MCH-206: INORGANIC CHEMISTRY PRACTICALS –III

60hrs

COURSE	DETAILS
CODE	MCH-206
TITLE	INORGANIC CHEMISTRY PRACTICALS –III
PROGRAMME	M.Sc ORGANIC CHEMISTRY
YEAR/SEMESTER	FIRST/SECOND
TYPE	HARD-CORE
TOTAL CREDITS	2
TOTAL CONTACT HOURS	60
COTACT HOURS PER WEEK	4
EXAMINATION DURATION	4
MAXIMUM MARKS	15(IA) + 35 = 50
TOTAL MODULES	10

PEDAGOGY	Lecture with practical training will be given to students.
EVALUATION METHOD	Lab performance, Observation and Mock tests will be given.

COURSE OBJECTIVES

This course aims to impart to the student, knowledge of:

CObj_ID	Course Objectives
CObj_1	Basic and advanced techniques required for the separation of metal ions of a binary mixture.
CObj_2	Techniques of gravimetric estimation of ions.
CObj_3	Handling sintered glass crucibles.

COURSE OUTCOMES

Upon the completion of this course, the students will be able to:

CO_ID	COURSE OUTCOMES
CO_1	Outline a protocol and carry out separation of metal ions in a mixture.
CO_2	Carry out the gravimetric estimation of a metal ion.
CO_3	Solve problems encountered during an analysis.
CO_4	Report the results of the experiment.
CO_5	To understand the techniques of gravimetric methods.

	PO_1	PO_2	PO_3	PO_4	PO_5	PSO_1	PSO_2	PSO_3	PSO_4	PSO_5
CO_1		X					X			
CO_2	X					X				

CO-PO Mapping:

CO_3		X					X			
CO_4	X					X				
CO_5			X				X			

MCH-206 Inorganic Chemistry Practical-III

60hrs

S. No	Module title	Module Content	Number of Hours	Skills Developed

1	Unit -1	Preparations of solutions from their Ore: 1. Preparation of Fe in iron ore as Fe_2O_3 . 2. Preparation of Ni in Cu and Ni solution. 3. Preparation of Fe in Fe and Cr solution. 4. Preparation of Fe and Al solution from Ore. 5. Preparation of Cu in Cu and Fe solution. 6. Preparation of Cu in Cu and Zn solution.	30hrs	Employable Skills EMP SKD EDP
2	Unit -2	Gravimetric analysis: 1. Gravimetric determination of Fe in iron ore as Fe_2O_3 . 2. Gravimetric determination of Ni in Cu and Ni solution. 3. Gravimetric determination of Fe in Fe and Cr solution 4. Total gravimetric estimation of Fe and Al. 5. Gravimetric estimation of Cu in Cu and Fe solution. 6. Gravimetric estimation of Cu in Cu and Zn solution.	30hrs	Employable Skills and analytical Skills EMP SKD EDP

REFERENCE BOOKS:

1. Vogel's Text book of Qualitative Chemical Analysis, J. Bassett, G. H. Jeffery and J. Mendham, ELBS (1986).
2. Vogel's text book of Quantitative Chemical Analysis, 5th Edition, J. Bassett, G. H. Jeffery and J. Mendham, and R. C. Denny, Longman Scientific and Technical (1999).
3. Inorganic Semimicro Qualitative Analysis, V. V. Ramanujam; the National Pub. Co. (1974).
4. Practical Inorganic Chemistry, G. Marr and B. W. Rockett, Von Nostrand Reinhold Co., London (1972).

M.Sc I SEMESTER-CHEMISTRY

MCH-207: INORGANIC CHEMISTRY PRACTICALS –IV

60hrs

COURSE	DETAILS
CODE	MCH-207
TITLE	INORGANIC CHEMISTRY PRACTICALS –IV
PROGRAMME	M.Sc ORGANIC CHEMISTRY
YEAR/SEMESTER	FIRST/SECOND
TYPE	HARD-CORE
TOTAL CREDITS	2
TOTAL CONTACT HOURS	60
COTACT HOURS PER WEEK	4
EXAMINATION DURATION	4
MAXIMUM MARKS	15(IA) + 35 = 50
TOTAL MODULES	10
PEDAGOGY	Lecture with practical training will be given to students.
EVALUATION METHOD	Lab performance, Observation and Mock tests will be given.

COURSE OBJECTIVES

course
impart
student,

CObj_ID	Course Objectives
CObj_1	Basic and advanced techniques required for the separation of metal ions of a binary mixture.
CObj_2	Volumetric techniques of quantitative analysis of metal ions.
CObj_3	Preparing ore solution by digestion methods.

This
aims to
to the

knowledge of

COURSE OUTCOMES

Upon the completion of this course, the students will be able to:

CO_ID	COURSE OUTCOMES
CO_1	Outline a protocol and carry out separation of metal ions in a mixture.

CO_2	Carry out the volumetric estimation of a metal ion.									
CO_3	Solve problems encountered during an analysis.									
CO_4	Design different volumetric methods to analyse.									
CO_5	PO_1	PO_2	PO_3	PO_4	PO_5	PSO_1	PSO_2	PSO_3	PSO_4	PSO_5
CO_1		X					X			
CO_2	X					X				
CO_3		X					X			
CO_4	X					X				
CO_5										

CO-PO Mapping:

			X				X			

MCH-207 Inorganic Chemistry Practical-IV

60hrs

S. No	Module title	Module Content	Number of Hours	Skills Developed
1	Unit -1	Volumetric analysis I 1. Preparation and Standardization of Ca and Mg in Dolomite solution. 2 Preparation and Standardization. of Cu in Cu and Ni (German Silver). 3. Preparation and Standardization of Fe in Cu and Fe solution. 4. Preparation and Standardization of Zn in Cu and Zn solution. 5. Preparation and Standardization of Ni in Ni and Zn solution.	30hrs	Employable Skills EMP SKD EDP
2	Unit -2	Volumetric analysis II 1. Volumetric estimation of Ca and Mg in Dolomite solution. 2. Volumetric estimation of Cu in Cu and Ni (German Silver). 3. Volumetric estimation of Fe in Cu and Fe solution. 4. Volumetric estimation of Zn in Cu and Zn solution. 5. Volumetric estimation of Ni in Ni and Zn solution.	30hrs	Employable Skills and analytical Skills EMP SKD EDP

REFERENCE BOOKS:

1. Vogel's Text book of Qualitative Chemical Analysis, J. Bassett, G. H. Jeffery and J. Mendham, ELBS (1986).
2. Vogel's text book of Quantitative Chemical Analysis, 5th Edition, J. Bassett, G. H. Jeffery and J. Mendham, and R. C. Denny, Longman Scientific and Technical (1999).
3. Inorganic Semimicro Qualitative Analysis, V. V. Ramanujam; The National Pub. Co. (1974).
4. Practical Inorganic Chemistry, G. Marr and B. W. Rockett, Von Nostrand Reinhold Co London (1972)

M.Sc I SEMESTER-CHEMISTRY

MCH-208: PHYSICAL CHEMISTRY PRACTICALS –III

60hrs

COURSE	DETAILS
CODE	MCH-208
TITLE	PHYSICAL CHEMISTRY PRACTICALS –III
PROGRAMME	M.Sc ORGANIC CHEMISTRY
YEAR/SEMESTER	FIRST/SECOND
TYPE	HARD-CORE
TOTAL CREDITS	2
TOTAL CONTACT HOURS	60
COTACT HOURS PER WEEK	4
EXAMINATION DURATION	4
MAXIMUM MARKS	15(IA) + 35 = 50
TOTAL MODULES	10
PEDAGOGY	Lecture with practical training will be given to students.
EVALUATION METHOD	Lab performance, Observation and Mock tests will be given.

COURSE OBJECTIVES

This course aims to impart to the student, knowledge of:

COBj_ID	Course Objectives
COBj_1	Preparation and standardization of solutions.
COBj_2	Kinetic studies of a reaction.
COBj_3	Use of a colorimeter in the study of the kinetics of a reaction and in the estimation of mixtures.

COURSE OUTCOMES

Upon the completion of this course, the students will be able to:

CO_ID	COURSE OUTCOMES
CO_1	Identify wavelength of maximum absorbance and Collect data using a colorimeter/spectrophotometer.
CO_2	Devise and carry out an experiment to study the kinetics of a reaction and Interpret the experimental data in terms of a rate equation.
CO_3	Use colorimeter/spectrophotometer for colorimetric estimations, titrations and kinetic studies.
CO_4	To plot phase diagram of two/three component systems and interpret them.
CO_5	Communicate the results of the experiment in a written and oral form.

CO-PO Mapping:

	PO_1	PO_2	PO_3	PO_4	PO_5	PSO_1	PSO_2	PSO_3	PSO_4	PSO_5
CO_1		X					X			
CO_2	X					X				
CO_3		X					X			
CO_4	X					X				
CO_5			X				X			

MCH-208 Physical Chemistry Practical –III

60hrs

S. No	Module title	Module Content	Number of Hours	40hrs Skills Developed
1	Unit -1	1. Study the hydrolysis of methyl acetate in presence of two different concentrations of HCl and report the relative strength. 2. Study the hydrolysis of methyl acetate in the presence of HCl at different temperatures and report the energy of activation. 3. Determination of dissociation constant of a given indicator by colorimetric method. 4. Study of kinetics of autocatalytic reaction between KMnO_4 versus oxalic acid. 5. Determination of degree of hydrolysis of aniline hydrochloride at room temperature and calculation of dissociation constant of the base by pH metry	30hrs	Employable Skills EMP SKD EDP
2	Unit -2	5. Determination of degree of hydrolysis of aniline hydrochloride at room temperature and calculation of dissociation constant of the base by pH metry 6. Analysis of a binary mixture of two miscible liquids and to determine the composition of the given unknown mixture 7. Determination of pH of acetic acid with sodium acetate buffer by pH metry method. 8. Determination of pH of formic acid with sodium formate buffer by pH metry method. 9. Evaluation of Arrhenius parameter for the reaction between $\text{K}_2\text{S}_2\text{O}_8$ versus KI (first order)	30hrs	Employable Skills and analytical Skills EMP SKD EDP

REFERENCE BOOKS:

1. Findlays practical physical chemisty revised by P. B. Levitt, Longman's London (1966)
2. Experiments in Physical Chemistry by Shoemaker and Garland, McGraw Hill International Edn. (1966)
3. Advanced Practical Physical Chemistry by J. B. Yadav, Goel Publications Meerut (1988)
4. Senior Practical Physical Chemistry by B. C. Kosla, Simla Printers New Delhi (1987)
5. Experimental Physical Chemistry by Daniel et al., McGraw Hill, New York (1962).
6. Practical Physical Chemistry by A.M James and P. E. Pritchard, Longman's Group Ltd (1968)
7. Experimental Physical Chemistry by Wilson, Newcombe & others, Pergamon Press, New York (1962)
8. Experimental Physical Chemistry by R. C. Behra and B Behra, Tata McGraw, New Delhi (1983)
9. Experimental Physical Chemistry by V. D. Atavale and Parul Mathur, New Age International, New York (2001)
10. Physical Chemistry Laboratory Principles and Experiments by H. W. Salberg J. I. Morrow.

M.Sc I SEMESTER-CHEMISTRY
MCH-209: PHYSICAL CHEMISTRY PRACTICALS –IV

60hrs

COURSE	DETAILS
CODE	MCH-209
TITLE	PHYSICAL CHEMISTRY PRACTICALS –IV
PROGRAMME	M.Sc ORGANIC CHEMISTRY
YEAR/SEMESTER	FIRST/SECOND
TYPE	HARD-CORE
TOTAL CREDITS	2
TOTAL CONTACT HOURS	60
COTACT HOURS PER WEEK	4
EXAMINATION DURATION	4
MAXIMUM MARKS	15(IA) + 35 = 50
TOTAL MODULES	10
PEDAGOGY	Lecture with practical training will be given to students.
EVALUATION METHOD	Lab performance, Observation and Mock tests will be given.

COURSE OBJECTIVES

This course aims to impart to the student, knowledge of:

COBj_ID	Course Objectives
COBj_1	The use of a conductivity meter for determination of specific conductance and solubility of electrolytes. Plotting of data in two dimensions and identifying the end point of the titration
COBj_2	The use of conductivity meter for titrations (acid base, redox, precipitation).
COBj_3	The working, calibration and use of a potentiometer. The use of different reference and working electrodes.

COURSE OUTCOMES

Upon the completion of this course, the students will be able to:

CO_ID	COURSE OUTCOMES
CO_1	Use the conductivity meter as a tool for quantitative analysis.
CO_2	Use conductivity measurements to distinguish between electrolytes (strong and weak).
CO_3	Identify problems where conductivity measurements can be used and devise protocols for the experiment. Carry out an experiment based on the protocol and find solutions to problems encountered during the

	experiment.
CO_4	Use the potentiometer as a tool for quantitative analysis.
CO_5	Identify problems where potentiometric measurements can be used and devise protocols for the experiment.

CO-PO Mapping:

	PO_1	PO_2	PO_3	PO_4	PO_5	PSO_1	PSO_2	PSO_3	PSO_4	PSO_5
CO_1		X					X			
CO_2	X					X				
CO_3		X					X			
CO_4	X					X				
CO_5			X				X			

MCH-209 Physical Chemistry Practical –IV

60hrs

S. No	Module title	Module Content	Number of Hours	Skills Developed
1	Unit -1	<u>Conductometry</u> 1. Acid mixture versus NaOH 2. Weak acid with salt versus NaOH 3. Strong acid with salt versus NaOH 4. Determination of strength of HCl, CH ₃ COOH and CuSO ₄ versus NaOH 5. To determine the acidic and basic dissociation constant of an amino acid and determination of isoelectric point by pH metry.	30hrs	Employable Skills EMP SKD EDP
2	Unit -2	<u>Potentiometry</u> 1. K ₂ Cr ₂ O ₇ versus FAS 2. Acid mixture versus NaOH 3. KMnO ₄ versus FAS 4. Determination of pK _a value of phosphoric acid by pH meter.	30hrs	Employable Skills and analytical Skills EMP SKD EDP

REFERENCE BOOKS:

- Findlays practical physical chemistry revised by P. B. Levitt, Longman's London (1966).
- Experiments in Physical Chemistry by Shoemaker and Garland, McGraw Hill
a. International Edn. (1966)
- Advanced Practical Physical Chemistry by J. B. Yadav, Goel Publications Meerut (1988)
- Senior Practical Physical Chemistry by B. C. Kosla, Simla Printers New Delhi (1987)
- Experimental Physical Chemistry by Daniel et al., McGraw Hill, New York (1962).
- Practical Physical Chemistry by A.M James and P. E. Pritchard, Longman's Group Ltd (1968)
- Experimental Physical Chemistry by Wilson, Newcombe & others, Pergamon Press,
a. New York (1962)
- Experimental Physical Chemistry by R. C. Behra and B Behra, Tata McGraw, New Delhi (1983)
- Experimental Physical Chemistry by V. D. Atavale and Parul Mathur, New Age International,

10. New York (2001)

11. Physical Chemistry Laboratory Principles and Experiments by H. W. Salberg J. I. Morrow.

M.Sc III SEMESTER-CHEMISTRY

MCH-301: ORGANIC REACTION MECHANISM

COURSE	DETAILS
CODE	MCH-301
TITLE	ORGANIC REACTION MECHANISM
PROGRAMME	M.Sc ORGANIC CHEMISTRY
YEAR/SEMESTER	SECOND/ THIRD
TYPE	HARD-CORE
TOTAL CREDITS	4
TOTAL CONTACT HOURS	52
COTACT HOURS PER WEEK	4
EXAMINATION DURATION	3
MAXIMUM MARKS	30(IA) + 70 = 100
TOTAL MODULES	4
PEDAGOGY	Lecture with practical problems being Worked out, Chalk and talk PPT presentations, Seminars and presentations.
EVALUATION METHOD	Two internal assessments, one mid-term examination, one end Semester examination,

	Class participation.

COURSE OBJECTIVES

This course aims to impart to the student, knowledge of:

COBJ_ID	Course Objectives
COBJ_1	Evidences for the mechanisms of substitution reactions. Factors affecting rate of substitution reaction. Molecular orbital diagram and conservation of orbital symmetry.
COBJ_2	Formation, structure, stability, reactivity and reactions of free radicals. Principles and terminologies in photochemistry and photochemical reactions.
COBJ_3	Pericyclic reactions, rules governing them and their applications. Molecular orbital diagram and conservation of orbital symmetry.

COURSE OUTCOMES

Upon the completion of this course, the students will be able to:

CO_ID	COURSE OUTCOMES
CO_1	Explain the mechanistic pathway for aliphatic substitutions and free radical reactions with stereochemistry.
CO_2	Describe and explain photochemical and photo physical processes with mechanisms, and apply established experimental methods for the investigation of these processes
CO_3	Predict and rationalize the outcomes of pericyclic reactions with stereochemistry.
CO_4	Understand Pericyclic reactions, rules governing them and their

	applications.
CO_5	Design the structure, stability, reactivity and reactions of free radicals.

	PO_1	PO_2	PO_3	PO_4	PO_5	PSO_1	PSO_2	PSO_3	PSO_4	PSO_5
CO_1		X					X			
CO_2	X					X				
CO_3		X					X			
CO_4	X					X				

CO-PO Mapping:

CO_5			X				X			

52hrs

S. No	Module title	Module Content	Number of Hours	Skills Developed
1	Unit -1	Aliphatic nucleophilic and electrophilic substitution reactions <i>Nucleophilic substitution reactions:</i> Substitution at allylic carbon (allylic rearrangement), at a trigonal carbon (hydrolysis of esters and amides, use of DCC in the formation of anhydrides), substitution at a vinylic carbon. Neighboring group participation and S_Ni reactions. <i>Electrophilic substitution reactions:</i> SE_2, SE_1 and SE_i mechanisms. Hydrogen exchange, migration of double bonds, α-halogenation of aldehydes, ketones and acids. Aliphatic diazonium coupling, nitrosation at carbon bearing active hydrogens, diazo transfer reaction, carbene and nitrene insertion, decarboxylation of aliphatic acids, haloform reaction, Haller-Bauer reaction.	10hrs	Employable Skills EMP SKD EDP
2	Unit -2	Free-radical chemistry Generation of free-radicals: Thermal homolysis of peroxides, peresters and azo compounds, photochemical methods. Free radical reactions: Free-radical mechanisms in general. Free-radical substitution mechanisms. Mechanisms at an aromatic substrate. Neighboring group assistance in free-radical reactions. Reactivity for aliphatic substrates, reactivity at a bridgehead, reactivity in aromatic substrates, reactivity in the attacking radical. Halogenation at an alkyl	10hrs	Employable Skills and analytical Skills EMP SKD EDP

		carbon and an allylic carbon, hydroxylation at an aliphatic carbon, hydroxylation at an aromatic carbon, oxidation of aldehydes to carboxylic acids, formation of hydroperoxides and peroxides, Gomberg-Bachmann reaction, Meerwein arylation, Sandmeyer reaction, Kolbe reaction and Hunsdiecker reaction.		
3	Unit-3	Photochemistry Physical and Chemical processes, Jablonski diagram. Photosensitization, quantum efficiency, quantum and chemical yields. <i>Photochemistry of functional groups:</i> i) <i>Olefins</i>: Cis-trans isomerism, [2 + 2]-cycloaddition, rearrangements. Reaction of conjugated olefins; di-π-methane rearrangements (including oxa- and aza- di-π-methane rearrangements).ii) <i>Ketones</i>: Excited state of C=O. Norrish type-I and type-II cleavages. Paterno-Buchi reaction. α,β-unsaturated ketones. [2+2] addition. Rearrangement of cyclohexadienones (application in the synthesis of some important natural products).iii) <i>Aromatic compounds</i>: Photorearrangement of benzene and its derivatives, cycloaddition of benzene.iv) <i>Photochemical oxidations and reductions</i>: Cycloaddition of singlet molecular oxygen{[2+2], [4+2]-additions}. Oxidative coupling of aromatic compounds, photoreduction by hydrogen abstraction. Peri-cyclic reactions-I Molecular orbital symmetry, Woodward-Hoffmann correlation diagrams. FMO and PMO approaches. Frontier orbitals of ethylene, 1,3-butadiene, 1,3,5-	11hrs	Employable Skills EMP SKD EDP
			6hrs	

		hexatriene and allyl system. Electrocyclic reactions: conrotatory and disrotatory motions, $4n$, $4n+2$ and allyl systems. Cycloadditions: antarafacial and suprafacial additions, $[\pi m_s + \pi n_a]$ and $[\pi m_s + \pi n_s]$ -cycloadditions. $[\omega 2_a + \pi 2_s]$ and $[\pi 4_s + \omega 2_s]$ -cheletropic reactions.		
4	Unit-4	Pericyclic reactions-II Regio, enantio and Endo selectivities in Diels-Alder reactions. Hetero Diels-Alder reaction. Sigmatropic rearrangements: suprafacial and antarafacial shifts of H, sigmatropic shifts involving carbon moieties. $[i, j]$-sigmatropic rearrangements (including Walk, Claisen, Cope, oxy and aza-Cope rearrangements). Biochemical mechanisms Introduction. The mechanistic role of the following in living systems. i). Thiamine pyrophosphate (TPP) in decarboxylation of α-ketoacids and in the formation of α-ketols. ii). Pyridoxal phosphate (PLP) in transamination, decarboxylation, dealdolisation and elimination reactions of amino acids. iii). Lipoic acid in the transfer of acyl group reactions. iv). Coenzyme A (CoASH) in the transfer of acyl group. v). Biotin and vi). Vitamin KH_2 coenzyme in carboxylation reactions. vii). Tetrahydrofolic acid (H_4F) in one-carbon transfer reactions. viii). Nicotinamide ix). Flavin coenzymes in biological redox reactions and x). Vitamin B12 Coenzymes in molecular rearrangement reactions in the synthesis of methionine.	5hrs 10hrs	Employable Skills EMP SKD EDP

REFERENCE BOOKS:

1. Advanced Organic Chemistry – Reactions, Mechanism and Structure, Jerry March, JohnWiley (2008).
2. Understanding organic reaction mechanisms, A. Jacob, Cambridge Univ. Press, 1997.
3. Introduction to organic chemistry A. Streitweiser, Jr and C. H. Heathcock, Macmillan1985.
4. Physical and mechanistic organic chemistry, R.A.Y. Jones, 1st Edn. Cambridge Univ. Press, 1979.
5. Mechanisms of molecular migrations, Vols I and II, B. S. Thiagarajan, 1st Edn. Pergamon Press, Oxford, 1979.
6. P. J. Garratt in Comprehensive organic chemistry, D. Barton and W. D. Ollis, 1st Edn.Pergamon Press, Oxford, 1979.
7. Radicals in organic synthesis, B. Giese, Pergamon Press, 1986.
8. Stereo electronic effects in organic chemistry, P. Deslongchamps, 1st Edn. Pergamon Press, 1983.
9. Frontier orbitals and organic chemical reactions, Ian Fleming, John Wiley, 1980.
10. Molecular orbital theory for organic chemistry, A. Streitweiser, 1st Ed. Wiley & Sons NY, 1969.
11. Organic photochemistry, J. M. Coxon and B. Halton, 1st Edn, Cambridge Univ. Press,London, 1974.
12. Orbital symmetry, R. E. Lehr and A. P. Marchand, Academic Press, 1972.
13. Molecular reactions and photochemistry, C. H. Deputy and D. S. Chapman, 1st Edn. Prentice-hall India, New Delhi, 1972.
14. Stereochemistry of Organic Compounds: Principles and Applications, D Nasipuri, New-Age International, (1999).
15. Biochemistry, G. Zubey, Macmillan, NY, 1998.
16. Biochemistry, D. Voet and J. G. Voet, John Wiley & Sons, 1998.
17. Principles of Biochemistry, A. L. Lehninger, D. L. Nelson & M. M. Cox, 2nd Edn. Worth Publishers, NY, 2005.

M.Sc III SEMESTER-CHEMISTRY
MCH-302: CHEMISTRY OF NATURAL PRODUCTS

COURSE	DETAILS
CODE	MCH-302
TITLE	CHEMISTRY OF NATURAL PRODUCTS
PROGRAMME	M.Sc ORGANIC CHEMISTRY
YEAR/SEMESTER	SECOND/ THIRD
TYPE	HARD-CORE
TOTAL CREDITS	4
TOTAL CONTACT HOURS	52
COTACT HOURS PER WEEK	4
EXAMINATION DURATION	3
MAXIMUM MARKS	30(IA) + 70 = 10
TOTAL MODULES	4
PEDAGOGY	Lecture with practical problems being Worked out, Chalk and talk PPT presentations, Seminars and presentations.
EVALUATION METHOD	Two internal assessments, one mid-term examination, one end Semester examination, Class participation.

COURSE OBJECTIVES

This course aims to impart to the student, knowledge of:

CObj_ID	Course Objectives
CObj_1	Classification, nomenclature, structure, biosynthesis, occurrence, analysis and pharmaceutical perspectives of natural products. Structural elucidation of these natural products by elemental analysis and characterization by different spectroscopic techniques.
CObj_2	Industrial synthesis of these natural products with stereochemistry and separation techniques.
CObj_3	Classification, synthesis and use of insect pheromones used in pest control.

COURSE OUTCOMES

Upon the completion of this course, the students will be able to:

CO_ID	COURSE OUTCOMES
CO_1	Understand extraction and purification methods of natural compounds from available sources.
CO_2	Design efficient total synthesis of complex molecules by recognizing substructures amenable to known transformations.
CO_3	Familiarize with various types of natural products from different sources and their applications.
CO_4	Synthesize natural products industrially.

CO_5	Design various techniques for the isolation of natural products.

	PO_1	PO_2	PO_3	PO_4	PO_5	PSO_1	PSO_2	PSO_3	PSO_4	PSO_5
CO_1		X					X			
CO_2	X					X				
CO_3		X					X			
CO_4	X					X				
CO_5			X				X			

CO-PO Mapping:

MCH-302: CHEMISTRY OF NATURAL PRODUCTS

52 Hours

S. No	Module title	Module Content	Number of Hours	Skills Developed
1	Unit -1	Terpenoids and Carotenoids Classification, nomenclature, occurrence and isolation. Isoprene rules. Stereochemistry of citral, farnesol, limonene, 1,8-cineole, menthols and borneols. Correlation of configurations of terpenoids. Structure elucidation of camphene, α -pinene, β -caryophyllene, and α -santonin. Synthesis and biosynthesis of the following: Linalool, α -terpineol, fenchone, eudesmol, abietic acid. Commercial synthesis of camphor. Carotenoids: Structural relationship of α -, β - and γ -carotenes. Structure elucidation and synthesis of β -carotene	12hrs	Employable Skills EMP SKD EDP
2	Unit -2	Alkaloids Definition, nomenclature, occurrence, isolation, classification, General methods of structure Elucidation. Synthesis and biosynthesis of the following alkaloids: Ephedrine, hygrine, coniine and cocaine. Cinchona alkaloids: Cinchonine and quinine. Opioid alkaloids: Morphine, codeine, thebaine and heroin. Structure elucidation and synthesis of papaverine, reserpine and ergotamine. Photochemical synthesis of Nuciferine, coradyline and tylophorine.	12hrs	Employable Skills and analytical Skills EMP SKD EDP
3	Unit-3	Porphyrins and vitamin B₁₂ Structure elucidation and synthesis of haemin, chlorophyll-a and vitamin-B ₁₂ (synthesis of Vitamin-B ₁₂ from cobyrinic acid). Nucleic acids Introduction, components of nucleic acids, nucleosides, nucleotides and oligonucleotides. Structure elucidation and synthesis of nucleosides and nucleotides. Chemical synthesis of oligonucleotides: Protecting groups for hydroxy group in sugar, aminogroup in the base and phosphate functions. Methods of formation of internucleotide bonds: DCC, phosphodiester approach, phosphotriester	7hrs 8hrs	Employable Skills EMP SKD EDP

[illegible]

REFERENCE BOOKS:

1. Natural products: Their chemistry and biological significance-J. Mann, R. S. Davidson, J. B. Hobbs, D. V. Banthorpe & J. B. Harborne, Longman, UK, 1994.
2. Terpenes, J. Verghese, Tata McGraw-Hill, New Delhi, 1982.
3. Chemistry of terpenes and terpenoids, A. Newman, Academic Press, London, 1975.

M.Sc III SEMESTER-CHEMISTRY
MCH-303: ORGANIC SPECTROSCOPY

COURSE	DETAILS
CODE	MCH-303
TITLE	ORGANIC SPECTROSCOPY
PROGRAMME	M.Sc ORGANIC CHEMISTRY
YEAR/SEMESTER	SECOND/ THIRD
TYPE	HARD-CORE
TOTAL CREDITS	4
TOTAL CONTACT HOURS	52
COTACT HOURS PER WEEK	4
EXAMINATION DURATION	3
MAXIMUM MARKS	30(IA) + 70 = 100
TOTAL MODULES	4
PEDAGOGY	Lecture with practical problems being Worked out, Chalk and talk PPT presentations, Seminars and presentations.
EVALUATION METHOD	Two internal assessments, one mid-term examination, one end Semester examination, Class participation.

COURSE OBJECTIVES

This course aims to impart to the student, knowledge of:

CObj_ID	Course Objectives
CObj_1	Spectroscopic techniques including the basic principles for recording of NMR, IR, UV, and MS spectra.
CObj_2	Applications of UV-Vis spectroscopy. Identification and characteristics of functional groups using IR spectroscopy
CObj_3	Principles of nuclear magnetic resonance spectroscopy of ^1H , ^{13}C (1D and 2D) and other nuclei (^{15}N , ^{19}F , ^{29}Si and ^{31}P).

COURSE OUTCOMES

Upon the completion of this course, the students will be able to:

CO_ID	COURSE OUTCOMES
CO_1	Combine information from experimental NMR, IR, UV, and MS spectra and elucidate the structure of unknown organic compounds.
CO_2	Argue for a suggested molecular structure from analysis of the spectral data.
CO_3	Predict the NMR, IR, UV-Vis and MS spectra from a given molecular structure.
CO_4	Understand Fragmentation pattern, effect of isotopes in Mass spectroscopy.
CO_5	Write schematic approach of spectral details.

CO-PO Mapping:

	PO_1	PO_2	PO_3	PO_4	PO_5	PSO_1	PSO_2	PSO_3	PSO_4	PSO_5
CO_1		X					X			
CO_2	X					X				
CO_3		X					X			
CO_4	X					X				
CO_5			X				X			

MCH-303: ORGANIC SPECTROSCOPY

52hrs

S. No	Module title	Module Content	Number of Hours	Skills Developed
1	Unit -1	Ultraviolet and visible spectroscopy Classification of electronic transitions, Terminology, Substituent and solvent effects, UV spectral study of alkenes, polyenes, enones and aromatic compounds. Empirical rules for calculating λ_{max}. Vibrational Spectroscopy: spectroscopy Sampling techniques, Group frequencies, factors affecting group frequencies, Bond order, Mass effect, Conjugation, Inductive, resonance, steric effects. Intramolecular interactions. Application of IR in the study of H-bonding, stereoisomerism and tautomerism. Complementarity of IR and Raman. Identification of the following organic compounds by IR: Alkanes, Alkenes, Alkynes, Aromatic compounds, Aldehydes, Ketones, Alcohols, Acids, Acid chlorides, Amides, Amines, Esters, Halides, Nitro compounds, etc., problems using UV and IR.	6hrs 9hrs	Employable Skills EMP SKD EDP
2	Unit -2	Nuclear magnetic resonance spectroscopy-I Introduction, Magnetic properties of nuclei-Resonance condition. Nuclear spin, population of nuclear spin levels and NMR isotopes, Relaxation methods. Instrumentation and sample handling, FT-NMR. Chemical shift. Mechanism of shielding and deshielding in Alkanes, Alkyl halides, Alkenes, Aromatic compounds, Carbonyl compounds and Annulenes. Pascal's triangle-low and high	13hrs	Employable Skills and analytical Skills EMP SKD EDP

		resolution, spectrum of ethanol. Karplus Curve, Diamagnetic and paramagnetic effects and magnetic anisotropy. Equivalence of protons-chemical and magnetic equivalence. Spin systems: First order and second order coupling of AB systems, Simplifications of complex spectra. Problems. Spin-spin interactions: AX, AX₂, AX₃, AMX, AB types. Vicinal, geminal and long range coupling-Spin decoupling. Chemical shift reagents and deuterium exchange. Stereochemistry and hindered rotations. Temperature effects.		
3	Unit-3	Nuclear magnetic resonance spectroscopy-II Nuclear Overhauser effect (NOE). Factors influencing coupling constants and Relative intensities. Protons attached to elements other than carbon. ¹³C NMR Spectroscopy: Range and factors affecting chemical shifts of alkanes, alkyl halides, alkenes, alcohols, ethers, alkynes, carbonyl compounds and aromatics. Multiple resonance spectroscopy: Introduction to 2D-techniques: DEPT, COSY, and HETCOR. Explanation of the principle, applications to structure elucidation and stereochemistry of simple organic molecules. NMR spectroscopy of other nuclei with spin I = ½. Introduction to ¹⁵N, ¹⁹F, ²⁹Si and ³¹P and their chemical shift values.	12hrs	Employable Skills EMP SKD EDP
4	Unit-4	Mass spectrometry and Composite Problems: Basic principles-instrumentation – ion production-ion analysis-magnetic sector instruments Quadrupole mass spectrometers. Mass spectrum-molecular ion-types of ions in mass spectra and effects of isotopes on mass spectra. Methods of ionization, EI, FAB mass and MALDI methods. Fragmentation of Alkanes, Alkenes, alkyl halides, alcohols, aldehydes, ketones, acids, esters, ethers, amines, nitro and halo compounds peptides, Nitrogen rule, Factors affecting cleavage patterns. McLafferty rearrangement. Determination of molecular formula. Composite	12hrs	Employable Skills EMP SKD EDP

		problems. Use of HRMS to determine exact molecular formulae of compounds. Application of UV, IR, NMR and MS methods and chemical reactions in the structure elucidation of organic compounds.		

REFERENCE BOOKS:

1. Applications of absorption spectroscopy to organic compounds, J. R. Dyer, Prentice-Hall, New Delhi, 1969.
2. Organic spectroscopy, P. Laszlo and P. Stang, Harper & Row, New York, 1971.
3. Organic spectroscopy, W. Kemp, ELBS London, 2000.
4. Spectrometric identification of organic compounds, R. M. Silverstien, and W. P. Weber, 2005.
5. Introduction to spectroscopy, 3rd Edn., D. L. Pavia, G. M. Laupman and G. S. Kriz, Harcourt College Publishers, 2001.
6. Organic mass spectroscopy, K. R. Dass & E. P. James, IBH New Delhi, 1976.

M.Sc III SEMESTER-CHEMISTRY
OPEN ELECTIVE: WRITE IT AND WRITE UP

COURSE	DETAILS
CODE	OPEN ELECTIVE
TITLE	WRITE IT AND WRITE
PROGRAMME	M.Sc ORGANIC CHEMISTRY
YEAR/SEMESTER	SECOND/ THIRD
TYPE	SOFT-CORE
TOTAL CREDITS	4
TOTAL CONTACT HOURS	52
COTACT HOURS PER WEEK	4
EXAMINATION DURATION	3
MAXIMUM MARKS	30(IA) + 70 = 100
TOTAL MODULES	4
PEDAGOGY	Lecture with practical problems being Worked out, Chalk and talk PPT presentations, Seminars and presentations.

EVALUATION METHOD	Two internal assessments, one mid-term examination, one end Semester examination, Class participation.

COURSE OBJECTIVES

This course aims to impart to the student, knowledge of:

CObj_ID	Course Objectives
CObj_1	
CObj_2	
CObj_3	

COURSE OUTCOMES

Upon the completion of this course, the students will be able to:

CO_ID	COURSE OUTCOMES
CO_1	
CO_2	
CO_3	
CO_4	

CO_5	

	PO_1	PO_2	PO_3	PO_4	PO_5	PSO_1	PSO_2	PSO_3	PSO_4	PSO_5
CO_1										
CO_2										
CO_3										
CO_4										
CO_5										

CO-PO Mapping:

MCH-304: ORGANIC CHEMISTRY PRACTICALS-I

COURSE	DETAILS
CODE	MCH-304
TITLE	ORGANIC CHEMISTRY PRACTICALS-I
PROGRAMME	M.Sc ORGANIC CHEMISTRY
YEAR/SEMESTER	SECOND/ THIRD
TYPE	HARD-CORE
TOTAL CREDITS	2
TOTAL CONTACT HOURS	60
COTACT HOURS PER WEEK	4
EXAMINATION DURATION	4
MAXIMUM MARKS	15(IA) + 35 = 50
MODULES	10
PEDAGOGY	Lecture with practical problems being Worked out, Chalk and talk PT presentations, Seminars and presentations
EVALUATION METHOD	Lab performance, Observation and Mock tests will be given.

COURSE OBJECTIVES

This course aims to impart to the student, knowledge of:

CObj_ID	Course Objectives
CObj_1	Laboratory set up, safe handling of chemicals, workup procedures and effective disposal of organic waste.
CObj_2	Various methods of preparing organic compounds in a single step.
CObj_3	Safety measurements used in the laboratory.

COURSE OUTCOMES

Upon the completion of this course, the students will be able to:

CO_ID	COURSE OUTCOMES
CO_1	Design and carry out experiments, accurately record and analyze the results of such experiments.
CO_2	Prepare the solutions.
CO_3	Know to calculate the yield of the product obtained.
CO_4	Design the alternate mechanisms for the products.
CO_5	Calculate the theoretical yield and practical yield of the compound.

CO-PO Mapping:

	PO_1	PO_2	PO_3	PO_4	PO_5	PSO_1	PSO_2	PSO_3	PSO_4	PSO_5
CO_1		X					X			
CO_2	X					X				
CO_3		X					X			
CO_4	X					X				
CO_5			X				X			

ORGANIC CHEMISTRY PRACTICALS

MCH-304 Organic Chemistry Practical-I

60hrs

S. No	Module title	Module Content	Number of Hours	Skills Developed
1	Unit -1	Preparation (one stag 1.Preparation 2.Purification 3.Characterisation	30hrs	Employable Skills EMP SKD EDP
2	Unit -2	1. Sandmeyer reaction: 4-Chlorotoluene from 4-toluidine. 2. Pechmann reaction: Resorcinol and ethylacetoacetate. 3. Oxidation of Cyclohexanol. 4. Preparation of S-Benzylisothiuronium chloride. 5.Synthesis of <i>p</i> -iodonitrobenzene 6. Synthesis of N-Phenyl-2,4-dinitroaniline. 7. Synthesis of 2,4,6-tribromoaniline. 8. Synthesis of 2,4-dichlorophenoxyacetic acid.	30hrs	Employable Skills and analytical Skills EMP SKD EDP

REFERENCE BOOKS:

1. Laboratory manual of Organic Chemistry- B. B. Dey, M V Sitaraman and T R Govindachari, Allied Publishers, New Delhi, (1996).

2. Practical Organic Chemistry – Mann and Saunders, (1980).
3. Text Book of Practical Organic Chemistry- A. I. Vogel, (1996).
4. Test Book of Quantitative Organic Analysis- A. I. Vogel, (1996).
5. A Handbook of Organic Analysis – Clarke and Hayes, (1964).
6. Comprehensive practical organic chemistry: Preparation and quantitative Analysis, V. K. Ahluwalia, R. Aggarwal, Universities Press (India), 2000.
7. Comprehensive practical organic chemistry: Qualitative analysis, V. K. Ahluwalia, S. Dhingra, Universities Press (India), 2000.
8. An advanced course in practical chemistry, A. Ghoshal, B. Mahapatra and A. Kr. Nad, New central book agency, Calcutta, 2000.

M.Sc III SEMESTER-CHEMISTRY
MCH-305: ORGANIC CHEMISTRY PRACTICALS –II

COURSE	DETAILS
CODE	MCH-305
TITLE	ORGANIC CHEMISTRY PRACTICALS –II
PROGRAMME	M.Sc ORGANIC CHEMISTRY
YEAR/SEMESTER	SECOND/ THIRD
TYPE	HARD-CORE
TOTAL CREDITS	2
TOTAL CONTACT HOURS	60
COTACT HOURS PER WEEK	4
EXAMINATION DURATION	4
MAXIMUM MARKS	15(IA) + 35 = 50
MODULES	10
PEDAGOGY	Lecture with practical problems being Worked out, Chalk and talk PT presentations, Seminars and presenPtations

EVALUATION METHOD	Lab performance, Observation and Mock tests will be given.

COURSE OBJECTIVES

This course aims to impart to the student, knowledge of:

CO _{Obj} _ID	Course Objectives
CO _{Obj} _1	The principles of separation and qualitative analysis of binary mixture of mono- and bifunctional organic compounds.
CO _{Obj} _2	Using separation techniques.
CO _{Obj} _3	Determining the melting points.

COURSE OUTCOMES

Upon the completion of this course, the students will be able to:

CO_ID	COURSE OUTCOMES
CO_1	Carryout effective separation (pilot and bulk) of mixture of organic compounds.
CO_2	Determine the functional group of the unknown compounds by systematic analysis in a semi-micro scale.
CO_3	Study the physical constants of the compounds.
CO_4	Design various separation techniques.

CO_5	Isolate the products obtained.

CO-PO Mapping:

	PO_1	PO_2	PO_3	PO_4	PO_5	PSO_1	PSO_2	PSO_3	PSO_4	PSO_5
CO_1		X					X			
CO_2	X					X				
CO_3		X					X			
CO_4	X					X				
CO_5			X				X			

MCH-305 Organic Chemistry Practical-II

60hrs

S. No	Module title	Module Content	Number of Hours	Skills Developed
1	Unit -1	Systematic analysis and identification of Various organic compounds.	30hrs	Employable Skills EMP SKD EDP
2	Unit -2	Systematic analysis and identification of Bi-functional groups in an organic compounds.	30hrs	Employable Skills and analytical Skills EMP SKD EDP

REFERENCE BOOKS:

1. Laboratory manual of Organic Chemistry- B. B. Dey, M V Sitaraman and T R Govindachari, Allied Publishers, New Delhi, (1996).
2. Practical Organic Chemistry – Mann and Saunders, (1980).
3. Text Book of Practical Organic Chemistry- A. I. Vogel, (1996).
4. Test Book of Quantitative Organic Analysis- A. I. Vogel, (1996).
5. A Handbook of Organic Analysis – Clarke and Hayes, (1964).
6. Comprehensive practical organic chemistry: Preparation and quantitative Analysis, V. K. Ahluwalia, R. Aggarwal, Universities Press (India), 2000.
7. Comprehensive practical organic chemistry: Qualitative analysis, V. K. Ahluwalia, S. Dhingra, Universities Press (India), 2000.
8. An advanced course in practical chemistry, A. Ghoshal, B. Mahapatra and A. Kr. Nad, New central book agency, Calcutta, 2000.

M.Sc I SEMESTER-CHEMISTRY
MCH-306: ORGANIC CHEMISTRY PRACTICALS –III

COURSE	DETAILS
CODE	MCH-306
TITLE	ORGANIC CHEMISTRY PRACTICALS –III
PROGRAMME	M.Sc ORGANIC CHEMISTRY
YEAR/SEMESTER	SECOND/ THIRD
TYPE	HARD-CORE
TOTAL CREDITS	2
TOTAL CONTACT HOURS	60
COTACT HOURS PER WEEK	4
EXAMINATION DURATION	4
MAXIMUM MARKS	15(IA) + 35 = 50
MODULES	10
PEDAGOGY	Lecture with practical problems being Worked out, Chalk and talk PT presentations, Seminars and presenPtations
EVALUATION METHOD	Lab performance, Observation and Mock tests will be given.

COURSE OBJECTIVES

This course aims to impart to the student, knowledge of:

CObj_ID	Course Objectives
CObj_1	Laboratory set up, safe handling of chemicals, workup procedures and effective disposal of organic waste.
CObj_2	Preparation of organic compounds in multiple steps.
CObj_3	Using separation techniques to isolate the compounds.

COURSE OUTCOMES

Upon the completion of this course, the students will be able to:

CO_ID	COURSE OUTCOMES
CO_1	Design and carry out experiments, accurately record and analyze the results, calculate overall yield of the final product.
CO_2	Study the physical constants of the compounds.
CO_3	Design various separation techniques.
CO_4	Isolate the products obtained.
CO_5	Carryout effective separation (pilot and bulk) of mixture of organic compounds.

CO-PO Mapping:

	PO_1	PO_2	PO_3	PO_4	PO_5	PSO_1	PSO_2	PSO_3	PSO_4	PSO_5
CO_1		X					X			
CO_2	X					X				
CO_3		X					X			
CO_4	X					X				
CO_5			X				X			

MCH-306 Organic Chemistry Practical – III

60hrs

S. No	Module title	Module Content	Number of Hours	Skills Developed
1	Unit -1	Preparation (Two and three stages) 1.Preparation 2.Purification 3.Characterisation	30hrs	Employable Skills EMP SKD EDP
2	Unit -2	Preparation (Two and three stages) Preparation (Two and three stages) 1. 2,4-Dinitrophenylhydrazine from chloronitrobenzene. 2. Anthranilic acid from phthalic acid. 3. Benzanilide from benzophenone. 5. Synthesis of Acridone. 6. Synthesis of Hydantoin. 7. Preparation of P-Nitroaniline from acetanilide 4. Synthesis of Acridone. 5. Synthesis of Hydantoin. 6. Preparation of P-Nitroaniline from acetanilide	30hrs	Employable Skills and analytical Skills EMP SKD EDP

REFERENCE BOOKS:

1. Laboratory manual of Organic Chemistry- B. B. Dey, M V Sitaraman and T R Govindachari, Allied Publishers, New Delhi, (1996).
2. Practical Organic Chemistry – Mann and Saunders, (1980).
3. Text Book of Practical Organic Chemistry- A. I. Vogel, (1996).
4. Test Book of Quantitative Organic Analysis- A. I. Vogel, (1996).
5. A Handbook of Organic Analysis – Clarke and Hayes, (1964).
6. Comprehensive practical organic chemistry: Preparation and quantitative Analysis, V. K. Ahluwalia, R. Aggarwal, Universities Press (India), 2000.

7. Comprehensive practical organic chemistry: Qualitative analysis, V. K. Ahluwalia, S. Dhingra, Universities Press (India), 2000.
8. An advanced course in practical chemistry, A. Ghoshal, B. Mahapatra and A. Kr. Nad, New central book agency, Calcutta, 2000.

M.Sc III SEMESTER-CHEMISTRY
MCH-307: ORGANIC CHEMISTRY PRACTICALS –IV

COURSE	DETAILS
CODE	MCH-307
TITLE	ORGANIC CHEMISTRY PRACTICALS –IV
PROGRAMME	M.Sc ORGANIC CHEMISTRY
YEAR/SEMESTER	SECOND/ THIRD
TYPE	HARD-CORE
TOTAL CREDITS	2
TOTAL CONTACT HOURS	60
COTACT HOURS PER WEEK	4
EXAMINATION DURATION	4
MAXIMUM MARKS	15(IA) + 35 = 50
MODULES	10
PEDAGOGY	Lecture with practical problems being Worked out, Chalk and talk PT presentations, Seminars and presenPtations
EVALUATION METHOD	Lab performance, Observation and Mock tests will be given.

COURSE OBJECTIVES

This course aims to impart to the student, knowledge of:

CObj_ID	Course Objectives
CObj_1	Quantitative estimation of organic compounds using various methods.
CObj_2	Principles of titre metric methods.
CObj_3	Precision and accuracy methods.

COURSE OUTCOMES

Upon the completion of this course, the students will be able to:

CO_ID	COURSE OUTCOMES
CO_1	Carry out quantitative analysis of organic compounds systematically.
CO_2	Use various analytical methods.
CO_3	Design various quantitative methods.
CO_4	Know the precision and accuracy methods.
CO_5	Designing the data formats.

CO-PO Mapping:

	PO_1	PO_2	PO_3	PO_4	PO_5	PSO_1	PSO_2	PSO_3	PSO_4	PSO_5
CO_1		X					X			
CO_2	X					X				
CO_3		X					X			
CO_4	X					X				
CO_5			X				X			

MCH-307 Organic Chemistry Practical-IV

60hrs

S. No	Module title	Module Content	Number of Hours	Skills Developed
1	Unit -1	Principles of Quantitative methods : 1. Titrimetric methods 2. Determination of molecular formula of the compound 3. Extraction 4. Precipitation 5. Experimental analysis	30hrs	Employable Skills EMP SKD EDP
2	Unit -2	Quantitative analysis 1. Titrimetric estimation of amino acids. 2. Saponification value of oil. 3. Estimation of glucose by Feighling's method. 4. Estimation of keto group. 5. Estimation of phenols. 6. Iodine value of oil (chloramine-T method).	30hrs	Employable Skills and analytical Skills EMP SKD EDP

REFERENCE BOOKS:

1. Laboratory manual of Organic Chemistry- B. B. Dey, M V Sitaraman and T R Govindachari, Allied Publishers, New Delhi, (1996).
2. Practical Organic Chemistry – Mann and Saunders, (1980).
3. Text Book of Practical Organic Chemistry- A. I. Vogel, (1996).
4. Test Book of Quantitative Organic Analysis- A. I. Vogel, (1996).
5. A Handbook of Organic Analysis – Clarke and Hayes, (1964).
6. Comprehensive practical organic chemistry: Preparation and quantitative Analysis, V. K. Ahluwalia, R. Aggarwal, Universities Press (India), 2000.

7. Comprehensive practical organic chemistry: Qualitative analysis, V. K. Ahluwalia, S. Dhingra, Universities Press (India), 2000.
8. An advanced course in practical chemistry, A. Ghoshal, B. Mahapatra and A. Kr. Nad, New central book agency, Calcutta, 2000.

M.Sc IV SEMESTER-CHEMISTRY

MCH-401: ORGANOMETALLIC AND HETEROCYCLIC CHEMISTRY

COURSE	DETAILS
CODE	MCH-401
TITLE	ORGANOMETALLIC AND HETEROCYCLIC CHEMISTRY
PROGRAMME	M.Sc ORGANIC CHEMISTRY
YEAR/SEMESTER	SECOND/ FOURTH
TYPE	HARD-CORE
TOTAL CREDITS	4
TOTAL CONTACT HOURS	52
COTACT HOURS PER WEEK	4
EXAMINATION DURATION	3
MAXIMUM MARKS	30(IA) + 70 = 100
TOTAL MODULES	4
PEDAGOGY	Lecture with practical problems being Worked out, Chalk and talk PPT presentations, Seminars and presentations.

EVALUATION METHOD	Two internal assessments, one mid-term examination, one end Semester examination, Class participation.

COURSE OBJECTIVES

This course aims to impart to the student, knowledge of:

CO _{Obj} _ID	Course Objectives
CO _{Obj} _1	σ -bonded and π -bonded ligands, metal-carbon bonding, 18- and 16-electron rules, Green rules for nucleophilic addition, complexation and decomplexation of organometallic compounds. Application of various organometallic compounds in organic synthesis.
CO _{Obj} _2	Transition metal complexes as protecting and stabilizing groups, electrophiles and nucleophiles in organic transformations, as catalysts in isomerization, oxidation, reduction, carbonylation and coupling reactions.
CO _{Obj} _3	Synthesis, properties and reactions of 3-, 4-, 5-, 6-, 7- and 8-membered heterocyclic compounds. Classification, synthesis and applications of mesoionic compounds.

COURSE OUTCOMES

Upon the completion of this course, the students will be able to:

CO_ID	COURSE OUTCOMES
CO_1	Understand the scope, diversity and applications of organometallic compounds.
CO_2	Predict the stability, reactivity of metal complexes and stereochemistry of products formed
CO_3	Rationalize the synthesis, structure and applications of organometallic compounds for organic transformations

CO_4		Analyze the properties and reactions of 3-, 4-, 5-, 6-, 7- and 8-membered heterocyclic compounds.									
CO_5	PO 1	Design the synthesis of industr					PSO_1	PSO_2	PSO_3	PSO_4	PSO_5
CO_1		X						X			
CO_2	X						X				
CO_3		X						X			
CO_4	X						X				
CO_5			X					X			

CO-PO Mapping:

**ORGANIC CHEMISTRY SPECIALISATION
FOURTH SEMESTER**

MCH-401: ORGANOMETALLIC AND HETEROCYCLIC CHEMISTRY

52 Hours

S. No	Module title	Module Content	Number of Hours	Skills Developed

1	Unit -1	Organometallic Compounds in Organic Synthesis-I <i>Chemistry of Organotransition metal complexes:</i> General introduction. 18- and 16-Electron rules. General rules. <i>Complexation and De-complexation Reactions:</i> s-Bonded systems including h¹ ligands. p-Bonded systems involving dihapto to octahapto ligands such as- olefins, acetylenes, allyl moieties, butadiene, cyclobutadiene, arenes, cyclopenta, cyclohexa and cycloheptadienyl moieties; cyclohepta, cyclooctatrienes, and cyclooctatetraene moieties. <i>Use of organotransition metal complexes as protecting and stabilizing groups:</i> Protection of olefins, acetylenes and dienes. Stabilization of cyclobutadines and norbornadienones. <i>Organometallics as electrophiles and nucleophiles:</i> Nucleophilic addition to h², h⁵ and h⁶ complexes. Electrophilic addition to h⁴, h⁶ and carbene complexes. <i>Organometallics in coupling and cyclization reactions:</i> Coupling and cyclization of organic nucleophiles with olefins (including Heck reaction), and coupling of olefins with acetylenes (including Felkin's reaction). <i>Organometallics in isomerization, oxidation and reduction reactions:</i> Isomerization of olefins, allylic alcohols and allylic ethers. Oxidation of olefins (including Wacker's process and epoxidation) and reduction of olefins and α,β-unsaturated compounds (including Wilkinson's reaction).	4hrs 3hrs 3hrs 4hrs	Employable Skills EMP SKD EDP
2	Unit -2	Organometallic Compounds in Organic Synthesis-II <i>Carbonylation reactions:</i> Use of zirconium complexes in the synthesis of esters, acids, aldehydes or acyl halides from alkyl halides and in the hydroformylation of olefins and dienes. Use of iron complexes for the insertion of CO group into organic molecules such as dienes, alkyl halides, and vinyl epoxides. Use of cobalt complexes in the synthesis of ketones from epoxides, lactones from allylic alcohols and in the hydroformylation of olefins. Use of palladium	4hrs	Employable Skills and analytical Skills EMP SKD EDP

		complexes for the carbonylation of alkyl halides, dienes and allenes. <i>Application of the following organometallics in Organic Synthesis:</i> <i>Organozincs:</i> Preparation, reaction with compounds containing acidic protons, reaction with C-C multiple bonds, trans-metallation, addition reactions of zinc reagents with carbonyl compounds. Simmons Smith, and Reformatsky reaction. <i>Organolithiums:</i> Preparation. Deprotonation reactions, nucleophilic addition reactions, reactions with imines, nitriles and isonitriles. <i>Organocopper reagents:</i> (Gilman reagents-lithium dialkyl cuprates): Preparation, reactions with alkyl, allyl, vinyl, benzyl and aryl halides, aldehydes, ketones (including α,β-unsaturated carbonyl compounds) and epoxides. <i>Organoseleniums:</i> preparation. Use of organoseleniums in the synthesis of alkenes from alkyl halides, α,β-unsaturated carbonyl compounds from carbonyl compounds. <i>Organotelluriums:</i> Debromination of vic-dibromides, deoxygenation of epoxides, oxidation of hydroquinone and synthesis of biaryls. <i>Organoaluminiums:</i> Preparation, hydroalumination and carboalumination of alkenes. Nucleophilic addition reactions with carbonyl compounds and Hydrocyanation. Preparation of alkenyldialkylalanes and their reactions.	4hrs	
			4hrs	

3	Unit-3	Organometallic Compounds in Organic Synthesis-III <i>Organosilicons:</i> Introduction, preparation and general reactions of trialkylsilyl halides. Peterson olefination. <i>Organotins:</i> Preparation and reactions of tri-<i>n</i>-butyltin hydride, Barton decarboxylation and Barton-McCombie reaction. <i>Organocerates:</i> Preparation and reactions of organocerates. <i>Organomercurials:</i> Preparation. Electrophilic substitution reactions. Solvomercuration-demercuration and cyclopropanation of alkenes. Heterocyclic Chemistry-I <i>Small ring heterocycles:</i> Properties and reactions of 3- and 4- membered heterocycles:-oxiranes, thiranes, aziridines, azetidines, oxetanes and thietanes. <i>Benzo-fused heterocycles:</i> Synthesis and reactions of benzofurans, benzothiophenes, benzoxazoles, benzothiazoles and benzimidazoles. <i>Six-membered heterocycles with two or more heteroatoms:</i> Synthesis of Diazines, triazines, tetrazines and thiazines.	4hrs 4hrs 3hrs 2hrs	Employable Skills EMP SKD EDP
4	Unit-4	Heterocyclic Chemistry-II <i>Seven and large membered heterocycles:</i> Synthesis and reactions of azepanes, oxepines, thiepinines, diazepines, thiazepines, azocines, diazocines, ioxocines and dithiocines <i>Heterocycles containing P, As, Sb and Bi:</i> Synthesis of 5- and 6- membered heterocycles with P, As, Sb and Bi. <i>Mesoionic compounds:</i> General classification, chemistry of some important meso-ionic heterocycles of type-A and type-B and their applications.	13hrs	Employable Skills EMP SKD EDP

REFERENCE BOOKS:

1. Organometallic Chemistry, R. C. Mehrotra and A. Singh, Wiley Eastern, 1991.
2. The Organometallic Chemistry of the transition metals, R. H. Crabtree, 1988.
3. Principles and application of the organotransition metal chemistry, J. P. Collman, L. S. Hegedus, University Science books, 1980.
4. An introduction to Organometallic Chemistry, A. W. Parkins and R. C. Poller, Macmillan, 1986.
5. Modern Synthetic Reactions, H. O. House, W.A. Benjamin, California, 2nd Edn. 1972.
98
6. Organometallics, Vol. 1 & 2, M. Bochmann, Oxford Chemistry primers, Oxford University Press, 1994.
7. Advanced Organic Chemistry, J. March, 4th Edn. John Wiley, 2008.
8. Organotransition metal chemistry, S. G. Davies, Pergamon Press, Oxford, 1982.
9. Heterocyclic Chemistry, Vols. 1-3, R. R. Gupta, M. Kumar and V. Gupta, Springer Verlag.
10. The Chemistry of Heterocycles, T. Eicher and S Hauptmann, Thieme.
11. Heterocyclic Chemistry, J. A. Joule, K. Mills and G. F. Smith, Chapman and Hill.
12. Heterocyclic Chemistry, T. L. Gilchrist, Longman Scientific Tech.
13. Contemporary Heterocyclic Chemistry, G. R. Newkome, and W. W. Paudler, Wiley-Inter Science.
14. An introduction to Heterocyclic Compounds, R. M. Acheson, John Wiley.
15. Comprehensive Heterocyclic Chemistry, A. R. Katritzky and C. W. Rees, Eds. Pergamon Press.
16. Stereochemistry of Organic Compounds, D Nasipuri, New-Age International, (1999).

M.Sc IV SEMESTER-CHEMISTRY

MCH-402: STEREOCHEMISTRY AND RETROSYNTHETIC ANALYSIS

COURSE	DETAILS
CODE	MCH-402
TITLE	STEREOCHEMISTRY AND RETROSYNTHETIC ANALYSIS
PROGRAMME	M.Sc ORGANIC CHEMISTRY
YEAR/SEMESTER	SECOND/ FOURTH
TYPE	<i>HARD-CORE</i>
TOTAL CREDITS	4
TOTAL CONTACT HOURS	52
COTACT HOURS PER WEEK	4
EXAMINATION DURATION	3
MAXIMUM MARKS	30(IA) + 70 = 10
TOTAL MODULES	4
PEDAGOGY	Lecture with practical problems being Worked out, Chalk and talk PPT presentations, Seminars and presentations.
EVALUATION METHOD	Two internal assessments, one mid-term examination, one end Semester examination, Class participation.

COURSE OBJECTIVES

This course aims to impart to the student, knowledge of:

CObj_ID	Course Objectives
CObj_1	Stereochemistry of organic compounds exhibiting atropisomerism and chirality due to the presence of heteroatoms.
CObj_2	Methods used in determining absolute configuration by various techniques. Disconnection approach to organic synthesis.
CObj_3	Protecting and deprotecting of functional groups in organic synthesis. Strategies needed to devise routes for the synthesis of simple to complex target compounds.

COURSE OUTCOMES

Upon the completion of this course, the students will be able to:

CO_ID	COURSE OUTCOMES
CO_1	Identify stereogenic centers and provide R/S designations for atropisomers and compounds with heteroatoms.
CO_2	Determine absolute configuration of organic by various rules and techniques.
CO_3	Analyze target compounds by retro synthetic strategy and devise suitable anionic, cationic and radical synths.
CO_4	Analyze the Disconnection approach in organic synthesis.

CO_5	Apply the knowledge and understanding of essential facts, concepts, principles and theories relating to retrosynthetic analysis for the synthesis of organic target molecules.

	PO_1	PO_2	PO_3	PO_4	PO_5	PSO_1	PSO_2	PSO_3	PSO_4	PSO_5
CO_1		X					X			
CO_2	X					X				
CO_3		X					X			
CO_4	X					X				
CO_5										

CO-PO Mapping:

			X				X			

52 Hours

S. No	Module title	Module Content	Number of Hours	Skills Developed
1	Unit -1	Optical activity in the absence of chiral atoms Chirality in biphenyls, adamantanes, ansa compounds, cyclophanes, <i>trans</i>-cyclooctene, catenanes, and rotaxanes. Assignment of R, S- configuration to these classes of compounds. Optical activity due to the presence hetero atoms Chirality of organic compounds due to the presence of silicon, nitrogen, phosphorous, arsenic and sulphur atoms. Determination of R,S-configuration of these compounds using CIP rules. Transannular reactions Conformational analysis of medium rings. Transannular reactions: Hydrolysis of medium ring epoxides and bromination of C₈–C₁₀ cyclic dienes.	5hrs 4hrs 3hrs	Employable Skills EMP SKD EDP
2	Unit -2	Determining absolute and relative configuration i). <u>Chemical correlation of configuration</u>: Methods without involving the chiral centre. Chemical transformation involving the chiral centre. Chemical correlation involving diastereomers. ii). <u>Methods based on comparison of optical rotation</u>: Distance rule, Rule of shift, Mill's rule, iii) The method of quasi-racemate. iv). <u>Use optical rotatory dispersion curves</u>: α-axial haloketone rule and its applications, octant rule (application of these rules in the determination of absolute configuration of substituted cyclohexanones, decalones and cholestanones). v). Method based on anomalous X- ray scattering.	10hrs	Employable Skills and analytical Skills EMP SKD EDP

		<u>RETROSYNTHETIC ANALYSIS</u> Disconnection approach Introduction to synthons, and synthetic equivalents, disconnection approach. Basic principles and terminologies used in disconnection approach. One group C-X and two group C-X disconnections. Chemoselectivity, reversal of polarity, cyclisation reactions.	6hrs	
3	Unit-3	Protecting groups Principle of protection of alcohols, amines, acids and carbonyl groups C-C one group and C-C two group disconnections Synthesis of alcohols, carbonyl compounds and alkenes. Use of acetylides and aliphatic nitro compounds in organic synthesis. Diels-Alder reaction, 1,3-difunctionalised compounds, α,β -unsaturated compounds, carbonyl compounds condensations, 1,5-difunctionalised compounds. Micheal addition and Robinson annelation.	4hrs 10hrs	Employabl e Skills EMP SKD EDP
4	Unit-4	Ring Synthesis Synthesis of saturated heterocycles and 3-, 4-, 5- and 6-membered rings. Synthesis of some complex molecules using disconnection approach Aromadendrene, longifloene, vitamin-D, reserpine, juvabione, and Lycorane.	10hrs	Employabl e Skills EMP SKD EDP

REFERENCE BOOKS:

1. Stereochemistry of carbon compounds, E. L. Eliel, S. H. Wilen and L. N. Mander, John Wiley & Sons, 1994.
2. Stereochemistry, Potapov, MIR, Moscow, 1984.
3. Stereochemistry, Nasipuri, D, New Age, 1999.

4. Advanced organic chemistry, J. March, 4th Edn. John Wiley, 2008.
5. Organic Chemistry, R. E. Ireland Prentice-Hall India, New Delhi, 1975.
6. Some modern methods of Organic Synthesis, W. Caruthers, Cambridge Uni. Press
London, 2nd Edn., 1998.
7. Stereochemistry of organic compounds- Principle and applications, D. Nasipuri, 2nd Edn.,
New Age International Publishers, 2001.
8. Organic synthesis: The synthon approach, S. Warren, John Wiley & Sons, New York, 1st.
Edn. 1983
9. Designing organic synthesis: A disconnection approach, S. Warren, John Wiley & Sons,
New York, 2nd Edn. 1987
10. Organic synthesis, C. Willis and M. Wills, Oxford University Press, 1995

M.Sc IV SEMESTER-CHEMISTRY
MCH-403: ORGANIC SYNTHESIS

COURSE	DETAILS
CODE	MCH-403
TITLE	ORGANIC SYNTHESIS
PROGRAMME	M.Sc ORGANIC CHEMISTRY
YEAR/SEMESTER	SECOND/ FOURTH
TYPE	HARD-CORE
TOTAL CREDITS	4
TOTAL CONTACT HOURS	52
COTACT HOURS PER WEEK	4
EXAMINATION DURATION	3
MAXIMUM MARKS	30(IA) + 70 = 100
TOTAL MODULES	4
PEDAGOGY	Lecture with practical problems being Worked out, Chalk and talk PPT presentations, Seminars and presentations.

EVALUATION METHOD	Two internal assessments, one mid-term examination, one end Semester examination, Class participation.

COURSE OBJECTIVES

This course aims to impart to the student, knowledge of:

CObj_ID	Course Objectives
CObj_1	Principles and terminologies in asymmetric synthesis and the importance of chirality in organic synthesis. Multi-component reactions as a tool for efficient atom economical reactions.
CObj_2	Stereoselective, diastereoselective and enantioselective strategies and the use of chiral auxiliary components for asymmetric synthesis.
CObj_3	Ultrasound, microwave, ionic liquids, phase transfer catalysts, polymer supports in organic synthesis

COURSE OUTCOMES

Upon the completion of this course, the students will be able to:

CO_ID	COURSE OUTCOMES
CO_1	Understand the importance of asymmetric synthesis and propose syntheses of molecules with control of the stereochemistry.
CO_2	Design chemical processes and products that eliminate the use or generation of hazardous substances
CO_3	Use ultrasound, microwave, ionic liquids, phase transfer catalysts, polymer supports and multi-component reactions for various organic

	transformations.									
CO_4	Analyze the reagents used in organic synthesis.									
CO_5	Design the C-C and C-N bond formation reactions.									
	PO_1	PO_2	PO_3	PO_4	PO_5	PSO_1	PSO_2	PSO_3	PSO_4	PSO_5
CO_1		X					X			
CO_2	X					X				
CO_3		X					X			
CO_4	X					X				
CO_5										

CO-

PO Mapping:

			X				X			

MCH-403: ORGANIC SYNTHESIS-II

52 Hours

S. No	Module title	Module Content	Number of Hours	Skills Developed
1	Unit -1	C-C and C-N bond forming reactions Darzen's reaction, Use of acetylides in C-C bond formation reactions. Acid-catalyzed self condensation of olefins, Prins reaction, Shapiro reaction, Dieckmann cyclization, Robinsonannulations, Hofmann-Loeffler-Freytag reaction. Hofmann-Martius reaction. Acyloincondensation. Houben-Hoesch reaction.Stork-enamine synthesis. Meyer synthesis. Use of nucleophilic nitrogen and electrophiliccarbon (NH_3 , amines and nitrite as nucleophiles in substitution, NH_3 and amines in addition to ketones and aldehydes) and electrophilic nitrogen and nucleophilic carbon (nitration, nitrosation)for the bond formation reactions (including Chichibabin reaction, Skraup synthesis, Mitsunobureaction, Fisher-Hepp reaction. Japp- Klingemann reaction.	12hrs	Employable Skills EMP SKD EDP
2	Unit -2	Reagents in organic synthesis Use of the following in organic synthesis and functional group tansformations. Aluminium iso-propoxide, NBS, LDA, DCC, DDQ, Corey-Chaykovsky reagent, Raney-Nickel,diazomethane, TMS-chloride, 1,3-Dithiane (reactivity and umpolung), PPA. Woodward and Prevost hydroxylation. Oxidations-I Cr (VI) oxidants, Mn (VII) oxidants, OsO_4 , SeO_2 , Pb (OAc) $_4$, HIO_4 , Ag_2O , DMSO	7hrs 5hrs	Employable Skills and analytical Skills EMP SKD EDP

3	Unit-3	Oxidations-II Ozone, peroxides (H₂O₂, <i>t</i>-BuOOH,) and peracids as oxidizing agents. Dess-Martin oxidation, Oppeneaur oxidation. Reductions Complex metal hydrides, dissolving metal reductions (including Birch, Benkeser, Clemmensen reductions), diimide reduction, MPV reduction, organoboranes as reducing agents. Wolf-Kishner reduction, McMurry reaction. Pummer, Willgerdot, and Tishchenko reactions.	4hrs 9hrs	Employable Skills EMP SKD EDP
4	Unit-4	Asymmetric Synthesis 'ee' and methods of determination of 'ee'. <u>Stereoselectivity</u>: classification, terminology and principle. Asymmetric synthesis and asymmetric induction. Double diastereoselection and double asymmetric induction. <u>Acyclic stereoselection</u>: Addition of nucleophiles to carbonyl compounds (1,2- 1,3- and 1,4- asymmetric induction). Asymmetric aldol condensation. <u>Diastereoselection in cyclic systems</u>: Nucleophilic addition to cyclic ketones (formation of axial and equatorial alcohols, catalytic hydrogenation, lkylation, diastereoselective oxidations). <u>Enantioselective synthesis</u>: Reduction with chiral hydride donors [(S)-PBMgCl, (-)-<i>i</i>BOAlCl₂, (S)-BINAL-H, (R,R)-DIOP, and (S,S)-CHIRAPHOS). Enantioselective alkylation of ketones <i>via</i> hydrazones. Enantioselective alkylation with chiral PTC. Enantioselective Michael addition. Enantioselective intramolecular aldol condensation. Use of (+)- and (-)- DET in asymmetric epoxidation. Polymer-bound chiral catalysts in asymmetric induction.	15hrs	Employable Skills EMP SKD EDP

REFERENCE BOOKS:

1. Advanced organic chemistry, J. March, 4th Edn. John Wiley, 2008.

- Organic synthesis, R.E.Ireland, Prentice-hall India, New Delhi, 1975.
2. Understanding organic reaction mechanisms, A. Jacob, Cambridge Univ Press, 1997.
 3. Introduction to organic chemistry, A. Streitweiser, Jr and C. H. Heathcock, Macmillan, 1985.
 4. Physical and mechanistic organic chemistry, R. A.Y. Jones, 1st Edn. Cambridge Univ Press, 1979.
 5. Modern synthetic reactions, H. O. House, W. A. Benjamin, California, 2nd Edn. 1972.
 6. Some modern methods of organic synthesis, W. Carruthurs, Cambridge Univ. Press, London, 2nd Edn. 1978.
 7. Mechanisms of molecular migration, Vols I & II, B.S. Thyagarajan, Pergamon Press, Oxford, 1979.
 8. Comprehensive organic chemistry, D. Barton and W. D. Wallis, Pergamon Press, Oxford, 1983.
 9. Organic chemistry Vol. II, I. L. Finar 6th Edn. Longman, 1992.
 10. Organic reaction Mechanisms, 3rd Edn., V. K. Ahluwalia and R. K. Prashar, Narosa, New Delhi, 2005.

M.Sc IV SEMESTER-CHEMISTRY
MCH-404: MEDICINAL ORGANIC CHEMISTRY

COURSE	DETAILS
CODE	MCH-404
TITLE	MEDICINAL ORGANIC CHEMISTRY
PROGRAMME	M.Sc ORGANIC CHEMISTRY
YEAR/SEMESTER	SECOND/ FOURTH
TYPE	HARD-CORE
TOTAL CREDITS	4
TOTAL CONTACT HOURS	52
COTACT HOURS PER WEEK	4
EXAMINATION DURATION	3
MAXIMUM MARKS	30(IA) + 70 = 100
TOTAL MODULES	4
PEDAGOGY	Lecture with practical problems being Worked out, Chalk and talk PPT presentations, Seminars and presentations.
EVALUATION METHOD	Two internal assessments, one mid-term examination, one end Semester examination, Class participation.

COURSE OBJECTIVES

This course aims to impart to the student, knowledge of:

CObj_ID	Course Objectives
CObj_1	Basic biological and pharmacological interactions of drugs with their targets. Process of drug discovery. Development of nanomedicine.
CObj_2	The relation of structure and physical properties of drugs to their pharmacological activity.
CObj_3	Synthesis and mode of action of the different classes of drugs.

COURSE OUTCOMES

Upon the completion of this course, the students will be able to:

CO_ID	COURSE OUTCOMES
CO_1	Use of the knowledge gained for the development of biologically and clinically active drugs.
CO_2	Describe the current challenges and opportunities in medicinal chemistry in light of contemporary developments in the field of drug discovery.
CO_3	Design the mode of action of different drugs.

CO_4	Analyze the structural and physical properties of drugs and their pharmacological action.
CO_5	Understand the pharmacological action of different drugs.

	PO_1	PO_2	PO_3	PO_4	PO_5	PSO_1	PSO_2	PSO_3	PSO_4	PSO_5
CO_1		X					X			
CO_2	X					X				
CO_3		X					X			
CO_4	X					X				

CO-

PO

Mapping:

CO_5			X				X			

MCH-404: MEDICINAL ORGANIC CHEMISTRY

52 Hours

S. No	Module title	Module Content	Number of Hours	Skills Developed
1	Unit -1	<u>Concepts of Medicinal Chemistry:</u> Important terminology in medicinal Chemistry, Drug, Pharmacy, Pharmaceutics, Toxicology, Pharmacodynamics agents, Pharmacophore, pharmacodynamics, metabolites and anti-metabolites, chemotherapy. Mechanism of chemotherapeutic actions: 1) Biological defences. 2) Chemical defences. a) Surface active agents; b) Metabolic antagonism. Assay of Drugs: Chemical Assay, Biological Assay, Immunological Assay, LD50, ED50, IC50 and ID50. <u>Concept of Prodrugs and soft drugs.</u> a. Prodrugs: i) Prodrugs designing, types of prodrugs; ii) Prodrug formation of compounds containing various chemical groups, Prodrugs and Drug delivery system .b.Soft drugs: i) soft drug cocept; ii) Properties of soft drugs. <u>Theories of drug activity & Drug design</u> Basics of drug receptor interactions. Theories of drug activity (Occupancy theory, Rate theory, Perturbation theory, Receptor theory,). Hansch equation. <u>Antibiotics</u> Structure elucidation and synthesis of penicillins, chloromycetin and tetracyclins (terramycin and aureomycin).	3hrs 4hrs 7hrs	Employable Skills EMP SKD EDP
2	Unit -2	<u>Steroids</u> Occurrence. Nomenclature, basic skeleton, Diels hydrocarbon and stereochemistry. Isolation, structure and structural elucidation of sterols and bile acids (determination of ring size, nature of side chain, position of angular methyl and stereochemistry of ring junctions). Sex hormones and corticosteroids. Synthesis of cholesterol, estrone, progesterone, androsterone, testosterone. Photoproducts of ergosterol-	13hrs	Employable Skills and analytical Skills EMP SKD EDP

		vitamins D. Barton reaction for the synthesis of aldosterone. Marker degradation. Brief discussion of homosteroids, norsteroids and oral contraceptives. Synthesis of (dl)-norgestrel and ethinyl oestradiol.		
3	Unit-3	<u>Mechanism of drug action and synthesis of the following classes of drugs, with recent developments:</u> <i>Antipyretics, analgesics and non-steroidal anti-inflammatory drugs</i>, phenacetin, novalgin, phenylbutazone and ibuprofen. <i>Antidiabetics</i>: Sequence of A- & B- chains of insulin, glibenclamide, metformin, ciglitazone. <i>Antihistamines</i>: Methapyrilene, chlorpheniramine. <i>Antivirals</i>: Acyclovir, amantidine, rimantidine and zidovudine. <i>Antineoplastic agents</i>: Introduction, cancer chemotherapy, role of alkylating agents and antimetabolites in treatment of cancer. Synthesis of mechlorethamine, cyclophosphamide, melaphan, uracil mustards and 6-mercaptopurine. Hormone and natural products. <i>Cardiovascular drugs</i>: Introduction, cardiovascular diseases. Synthesis of amyl nitrite, sorbitrate, diltiazem, quinidine, verapamil, methyl dopa, atenolol, oxyphenol.	13hrs	Employable Skills EMP SKD EDP
4	Unit-4	<u>Local anti-infective agents:</u> Introduction and general mode of action. Synthesis of sulphonamides, furazolidone, nalidixic acid, ciprofloxacin, dapsone, aminosalicyclic acid, isoniazide, ethionamide, ethambutal, fluconazole, econazole, griseofulvin, and chloroquin <u>Psychoactive drugs- chemotherapy of the mind:</u> Introduction, benzodiazepines, buspirone. Antipsychotic drugs- butyrophenones, Synthesis of chlorpromazine, oxazepam, chlorazepam, alprazolam, phenytoin, ethosuximide, trimethadione, barbiturates, thiopental sodium, glutethimide.	12hrs	Employable Skills EMP SKD EDP

REFERENCE BOOKS:

1. Burger's Medicinal Chemistry and Drug Discovery, Vols. 1-6 Ed. D.J. Abraham, John Wiley, 2003
2. Foye's Principles of Medicinal Chemistry, 6th Edn., T L Lemke and D A Williams Eds., Lippincott, Williams and Wilkins, 2007
3. An Introduction to Medicinal Chemistry, P Graham, III Ed., Oxford, 2006
4. Medicinal Chemistry, N Weaver, Oxford, 2006
5. Goodman and Gilman's Pharmacological Basis of Therapeutics, 11th Edn., Tata McGraw-Hill, 2005.
6. The Organic Chemistry of Drug Design and Drug Action, R B Silverman, II Edn, Academic Press, Amsterdam, 2004.
7. Wilson and Gisvold's Text Book of Organic Medicinal and Pharmaceutical chemistry, J H Block and J M Beale, Jr., Eds., Lippincott, Williams and Wilkins, 2003.
8. Medicinal Chemistry – G R Chatwal, Himalaya, New Delhi, 2002
9. Instant Notes Medicinal Chemistry, P Graham, Viva, New Delhi, 2002
10. Medicinal Chemistry, A Kar, Wiley, 2000.
11. An Introduction to Drug Design, S.S. Pandey and J.R. Dimmock, New Age International, 1999.
12. Strategies for Organic Drug Synthesis and Design, D. Lednicer, John Wiley, 1998.
13. Synthetic drugs, G. R. Chatwal, Himalaya, New Delhi, 1995.
14. Natural Products Chemistry Vol 1 and 2, G R Chatwal, Himalaya, New Delhi, 1990
15. Comprehensive Organic Chemistry, Vol. 5 (Antibiotics), D. H. R. Barton, W. D. Ollis, Pergamon Press, NY, 1979.
16. Organic chemistry Vol.II, I. L. Finar, 6th Edn. Longman, 1992.
17. Total synthesis of natural products: The chiral approach Vol.III, S. Hanessian Pergamon Press, 1983.
18. Total synthesis of steroids, Akhaun & Titov, Jerusalem, 1969.
19. Medicinal natural products: A biosynthetic approach, P. M. Dewick. John Wiley, Chichester, 1997.
20. Natural products: Their chemistry and biological significance-J. Mann, R. S. Davidson, J. B. Hobbs, D. V. Banthorpe & J. B. Harborne, Longman, UK, 1994.
21. Natural products chemistry Vol. I & II, K. Nakanishi, T. Goso, S. Ito., S. Natori & S. Nozoe, Academic Press, NY, 1974.
22. Chemistry of natural products Vol. I & II, O. P. Aggarwal, Goel Publishing House, 6th Edn. 1982.
23. Total synthesis of natural products: The chiral approach Vol.III, S. Hanessian Pergamon Press, 1983.
24. Interpretation of the UV spectra of natural products, A.I. Scott, Pergamon Press, Oxford, 1964.

M.Sc IV SEMESTER-CHEMISTRY
MCH-405: ORGANIC CHEMISTRY PRACTICALS –V

COURSE	DETAILS
CODE	MCH-405
TITLE	ORGANIC CHEMISTRY PRACTICALS –V
PROGRAMME	M.Sc ORGANIC CHEMISTRY
YEAR/SEMESTER	SECOND/ THIRD
TYPE	HARD-CORE
TOTAL CREDITS	2
TOTAL CONTACT HOURS	60
COTACT HOURS PER WEEK	4
EXAMINATION DURATION	4
MAXIMUM MARKS	15(IA) + 35 = 50
TOTAL MODULES	10
PEDAGOGY	Lecture with practical problems being Worked out, Chalk and talk PT presentations, Seminars and presenPtations
EVALUATION METHOD	Lab performance, Observation and Mock tests will be given.

COURSE OBJECTIVES

This course aims to impart to the student, knowledge of:

CObj_ID	Course Objectives
CObj_1	Preparation of organic compounds by various methods.
CObj_2	Preparations of laboratory solutions.
CObj_3	The safety methods used to prepare solutions.

COURSE OUTCOMES

Upon the completion of this course, the students will be able to:

CO_ID	COURSE OUTCOMES
CO_1	Design and carry out experiments employing suitable techniques, accurately record and analyze the results, calculate overall yield of the final product.
CO_2	Know what type of precautions should take during the preparation of compounds.
CO_3	Understand to calculate the theoretical yield and practical yields.
CO_4	Design the mechanisms for the reactions carried.
CO_5	Handled the separation methods.

PO	CO-									
	PO_1	PO_2	PO_3	PO_4	PO_5	PSO_1	PSO_2	PSO_3	PSO_4	PSO_5
	CO_1	X					X			
	CO_2	X				X				
	CO_3	X					X			
	CO_4	X				X				

Mapping:

CO_5			x				x			

MCH-405-ORGANIC CHEMISTRY PRACTICALS – V

60hrs

S. No	Module title	Module Content	Number of Hours	Skills Developed
1	Unit -1	<u>Preparations:</u> 1.Preparation of NBS from succinic acid and its application in allylic bromination reactions. 2.Preparation of benzpinacolone from benzophenone. 3.Preparation of 2,4,5-triphenyloxazole from benzoin 4.Synthesis of Methyl Red 5.Synthesis of 1-bromo-2-naphthol from 2-naphthol	30hrs	Employable Skills EMP SKD EDP
2	Unit -2	<u>Qualitative analysis:</u> Separation of a binary mixture of organic compounds and identification of the separated components by systematic qualitative organic analysis	30hrs	Employable Skills and analytical Skills EMP SKD EDP

REFERENCE BOOKS:

- 1.Semi-micro qualitative organic analysis, Cheronis, Entrikin & Hoanett.
2. Preparation of organic intermediates, D. A. Hirley, John Wiley.
3. Text book of practical organic chemistry, A. I. Vogel, Pearson, 5th Edition, Delhi, 2004.
4. A laboratory manual of qualitative organic analysis, H.T. Openshaw, Univ. Press, 1999.
5. Organic Synthesis collective Vols. I to X, 1956-1999.
6. Laboratory Techniques in Organic Chemistry, V K Ahluwalia, Pooja Bhagat and Renu Aggarwal, I K international Publishing House, New Delhi, 2005.
7. Intermediates for Organic Synthesis, V K Ahluwalia, Pooja Bhagat, Ramesh Chandra and Renu Aggarwal, I K international Publishing House, New Delhi, 200

M.Sc IV SEMESTER-CHEMISTRY
MCH-406: ORGANIC CHEMISTRY PRACTICALS –VI

COURSE	DETAILS
CODE	MCH-406
TITLE	ORGANIC CHEMISTRY PRACTICALS –VI
PROGRAMME	M.Sc ORGANIC CHEMISTRY
YEAR/SEMESTER	SECOND/ THIRD
TYPE	HARD-CORE
TOTAL CREDITS	2
TOTAL CONTACT HOURS	60
COTACT HOURS PER WEEK	4
EXAMINATION DURATION	4
MAXOMUM MARKS	15(IA) + 35 = 50
TOTAL MODULES	10
PEDAGOGY	Lecture with practical problems being Worked out, Chalk and talk PT presentations, Seminars and presenPtations
EVALUATION METHOD	Lab performance, Observation and Mock tests will

	be given.

COURSE OBJECTIVES

This course aims to impart to the student, knowledge of:

CObj_ID	Course Objectives
CObj_1	Recording of spectral data using various spectroscopic techniques.
CObj_2	Methods employed for extraction/isolation of important natural products.
CObj_3	Chromatographic separation of mixtures.

COURSE OUTCOMES

Upon the completion of this course, the students will be able to:

CO_ID	COURSE OUTCOMES
CO_1	Carry out spectral analysis and confirmation of structure of organic compounds.
CO_2	Design extraction, isolation and purification (using chromatographic techniques) of natural products.
CO_3	Handling separation techniques.
CO_4	Process and isolation of various plant materials.
CO_5	Know the different chromatography techniques used.

CO-PO Mapping:

	PO_1	PO_2	PO_3	PO_4	PO_5	PSO_1	PSO_2	PSO_3	PSO_4	PSO_5
CO_1		X					X			
CO_2	X					X				
CO_3		X					X			
CO_4	X					X				
CO_5			X				X			

MCH-406: ORGANIC CHEMISTRY PRACTICALS – VI

60hrs

S. No	Module title	Module Content	Number of Hours	Skills Developed
1	Unit -1	<u>Extractions & Isolations:</u> 1.Extraction of caffeine from tea leaves. 2.Extraction of limonene from citrus rinds. 3.Isolation of essential oil from rose petals. 4. Isolation and separation of pigments chlorophyll and β -carotenes from spinach.	30hrs	Employable Skills EMP SKD EDP
2	Unit -2	<u>Instrumental methods in organic analysis:</u> 1. Recording/predicting/downloading from web sites the UV, IR, NMR and GC-MS/mass spectra of the compounds prepared in III & IV semesters. 2. Structural elucidation of organic compounds with the help of spectra provided by the instructors/examiners.	30hrs	Employable Skills and analytical Skills EMP SKD EDP

REFERENCE BOOKS:

- Natural products, Laboratory manual, Ikan, 2000.
- Organic experiments, L. F. Fieser, 2nd Edn. D. C. Heath & Co. USA, 1974-2000.
- Practical organic chemistry F.G. Mann and B. C. Saunders 4th Edn. Longman, 2002.
- Comprehensive practical organic chemistry: Preparation and quantitative Analysis, V. K. Ahluwalia, R. Aggarwal, Universities Press (India), 2000.
- Comprehensive practical organic chemistry: Qualitative analysis, V. K. Ahluwalia, S. Dhingra, Universities Press (India), 2000.
- An advanced course in practical chemistry, A. Ghoshal, B. Mahapatra and A. K. Nad, New central book agency, Calcutta, 2000.
- Advanced practical organic chemistry, J. Mohan, Vol. I and II, Himalaya Publishing House, 1992.
- Practical organic chemistry (Quantitative analysis), B. B. Dey, M V Sitaraman and T. R. Govindachari, Allied Publishers, New Delhi, 1992, 200

M.Sc IV SEMESTER-CHEMISTRY
MCH-407: PROJECT WORK

COURSE	DETAILS
CODE	MCH-407
TITLE	PROJECT WORK
PROGRAMME	M.Sc ORGANIC CHEMISTRY
YEAR/SEMESTER	SECOND/ FOURTH
TYPE	HARD-CORE
TOTAL CREDITS	4
TOTAL CONTACT HOURS	80
COTACT HOURS PER WEEK	8
EXAMINATION DURATION	4
TOTAL MAXIMUM MARKS	30(IA) + 70 = 100
TOTAL MODULES	6 MONTH PROJECT
PEDAGOGY	Lecture with practical problems being Worked out, Chalk and talk PT presentations, Seminars and presentations

EVALUATION METHOD	Project performance, Research skills and viva voce performance will be taken under consideration.

COURSE OBJECTIVES

This course aims to impart to the student, knowledge of:

CObj_ID	Course Objectives
CObj_1	Selecting the topics of the research project work.
CObj_2	Writing the thesis part.
CObj_3	Interpreting the results.

COURSE OUTCOMES

Upon the completion of this course, the students will be able to:

CO_ID	COURSE OUTCOMES
CO_1	To design the project by collecting required background material by referring the literature.
CO_2	To understand the functioning and safety features in the industry.
CO_3	To improve the experimental and soft skills.
CO_4	Know the methodology of preparing the synopsis of the project work.
CO_5	To learn various analytical and instrumental techniques and

	interpretation of analytical data.

	PO_1	PO_2	PO_3	PO_4	PO_5	PSO_1	PSO_2	PSO_3	PSO_4	PSO_5
CO_1		X					X			
CO_2	X					X				
CO_3		X					X			
CO_4	X					X				
CO_5			X				X			

CO-PO MAPPING:

MCH-407: ORGANIC CHEMISTRY PRACTICALS – VII
80hrs

S. No	Module title	Module Content	Number of Hours	Skills Developed
1	Unit -1	Research Project	80hrs	Employable Skills EMP SKD EDP

Department of Physical Sciences
Electronics



MATRIX AND SYLLABUS

For the Programme B.Sc. (Electronics/Computer Science)

Electronics

NEP Based Curriculum (2021 onwards)

I Semester

NEP- Curriculum Framework for Approval

B.Sc. (Electronics/Computer Science) - Matrix for I Semester (w.e.f. 2021-22 onwards)

I Semester							
Code	Course Code	Course	Teaching Hours	Course Components			Credits
				L	T	P	
AECC	S21 KN 1.1/ S21 HN 1.1/ S21 AE 1.1	Language I (Kannada/Hindi/Additional English)	45	3	1	-	3
AECC	S21 GE 1.1	Language II (Generic English)	60	3	1	-	3
DSC1	S21 EL 1.1	Electronic Devices and Circuits- (Theory)	60	4	-	-	4
DSC 1	S21 EL 1.2	Electronic Devices and Circuits – Lab – (Practical)	60	-	-	4	2
DSC 1	S21 CS 1.1	Problem Solving Techniques- (Theory)	60	4	-	-	4
DSC 1	S21 CS 1.2	C Programming Lab– (Practical)	60	-	-	4	2
OE-1	S21 OE/ B21 OE/	Domestic Equipment Maintenance / Office Automation and Design	45	2	1	-	3
SEC-SB	21SBC 1.1	Digital Fluency-I	30	1	-	2	2
SEC-VB	21VBC 1.1	Health and Well-being	30	-	-	2	1
SEC-VB	21VBC 1.2	Yoga	30	-	-	2	1
Total							25

Note 1:

DSC - Discipline-Specific Course

DSE – Discipline-Specific Elective

SEC - VB Skill Enhancement Course -Value Based

SEC - SB Skill Enhancement Course -Skill Based

Note 2:

The DSE and Vocational courses are programme specific and may vary depending on programme offered.

Continuous Internal Assessment – Scheme of Evaluation

For Theory Courses

End Semester Examination: 60%

Continuous Internal Assessment: 40%

Activities (CIA: 40 Marks)	Proposed and Approved Scheme		Total Marks (40)
	IA-1	IA-2	
Session Test Maximum Marks	30	30	
1. Weightage (Marks)	10	10	20
2. Assignment (Marks)	20		20
i. Writing	10		
ii.Quiz / Presentation / Creating diagrams /charts / Classwork / Case study / Viva / Field work etc.	05		
iii. Classroom participation	05		
Total			40

For Practical Courses

End Semester Examination: 50%

Continuous Internal Assessment: 50%

CIA (25 marks) + End Semester Exam (25 marks)

Activities	Total Marks
1. Lab Performance	10
2. Observation record	05
3. Internal exam	10
Total	25

S21 EL 1.1: ELECTRONIC DEVICES AND CIRCUITS

THEORY

Total Teaching Hours: 60

No. of Hours per Week: 4

(4 credits)

CObj	Course Objectives
CObj_1	To understand various fundamental principles of network analysis
CObj_2	To understand number systems and Boolean algebra and become familiar with the basic operation of electronic devices
CObj_3	To design electronic circuits, devices and gadgets

CO	Course Outcomes
	After completion of this subject, students should be able to:
CO_1	Understand the elementary aspects of Electronic devices.
CO_2	Apply on the choice and selection of semiconductor devices.
CO_3	Analyze the electric circuits using network theorems.
CO_4	Evaluate the working of transistors, transistor-based amplifiers and IC's leading towards digital electronic devices.
CO_5	Design the Analog and Digital electronic circuit devices.

CO-PO Mapping

[illegible]

Course Content

S. No	Unit/chapter title	Content	Number of hours	Skills developed
1.	Unit – I		15 Hrs	
	Electronic Components	Electronic passive and active components, types and their properties, Concept of Voltage and Current Sources, electric energy and power.(Qualitative only)		Cognitive/ Employable/Skills 1. EMP 2. SKD 3. EDP
	Network Theorems	Superposition, Thevenin's, Norton's, Maximum Power Transfer, and Reciprocity Theorems.DC and AC analysis of RC and RL circuits, RLC series and parallel Resonant Circuits.		Cognitive/ Employable/Skills
	PN junction diode	Ideal and practical diodes, Formation of Depletion Layer, Diode Equation and I-V characteristics. Idea of static and dynamic resistance, Zener diode, Reverse saturation current, Zener and avalanche breakdown.		Cognitive/ Employable/Skills
	Rectifiers	Half wave and Full wave (centre tap and bridge) rectifiers, expressions for output voltage, ripple factor and efficiency (mention only), Shunt capacitor filter. (Numerical examples wherever applicable). Testing of PN junction diodes using Multimeter.		Cognitive/ Employable/Skills
2.	Unit – II		15 Hrs	
	Voltage regulator	Block diagram of regulated power supply, Line and Load regulation, Zener diode as voltage regulator – circuit diagram, load and line regulation, disadvantages. Fixed and Variable IC Voltage Regulators (78xx, 79xx, LM317), Clippers (shunt type) and clampers(Qualitative analysis only), Voltage Multipliers.		Cognitive, Employable/Skills
	Bipolar Junction Transistor	Construction, types, CE,CB and CC configurations (mention only), VI characteristics of a transistor in CE mode, Regions of operation (active, cut off and saturation), leakage currents (mention only), Current gains α , β and their inter-relations, dc load		Cognitive/ Employable/Skills

		line and Q point. Applications of transistor as amplifier and switch - circuit and working. (Numerical examples wherever applicable), Testing of bipolar junction transistors using Multimeter.		
	Unit - III			
	Transistor biasing and	Fixed Bias and Voltage Divider Bias. Thermal runaway, stability and stability factor. Transistor as a two-port network, h-parameter equivalent circuit.		Cognitive/Employable/ Skills
	Stabilization circuits Amplifier	Small signal analysis of single stage CE amplifier using h-parameters. Input and Output impedances, Current and Voltage gains. Advantages of CC amplifier. Class A, B and C Amplifiers (qualitative). Types of coupling, Two stage RC Coupled Amplifier – circuit, working and its Frequency Response, loading effect, GBW product, Darlington transistor, Current gain.	15 Hrs	Cognitive/ Employable/Skills
	Special Semiconductor Diodes	Varactor diode, Schottky diode, Tunnel diode, -construction, characteristics, working, symbol, and applications for each. LED, LCD and solar cell – construction, operation and applications, 7-segment display, concept of common anode and common cathode types. (Numerical problems, wherever applicable), Testing of Special semiconductor diodes using Multimeter.		Cognitive/Employable/ Analytical Skills
4.	Unit - IV			
	Number System	Decimal, Binary, Octal and Hexadecimal number systems, base conversions. Representation of signed and unsigned numbers, Binary arithmetic; addition, subtraction by 1's and 2's complement method, BCD code (8421, 2421, Excess-3), Gray code, error checking and correction codes (Only parity check).	15 Hrs	Cognitive/Analytical

	Boolean Algebra	Constants, variables, operators, basic logic gates-AND, OR, NOT, Positive and negative logic, Boolean laws, Duality Theorem, De Morgan's Theorem, simplification of Boolean expressions using Boolean laws. Derived logic gates (NAND, NOR, XOR & XNOR). Universal property of NOR and NAND gates. (Numerical examples wherever applicable)		Cognitive/Employable, Analytical Skills

Books of Reference:

1. Bell, David A. *Electronic Devices and Circuits*. Oxford University Press, USA, 1999.
2. Boylestad, Robert L. *Electronic Devices and Circuit Theory*. 2012.
3. Floyd, Thomas L. *Digital Fundamentals*. 1997.
4. *Fundamentals of Digital Circuits*. Delhi, Phi Learning Private Limited, July, 2016.
5. *Fundamentals of Digital Circuits*. Delhi, Phi Learning Private Limited, July, 2016.
6. Leach, Donald P, et al. *Digital Principles and Applications*. New Delhi, McGraw Hill Education, 2015.
7. Mahmood Nahvi, and Joseph Edminister. *Schaum's Outline of Electric Circuits*. New York, McGraw-Hill, 2018.
8. Malvino, Albert. *Electronic Principles*. New York, New York, McGraw-Hill Education, 2021.
9. Meyers, Fred E, and Matthew P Stephens. *Manufacturing Facilities Design and Material Handling*. Allyn & Bacon, 2000.
10. Sedha, R S. *Text Book of Applied Electronics : For the Students of BE/B Tech, B Sc(Engg)*, New Delhi, S Chand, 2013.

S21 EL 1.2: ELECTRONIC DEVICES AND CIRCUITS - LAB**PRACTICAL****Total Teaching Hours: 60****No. of Hours per Week: 4****(2 credits)**

Sl. No.	Unit/chapter title	Content	Number of hours	Skills developed
1.	Module 1	Verification of Thevenin's Theorem and Maximum power transfer theorem	04 Hrs	Research/ Analytical/ Employable Skills 1. EMP 2. SKD 3. EDP
2.	Module 2	Verification of Superposition Theorem	04 Hrs	Research/ Analytical/ Employable Skills
3.	Module 3	Study of V-I characteristics of a) PN diode b) Zener diode	04 Hrs	Research/ Analytical/ Employable Skills
4.	Module 4	Study of V-I characteristics of LEDs of two different colours and 7-segment display	04 Hrs	Research/ Analytical/ Employable Skills
5.	Module 5	Study of Half wave rectifier without and with shunt capacitor filter	04 Hrs	Research/ Analytical/ Employable Skills
6.	Module 6	Study of Full wave rectifier without and with shunt capacitor filter	04 Hrs	Research/ Analytical/ Employable Skills
7.	Module 7	Study of Bridge wave rectifier without and with shunt capacitor filter	04 Hrs	Research/ Analytical/ Employable Skills
8.	Module 8	Study of Zener diode as a voltage regulator (line and load regulation)	04 Hrs	Research/ Analytical/ Employable Skills
9.	Module 9	Study of clipping and clamping circuits	04 Hrs	Research/ Analytical/ Employable Skills
10.	Module 10	Designing and testing of fixed positive and negative voltage regulators using 78xx and 79xx series ICs.	04 Hrs	Research/ Analytical/ Employable Skills
11.	Module 11	Designing and testing of variable voltage regulator using IC LM317	04 Hrs	Research/ Analytical/ Employable Skills
12.	Module 12	Study of Transistor characteristics in CE configuration	04 Hrs	Research/ Analytical/ Employable Skills

13.	Module 13	Study of fixed bias and voltage divider bias circuits	04 Hrs	Research/ Analytical/ Employable Skills
14.	Module 14	Study of single stage CE amplifier – Frequency response	04 Hrs	Research/ Analytical/ Employable Skills
15.	Module 15	Study of two stage RC -coupled CE amplifier – Frequency response	04 Hrs	Research/ Analytical/ Employable Skills
16.	Module 16	Verification of truth tables of OR,AND,NOT,NAND,NOR,XOR and XNOR gates using respective ICs	04 Hrs	Research/ Analytical/ Employable Skills
17.	Module 17	Study of NAND and NOR as universal gates	04 Hrs	Research/ Analytical/ Employable Skills
18.	Module 18	Binary to Gray and Gray to Binary code conversion	04 Hrs	Research/ Analytical/ Employable Skills

Demonstration Experiments

1. Electronics components
2. Resistance in series, parallel and series-parallel
3. Capacitors and Inductors in series and parallel
4. Multimeter and LCR meter – Checking of components / Measurements
5. Voltage source in series, parallel and series-parallel
6. Voltage and current dividers
7. Measurement of Amplitude, Frequency and Phase difference using CRO

***Minimum of EIGHT Experiments to be performed excluding demonstration experiments.**

S21 OE 1.1: DOMESTIC EQUIPMENT MAINTAINENCE
THEORY

Total Teaching Hours: 45

No. of Hours per Week: 3

(3 credits)

CObj	Course Objectives
CObj_1	To understand the working and parts of Geyser and cooker
CObj_2	To gain the knowledge on micro oven and refrigerator
CObj_3	To know about the working process of AC and general faults

CO	Course Outcomes
	After completion of this subject, students should be able to:
CO_1	Gain the knowledge on Geyser, induction cooktop, micro oven, AC and refrigerator
CO_2	Able to understand the common faults and their troubleshooting in cooker, refrigerator, Geyser and micro oven,
CO_3	Able to understand the manufacturing process and working of air conditioner, refrigerator, Geyser, induction cooktop and microwave oven
CO_4	Able to understand the electrical wiring diagram
CO_5	Ability to repair/replace the components of Geyser, micro oven, induction cooktop, AC and refrigerator

Course Content

S. No	Unit/chapter title	Content	Number of hours	Skills developed
1.	Unit-I Geyser Common faults and their troubleshooting	Construction and working, parts and manufacturing process, types. Common faults and their troubleshooting: Dripping geyser overflow, overheating, steam or hot water escaping from overflow, water leaking through the ceiling, no hot water, water not hot enough, poor hot water pressure.	7 Hrs	Cognitive,/ Employable
2.	Unit – II Induction Cooker Common faults and their troubleshooting	Induction cooker: Construction and working, parts and manufacturing process, types. Cooker fuse blown, cooker buttons not working, cooktop shuts off while cooking, food not get cooked or heated properly, overheating and uneven heating, display keep flashing, weird noises–crackling, fan noise, humming sound, clicking.	8 Hrs	Cognitive/ Employable
3.	Unit – III Microwave Oven Common faults and their troubleshooting Refrigerator	Working, raw material and manufacturing process, types, Common faults and their troubleshooting: Microwave does not heat, runs then stops, buttons do not work, plate do not spin, bulb does not turn ON during operation, sparking inside, shuts OFF after few seconds. Working, raw material and manufacturing process, electrical wiring diagram, types of refrigerator. Common faults and their troubleshooting: fridge not cooling, fridge not defrosting, leaking water, freezing food light not working, freezer is cooled but fridge stays warm, dead refrigerator, not enough cooling, keeps running, leakage, makes noise. Replacement procedure for: seal (gasket), evaporator fan motor, PTC relay, thermostat, compressor, and bulb.	15 Hrs	Cognitive/ Employable

4.	Unit - IV	Working, raw material and manufacturing process, electrical wiring diagram, types. Common Faults and their troubleshooting: Faults in following parts of AC: Filter, thermostat, refrigerant leaks, breakers, capacitors, compressor, evaporator coils, condenser coils, and warm contactor. AC unit has an odour, shuts ON and OFF repeatedly, does not blow cold air, repeatedly tripping a circuit breaker, indoor unit is leaking water inside the room, outdoor unit is making an unusually loud sound, room is not getting cold enough, AC not turning ON.	15 Hrs	Cognitive/ Employable
	Demonstration Experiments	a. Working of Air Conditioner b. Working of Refrigerator c. Working of Geyser d. Working of Microwave Oven e. Working of Induction Cooker		Evaluation and Synth esis

Books for References:

1. Bell, D. A. (2007). *Electronic Instrumentation and Measurements* (2nd ed.). David Bell.
2. Olsen, G. H. (1987). *Electronics and electronic systems*. Butterworth-Heinemann.
3. Prensky, S. D. (1971). *Electronic Instrumentation* (2nd ed.). Prentice Hall.
4. Tomal, D. R., & Widmer, N. S. (1998). *Electronic Troubleshooting* (2nd ed.). McGraw-Hill.
5. Van Putten, A. F. P. (1996). *Electronic measurement systems: Theory and practice*. Institute of Physics Publishing.
6. Whitaker, J. C. (Ed.). (2001). *Electronic systems maintenance handbook, second edition* (2nd ed.). CRC Press.
7. Bakshi, A. V., & Bakshi, U. A. (2020). *Electronic measurements and instrumentation: Analog and digital meters, signal generators and analyzers, oscilloscopes, transducers*. Amazon Digital Services LLC - KDP Print.
8. Berlin, H. M., & Getz, J. F. C. (1988). *Principles of electronic instrumentation and measurement*. Merrill.
9. Buchla, D. M., & McLachlan, W. (1991). *Electronic Instrumentation and Measurement*. Prentice-Hall.
10. Joshi, J. G. (n.d.). *Electronic measurements and instrumentation*. KHANNA PUBLISHING HOUSE.
11. Oliver, B. M. (1971). *Electronic Measurements and Instrumentation*. McGraw-Hill.
12. Sachan. (2019). *Fundamentals of electronic measurement & instrumentation*. Independently Published.



MATRIX AND SYLLABUS

For the Programme B.Sc. (Electronics/Computer Science)

Electronics

NEP Based Curriculum (2021 onwards)

II Semester

NEP- Curriculum Framework for Approval

B.Sc. (Electronics/Computer Science) - Matrix for II Semester (w.e.f. 2021-22 onwards)

II Semester							
Code	Course Code	Course	Teaching Hours	Course Components			Credits
				L	T	P	
AECC	S21 KN 2.1/ S21 HN 2.1/ S21 AE 2.1	Language I (Kannada/Hindi/Additional English)	45	3	1	-	3
AECC	S21 GE 2.1	Language II (Generic English)	60	3	1	-	3
AECC	21 SBC 2.1	Environmental Studies	45	2	1	-	3
DSC2	S21 EL 2.1	Analog and Digital Electronics - (Theory)	60	4	-	-	4
DSC2	S21 EL 2.2	Analog and Digital Electronics-Lab- (Practical)	60	-	-	4	2
DSC2	S21 CS 2.1	Data Structures - (Theory)	60	4	-	-	4
DSC2	S21 CS 2.2	Data Structures Lab- (Practical)	60	-	-	4	2
OE-2	S21 OE/ B21 OE	Consumer Electronics / Cyber Space	45	2	1	-	3
SEC-VB	21VBC 2.1	NCC/NSS/Cultural	30	-	-	2	1
SEC-VB	21VBC 2.2	Sports	30	-	-	2	1
Total							26

Note 1:

DSC - Discipline-Specific Course

DSE – Discipline-Specific Elective

SEC - VB Skill Enhancement Course -Value Based

SEC - SB Skill Enhancement Course -Skill Based

Note 2:

The DSE and Vocational courses are programme specific and may vary depending on programme offered.

Continuous Internal Assessment – Scheme of Evaluation

For Theory Courses

End Semester Examination: 60%

Continuous Internal Assessment: 40%

Activities (CIA: 40 Marks)	Proposed and Approved Scheme		Total Marks (40)
	IA-1	IA-2	
Session Test Maximum Marks	30	30	
1. Weightage (Marks)	10	10	20
2. Assignment (Marks)	20		20
i. Writing	10		
ii.Quiz / Presentation / Creating diagrams /charts / Classwork / Case study / Viva / Field work etc.	05		
iii. Classroom participation	05		
Total			40

For Practical Courses

End Semester Examination: 50%

Continuous Internal Assessment: 50%

CIA (25 marks) + End Semester Exam (25 marks)

Activities	Total Marks
1. Lab Performance	10
2. Observation record	05
3. Internal exam	10
Total	25

S21 EL 2.1: ANALOG AND DIGITAL ELECTRONICS

THEORY

Total Teaching Hours: 60

No. of Hours per Week: 4

(4 credits)

CObj	Course Objectives
CObj_1	To recognize the various working principles of widely used electronic devices, linear and digital ICs
CObj_2	The students will learn the design and working of BJT, JFET, MOSFET
CObj_3	The students will learn arithmetic circuits, multiplexing and demultiplexing operations and a few logic families,

CO	Course Outcomes
	After completion of this subject, students should be able to:
CO_1	Understanding of the fundamental concepts and techniques used in analog and digital electronics.
CO_2	Apply various combinational circuits, sequential circuits and Analog circuits.
CO_3	Analyze various combinational circuits, sequential circuits and Analog circuits.
CO_4	Evaluate the application potential, pre-requisites for a circuit design and solve timing problems in a digital design.
CO_5	Design and Analyze circuits using Analog and Digital Electronics.

CO-PO Mapping

[illegible]

Course Content

S. No	Unit/chapter title	Content	Number of hours	Skills developed
1.	Unit –I		15 Hrs	1. EMP 2. SKD 3. EDP Cognitive/Employable
	JFET	Types - p-channel and n-channel, working and I-V characteristics - n-channel JFET, parameters and their relationships, Comparison of BJT and JFET.		
	MOSFET	E – MOSFET, D – MOSFET – n-channel and p-channel, Construction, working, symbols, biasing, drain and transfer characteristics, VMOS, UMOS Power MOSFETs, handling, MOS logic, symbols and switching action of MOS, NMOS inverter, CMOS logic, CMOS – inverter, circuit and working, CMOS characteristics, IGBT construction and working		
	UJT	Basic construction, working, equivalent circuit and I-V characteristics, intrinsic stand-off ratio, relaxation oscillator		
	SCR	Construction, VI characteristics, working, symbol, and applications – HWR and FWR. (Numerical examples wherever applicable) Diac and Triac-construction, working, characteristics, applications,		
2.	Unit-II			
	Op-Amp	Differential Amplifier, Block diagram of Op-Amp, Characteristics of an Ideal and Practical Op-Amp, Open and closed loop configuration, Frequency Response, CMRR, Slew Rate and concept of Virtual Ground.		

	Concept of feedback, negative and positive feedback, advantages of negative feedback (Qualitative Study) Applications of Op-Amps Inverting and non-inverting amplifiers, Summing and Difference Amplifier, Differentiator, Integrator, Comparator and Zero-crossing detector Filters First and second order active low pass, high pass and bandpass Butterworth filters. Oscillators Barkhausen criterion for sustained oscillations, Colpitt's oscillator and crystal oscillators using transistor, Phase Shift oscillator, Wien-bridge oscillator – (no derivation for each) IC 555Timer Introduction, Block diagram, Astable and Monostable multivibrator circuits. (Numerical Examples wherever applicable)	15 Hrs	Cognitive/Employable /Analytical Skills
Unit-III	Logic Families Pulse characteristics, Logic Families-classification of digital ICs. Characteristics of logic families, circuit description of TTL NAND gate with totem pole and open collector. TTL IC terminology. CMOS NAND, comparison of TTL and CMOS families. Combinational Logic Circuits Minimisation techniques using K-maps - SOP and POS, Minterm, Maxterm, SSOP, SPOS, Simplification of Boolean expressions, K-Map for 3 and 4 variable. Digital to Analog converter- DAC with binary weighted resistor and R-2R resistor ladder network. Analog to Digital converter: Successive approximation methodperformance characteristics. Design of	15 Hrs	

		Arithmetic logic circuits:Half Adder, Full Adder, Half Subtractor, Full Subtractor. 4-bit parallel binary adder, 2-bit and 4-bit magnitude comparator. Encoder, decimal to BCD priority encoder. Decoder, 2:4 decoder using AND gates, 3:8 decoder using NAND gates, BCD to decimal decoder, BCD to 7-Segment decoder, Multiplexer - 4:1 and 8:1 multiplexer, Demultiplexer - 1:4 and 1:8 demultiplexer - logic diagram and truth table of each, Realization of Full adder and Full subtractor using Mux and Decoder.		Cognitive,/Employable/ Analytical Skills
4.	Unit –IV Sequential Logic Circuits Registers and Counters	Flip-Flops - SR Latch, RS, D and JK Flip-Flops. Clocked (Level and Edge Triggered) Flip-Flops. Preset and Clear operations. Race-around conditions in JK Flip-Flop. Master-Slave JK and T Flip-Flops. Applications of Flip-Flops in semiconductor memories, RAM, ROM and types. Types of Shift Registers, Serial-in-Serial-out(SISO),Serial-in,Parallel-out (SIPO), Parallel-in-Serial-out (PISO) and Parallel-in-Parallel-out (PIPO) Shift Registers (only up to 4 bits), applications. Ring counter, Johnson counter applications. Asynchronous Counters: Logic diagram, Truth table and timing diagrams of 4-bit ripple counter, modulo-n counters,4-bit Up-Down counter, Synchronous Counter: 4-bit counter, Design of Mod 3, Mod 5 and decade Counters using K-maps.	15 Hrs	Cognitive/Employable / Analytical Skills

Books for Reference:

1. Bell, David A. *Electronic Devices and Circuits*. Oxford University Press, USA, 1999.
2. Boylestad, Robert L. *Electronic Devices and Circuit Theory*. 2012.
3. Fiore, James. *Operational Amplifiers & Linear Integrated Circuits*. 2018.
4. Floyd. *Digital Fundamentals*. Pearson Education India, 1 Sept. 2005.
5. Floyd, Thomas L. *Electronic Devices : Conventional Current Version*. Upper Saddle River, N.J., Pearson Prentice Hall, 2008.
6. Gayakwad, Ramakant A. *Op-Amps and Linear Integrated Circuits*,3/E. 1988.
7. Leach, Donald P, et al. *Digital Principles and Applications*. New Delhi, Mcgraw Hill Education, 2015.
8. Sedha, R S. *Text Book of Applied Electronics : For the Students of BE/B Tech, B Sc(Engg) ...* New

Delhi, S Chand, 2013.

9. Tokheim, Roger L. *Schaum's Outline of Digital Principles*. McGraw-Hill Education, 22 Jan. 1994.
10. Tokheim, R. L. (1998). *Digital electronics: Principles and applications experiment manual* (5th ed.). McGraw-Hill.

S21 EL 2.2: ANALOG AND DIGITAL ELECTRONICS - LAB**PRACTICAL****Total Teaching Hours: 60****No. of Hours per Week: 4****(2 credits)**

Sl. No.	Unit/chapter title	Content	Number of hours	Skills developed
1.	Module 1	Study of JFET/MOSFET characteristics – determination of parameters.	04 Hrs	Research/ Analytical/ Employable Skills
2.	Module 2	Study of single stage JFET amplifier.(frequency response and band width)	04 Hrs	Research/ Analytical/ Employable Skills
3.	Module 3	UJT characteristics and relaxation oscillator	04 Hrs	Research/ Analytical/ Employable Skills
4.	Module 4	SCR characteristics – determination of IH and firing voltage for different gate currents.	04 Hrs	Research/ Analytical/ Employable Skills
5.	Module 5	Design of inverting and non-inverting amplifier using op-amp & study of frequency response.	04 Hrs	Research/ Analytical/ Employable Skills
6.	Module 6	Op-amp inverting and non-inverting adder, subtractor and averaging amplifier.	04 Hrs	Research/ Analytical/ Employable Skills
7.	Module 7	Study of the zero-crossing detector and comparator.	04 Hrs	Research/ Analytical/ Employable Skills
8.	Module 8	Design and study of differentiator and integrator using op-amp for different input waveforms.	04 Hrs	Research/ Analytical/ Employable Skills
9.	Module 9	Design and study of Wien bridge and RC phase shift oscillator using op-amp.	04 Hrs	Research/ Analytical/ Employable Skills
10.	Module 10	Design and study of first order high-pass and low-pass filters using op-amp.	04 Hrs	Research/ Analytical/ Employable Skills
11.	Module 11	Study of Colpitt's and crystal oscillator using transistor.	04 Hrs	Research/ Analytical/ Employable Skills
12.	Module 12	Astable multivibrator using IC555 timer.	04 Hrs	Research/ Analytical/ Employable Skills

13.	Module 13	Monostable multivibrator using IC555 timer.	04 Hrs	Research/ Analytical/ Employable Skills
14.	Module 14	Half Adder and Full Adder using (a) logic gates (b) using only NAND gates.	04 Hrs	Research/ Analytical/ Employable Skills
15.	Module 15	Half Subtractor and Full Subtractor(a) logic gates (b) using only NAND gates.	04 Hrs	Research/ Analytical/ Employable Skills
16.	Module 16	4 bit parallel binary adder and subtractor using IC7485.	04 Hrs	Research/ Analytical/ Employable Skills
17.	Module 17	Study of BCD to decimal decoder using IC7447	04 Hrs	Research/ Analytical/ Employable Skills
18.	Module 18	Study of the Encoders and priority encoders.	04 Hrs	Research/ Analytical/ Employable Skills
19.	Module 19	Study of Multiplexer and Demultiplexer using ICs.	04 Hrs	Research/ Analytical/ Employable Skills
20.	Module 20	Study of 2-bit and 4-bit magnitude comparators.	04 Hrs	Research/ Analytical/ Employable Skills
21.	Module 21	Study of Clocked RS, D and JK Flip-Flops using NAND gates.	04 Hrs	Research/ Analytical/ Employable Skills
22.	Module 22	Study of 4-bit asynchronous counter using JK Flip-Flop IC7476, modify to decade counter and study their timing diagrams.	04 Hrs	Research/ Analytical/ Employable Skills
23.	Module 23	Study of 4-bit Shift Register – SISO, modification to ring counter using IC 7495.	04 Hrs	Research/ Analytical/ Employable Skills
24.	Module 24	Digital to Analog converter using binary weighted resistor method, determination of resolution, accuracy and linearity error	04 Hrs	Research/ Analytical/ Employable Skills

***Minimum of EIGHT Experiments to be performed excluding demonstration experiments.**

S21 OE 2.1: CONSUMER ELECTRONICS**THEORY****Total Teaching Hours: 45****No. of Hours per Week: 3****(3 credits)**

CObj	Course Objectives
CObj_1	To understand the audio systems of Microphones, Amplifier, Loudspeakers, Radio Receivers, AM/FM, Audio Recording, and reproduction, Installation of Audio/Video systems – site preparation, electrical requirements, cables and connectors.
CObj_2	To know functions of set top box, CATV and Dish TV, LCD, Plasma, LED, OLED, QDLED and LED TV, Projectors: DLP, Home Theatres, Remote controls
CObj_3	To get the knowledge on landline and mobile telephony, electronic gadgets

CO	Course Outcomes
	After completion of this subject, students should be able to:
CO_1	Gain the knowledge on the audio systems of Microphones, Amplifier, Loudspeakers and their installation
CO_2	Able to understand functions of TV, TV displays
CO_3	Able to analysis the process of projectors: DLP, Home Theatres, Remote controls
CO_4	Able to understand the design of Basic landline equipment, CL1, cordless intercom/EPABX system, mobile phones and also understand the working process of Scanners, Barcode / flat bed, printers, Xerox, Multifunction UNITs (Print, Scan, and copy)
CO_5	Able to recognize process of the digital clock, digital camera, handcam, home security system, CCTV,

Course Content

S. No	Unit/chapter title	Content	Number of hours	Skills developed
1.	Unit –I Audio Systems	PA system, Microphones, Amplifier, Loudspeakers, Radio Receivers, AM/FM, Audio Recording, and reproduction, Installation of Audio/Video systems – site preparation, electrical requirements, cables and connectors. Study of PA systems for various situations – Public gathering, Closed theatre / Auditorium, Conference room, Prepare bill of material (Costing)	7 Hrs	Cognitive/ Employable
2.	Unit-II TV and Displays	Set top box, CATV and Dish TV, LCD, Plasma, LED, OLED, QDLED and LED TV, Projectors: DLP, Home Theatres, Remote controls	8 Hrs	Cognitive/ Employable
3.	Unit – III Landline and Mobile Telephony	Mobile Phones, Smart Phone, Smart Watch, GPRS and Bluetooth, GPS Navigation system. Office Equipment: Scanners, Barcode / flat bed, printers, Xerox, Multifunctional Units (Print, Scan, and copy)	15 Hrs	Cognitive/ Employable
4.	Unit-IV Electronic gadgets and Domestic Appliances	Digital Clock, Digital Camera, Handicam, Home security system, CCTV, Air conditioners, Refrigerators, washing machine / Dish washer, Microwave oven, Vacuum cleaners. Market survey of products (at least one from each module). Identification of block and tracing the system, Assembly and Disassembly of system using toolkit	15 Hrs	Cognitive/ Employable

Books for References

1. Bali, S. P. (2009). *Consumer Electronics*. Pearson Education.
2. Lee, J.-H., Cheng, I.-C., Hua, H., and Wu, S.-T. (2020). *Introduction to flat panel displays* (2nd ed.). John Wiley & Sons.
3. Nsca. (2000). *Audio Systems Technology: Level 3*. Butterworth-Heinemann.
4. Davidson, H. L. (1998). *Consumer electronics component handbook: How to identify, locate and test consumer electronic components*. McGraw-Hill.

5. Davidson, H. L. (2004). *Troubleshooting & repairing consumer electronics without a schematic* (3rd ed.). TAB Books.
6. Kinney, D. (2006). *A beginners guide to consumer electronics repair: Hand book and tutorial*. iUniverse.



MATRIX AND SYLLABUS

For the Programme B.Sc. (Electronics/Computer Science)

Electronics

NEP Based Curriculum (2021 onwards)

III Semester

NEP- Curriculum Framework for Approval

B.Sc. (Electronics/Computer Science) - Matrix for III Semester (w.e.f. 2022-23 onwards)

III Semester							
Code	Course Code	Course	Teaching Hours	Course Components			Credits
				L	T	P	
AECC	S21 KN 3.1/ S21 HN 3.1/ S21 AE 3.1	Language I (Kannada/Hindi/Additional English)	45	3	1	-	3
AECC	S21GE 3.1	Language II (Generic English)	60	3	1	-	3
DSC3	S21 EL 3.1	Digital Design Using Verilog and VHDL Programming- (Theory)	60	4	-	-	4
DSC3	S21 EL 3.2	Digital Design Using Verilog and VHDL Programming - Lab- (Practical)	60	-	-	4	2
DSC3	S21 CS 3.1	Object Oriented Programming Using Java- (Theory)	60	4	-	-	4
DSC3	S21 CS 3.2	Java Lab- (Practical)	60	-	-	4	2
OE-3	S21OE/ B21OE	Medical Electronics / Computer Fundamentals and Programming Concepts in C	45	2	1	-	3
SEC- SB	21SBC 3.1	Digital fluency-II	30	1	-	2	2
SEC-VB	21VBC 3.1	NCC/NSS/Cultural	30	-	-	2	1
SEC-VB	21VBC 3.2	Sports	30	-	-	2	1
Total							25

Note 1:

DSC - Discipline-Specific Course

DSE – Discipline-Specific Elective

SEC - VB Skill Enhancement Course -Value Based

SEC - SB Skill Enhancement Course -Skill Based

Note 2:

The DSE and Vocational courses are programme specific and may vary depending on programme offered.

Continuous Internal Assessment – Scheme of Evaluation

For Theory Courses

End Semester Examination: 60%

Continuous Internal Assessment: 40%

Activities (CIA: 40 Marks)	Proposed and Approved Scheme		Total Marks (40)
	IA-1	IA-2	
Session Test Maximum Marks	30	30	
1. Weightage (Marks)	10	10	20
2. Assignment (Marks)	20		20
i. Writing	10		
ii.Quiz / Presentation / Creating diagrams /charts / Classwork / Case study / Viva / Field work etc.	05		
iii. Classroom participation	05		
Total			40

For Practical Courses

End Semester Examination: 50%

Continuous Internal Assessment: 50%

CIA (25 marks) + End Semester Exam (25 marks)

Activities	Total Marks
1. Lab Performance	10
2. Observation record	05
3. Internal exam	10
Total	25

S21 EL 3.1: DIGITAL DESIGN USING VERILOG AND VHDL PROGRAMMING
THEORY

Total Teaching Hours: 60

No. of Hours per Week: 4

(4 credits)

CObj	Course Objectives
CObj_1	To familiarize with the concepts of programming using Verilog and VHDL
CObj_2	To identify language elements and keywords used in Verilog and VHDL
CObj_3	To write the Verilog programs in structural and dataflow modelling levels of Abstraction

CO	Course Outcomes
	After completion of this subject, students should be able to:
CO_1	Understand of the fundamental concepts and techniques of hardware description languages Verilog HDL and VHDL.
CO_2	Apply fundamental programming skills to write Verilog/VHDL
CO_3	Analyze any basic building block and simulate any digital function in Verilog HDL and VHDL.
CO_4	Evaluate and Construct Verilog programs in structural and dataflow modelling levels of Abstraction
CO_5	Design and Develop Verilog programs in behavioural modelling levels of Abstraction

CO-PO Mapping

[illegible]

Course Content

S. No	Unit/chapter title	Content	Number of hours	Skills developed
1.	Unit –I Overview of Digital Design with Verilog HDL	Evolution of CAD, emergence of HDLs, typical HDL-flow, why Verilog HDL? Trends in HDLs. Hierarchical Modeling Concepts - Top-down and bottom-up design methodology, differences between modules and module instances, parts of a simulation, design block, stimulus block. Verilog- Module, Delays, brief description - data flow style, behavioral style, structural style, mixed style.	12 Hrs	1. EMP 2. SKD 3. EDP Cognitive/ Employable/ Analytical
2.	Unit-II Introduction to Gate level Modeling and Structural Modeling	Language Elements-Introduction, Keywords, Identifiers, White space characters, integers, data types, net types, register types and parameter; Expressions - Operands, Operators and types of expressions. Gate level Modeling - Introduction, built in primitive gates, multiple input gates, Tristate gates, pull gates, MOS switches, bidirectional switches, gate delay-illustrative examples. Structural modeling: Component declaration, Component instantiation, Examples	18 Hrs	Cognitive/ Employable/ Analytical
3.	Unit – III Introduction to Data Flow Modeling and Behavioral Modeling	Data flow modeling - Continuous assignment, net declaration assignments, delays, net delays - illustrative examples. Dataflow Modeling: Concurrent signal assignment statement, Sequential signal assignment statement, Delta delay revisited, multiple drivers, Block statement. Examples. Behavioral Modeling - Procedural constructs, timing controls, conditional statement, loop	18 Hrs	

		statement, Procedural continuous assignment, illustrative examples. Behavioral Modeling: Entity declaration, Architecture body, Process statement, Variable assignment statement, Signal assignment statement, Wait statement, If statement, Case statement, Null statement, Loop statement, Exit statement, Next statement, Examples.		Cognitive/ Employable/ Analytical
4.	Unit-IV Introduction to VHDL	What is VHDL? History, capabilities, hardware abstraction, basic terminology, entity declaration, Architecture body, Configuration declaration, Package declaration, Package body, Model analysis. Language Elements-Introduction, Identifiers, keywords, data objects, data types, Composite types, Operators. OOPS concept-features, class, objects, instances, attributes. (Concept only)	12 Hrs	Cognitive/ Employable/ Analytical

Books for Reference:

1. Ciletti, Michael D. *Modeling, Synthesis, and Rapid Prototyping with the Verilog HDL*. Pearson, 1999.
2. Jayaram Bhasker. *A VHDL Primer*. Prentice Hall, 1995.
3. Merrick, Russell. *Getting Started with FPGAs*. No Starch Press, 21 Nov. 2023.
4. Thomas. *Verilog Hardware Description Language*. Springer, India, 2010.
5. Thomas, Donald, et al. *The Verilog® Hardware Description Language*. Boston, Ma, Springer Us, 2002.
6. Vaibbhav Taraate. *Digital Logic Design Using Verilog Coding and RTL Synthesis*. New Delhi Springer India, 2016.
7. Botros, N. (2006). *HDL programming fundamentals: VHDL and Verilog*. Charles River Media.
8. Brown, S. A., & Vranesic, Z. G. (2013). *Fundamentals of digital logic with verilog design* (3rd ed.). McGraw-Hill Professional.
9. Sarma, R., & Bhargava, C. (2020). *Hardware description language demystified: Explore digital system design using verilog HDL and VLSI design tools (English edition)*. BPB Publications.
10. Thomas, D. E., & Moorby, P. R. (2002). *The Verilog (R) Hardware Description Language* (Z. Navabi, Ed.; 5th ed.). Springer.

S21 EL 3.2: DIGITAL DESIGN USING VERILOG AND VHDL PROGRAMMING - LAB PRACTICAL

Total Teaching Hours: 60

No. of Hours per Week: 4

(2 credits)

Sl. No.	Unit/chapter title	Content	Number of hours	Skills developed
1.	Module 1	Write a Verilog code to realize basic and derived logic gates	04 Hrs	Research/ Analytical/ Employable Skills 1. EMP 2. SKD 3. EDP
2.	Module 2	Write a Verilog code to realize the universal property of NAND and NOR gates	04 Hrs	Research/ Analytical/ Employable Skills
3.	Module 3	Write a Verilog code to realize Half adder using basic and derived gates	04 Hrs	Research/ Analytical/ Employable Skills
4.	Module 4	Write a Verilog code to realize Full adder using basic gates.	04 Hrs	Research/ Analytical/ Employable Skills
5.	Module 5	Write a Verilog code to realize Half subtractor using basic gates and derived gates	04 Hrs	Research/ Analytical/ Employable Skills
6.	Module 6	Write a Verilog code to realize 4:1 Decoders	04 Hrs	Research/ Analytical/ Employable Skills
7.	Module 7	Write a Verilog code to realize Code converters (Binary to Gray and vice versa)	04 Hrs	Research/ Analytical/ Employable Skills
8.	Module 8	Write a VHDL code to realize basic and derived logic gates	04 Hrs	Research/ Analytical/ Employable Skills
9.	Module 9	Write a VHDL code to realize the universal property of NAND and NOR gates	04 Hrs	Research/ Analytical/ Employable Skills
10.	Module 10	Write a VHDL code to realize Half adder using basic and derived gates	04 Hrs	Research/ Analytical/ Employable Skills
11.	Module 11	Write a VHDL code to realize Full adder using basic gates	04 Hrs	Research/ Analytical/ Employable Skills
12.	Module 12	Write a VHDL code to realize Half subtractor using basic gates and derived	04 Hrs	Research/ Analytical/ Employable Skills

13.	Module 13	Write a VHDL code to realize 4:1 Decoders	04 Hrs	Research/ Analytical/ Employable Skills
14.	Module 14	Write a VHDL code to realize Code converters (Binary to Gray and vice versa)	04 Hrs	Research/ Analytical/ Employable Skills

***Minimum of TEN Experiments to be performed excluding demonstration experiments**

S21 OE 3.5: MEDICAL ELECTRONICS**THEORY****Total Teaching Hours: 45****No. of Hours per Week: 3****(3 credits)**

CObj	Course Objectives
CObj_1	To understand the electro-physiology and bio-potential recording
CObj_2	To describe the bio-chemical and non-electrical parameter measurement
CObj_3	To discuss the various recent trends in medical instrumentation

CO	Course Outcomes
	After completion of this subject, students should be able to:
CO_1	Understand the electro-physiology and bio-potential recording
CO_2	Able to describe the bio-chemical and non-electrical parameter measurement
CO_3	Able to outline the different types of assist devices
CO_4	Able to describe the concepts of physical medicine and biotelemetry.
CO_5	Able to discuss the various recent trends in medical instrumentation

Course Content

S. No	Unit/chapter title	Content	Number of hours	Skills Developed
1.	Unit – I Electro-Physiology and Bio-Potential Recording	The origin of Bio-potentials; bio potential electrodes, biological amplifiers, ECG, EEG, EMG, PCG, lead systems and recording methods, typical waveforms and signal characteristics.	7 Hrs	Cognitive/ Employable
2.	Unit – II Bio-Chemical And Non Electrical Parameter	pH, PO ₂ , PCO ₂ , colorimeter, Auto analyzer, Blood flow meter, cardiac output, respiratory measurement, Blood pressure, temperature, pulse, Blood Cell Counters.	8 Hrs	Cognitive/ Employable
3.	Unit – III Measurement Assist Devices Recent Trends In Medical Instrumentation	Cardiac pacemakers, DC Defibrillator, Dialyser, Heart lung machine. Thermograph, endoscopy unit, Laser in medicine, cryogenic application, Introduction to telemedicine.	15 Hrs	Cognitive/ Employable
4.	Unit – IV Physical Medicine and Biotelemetry	Diathermies- Shortwave, ultrasonic and microwave type and their applications, Surgical Diathermy Telemetry principles, frequency selection, biotelemetry, electrical safety	15 Hrs	Cognitive/ Employable

Books for Reference:

1. Carr, J. J., & Brown, J. M. (2000). *Introduction to biomedical equipment technology (4th ed.)*. Pearson.
2. Cromwell, L. (1973). *Biomedical Instrumentation*. Prentice Hall.
3. Khandpur, R. S. (2014). *Handbook of Biomedical Instrumentation (3rd ed.)*. Tata McGraw-Hill Education.
4. Webster, J. (2009). *Medical Instrumentation: Application and design, 3Rd ed*. John Wiley & Sons.
5. Kumar, R. (2008). *Medical electronics*. SK Kataria and sons.
6. Nokes, L., Jennings, D., Flint, T., & Turton, B. (1995). *Introduction to medical electronics applications*. Butterworth-Heinemann.



MATRIX AND SYLLABUS

For the Programme B.Sc. (Electronics/Computer Science)

Electronics

NEP Based Curriculum (2021 onwards)

IV Semester

NEP- Curriculum Framework for Approval

B.Sc. (Electronics/Computer Science) - Matrix for IV Semester (w.e.f. 2022-23 onwards)

IV Semester							
Code	Course Code	Course	Teaching Hours	Course Components			Credits
				L	T	P	
AECC	S21 KN 4.1/ S21 HN 4.1/ S21 AE 4.1	Language I (Kannada/Hindi/Additional English)	45	3	1	-	3
AECC	S21 GE 4.1	Language II (Generic English)	60	3	1	-	3
AECC	21SBC 4.1	Constitution of India	45	2	1	-	3
DSC4	S21 EL 4.1	Electronic Communications – I (Theory)	60	4	-	-	4
DSC4	S21 EL 4.2	Electronic Communications – I-Lab– (Practical)	60	-	-	4	2
DSC4	S21 CS 4.1	Operating System - (Theory)	60	4	-	-	4
DSC4	S21 CS 4.2	Unix Lab – (Practical)	60	-	-	4	2
OE-4	S21OE/ B21OE	Mobile Application Development / Web Designing	45	3	-	-	3
SEC-VB	21VBC 4.1	Sports	30	-	-	2	1
SEC-VB	21VBC 4.2	NCC/NSS/Cultural	30	-	-	2	1
Total							26

Note 1:

DSC - Discipline-Specific Course

DSE – Discipline-Specific Elective

SEC - VB Skill Enhancement Course -Value Based

SEC - SB Skill Enhancement Course -Skill Based

Note 2:

The DSE and Vocational courses are programme specific and may vary depending on programme offered.

Continuous Internal Assessment – Scheme of Evaluation**For Theory Courses****End Semester Examination: 60%****Continuous Internal Assessment: 40%**

Activities (CIA: 40 Marks)	Proposed and Approved Scheme		Total Marks (40)
	IA-1	IA-2	
Session Test Maximum Marks	30	30	
1. Weightage (Marks)	10	10	20
2. Assignment (Marks)	20		20
i. Writing	10		
ii.Quiz / Presentation / Creating diagrams /charts / Classwork / Case study / Viva / Field work etc.	05		
iii. Classroom participation	05		
Total			40

For Practical Courses**End Semester Examination: 50%****Continuous Internal Assessment: 50%****CIA (25 marks) + End Semester Exam (25 marks)**

Activities	Total Marks
1. Lab Performance	10
2. Observation record	05
3. Internal exam	10
Total	25

S21 EL 4.1: ELECTRONICS COMMUNICATION - I**THEORY****Total Teaching Hours: 60****No. of Hours per Week: 4****(4 credits)**

CObj	Course Objectives
CObj_1	To understand the analog communication system and its applications.
CObj_2	To demonstrate analog modulation techniques-AM & FM
CObj_3	To illustrate the concept of resonant and non-resonant antennas

CO	Course Outcomes
	After completion of this module, students should be able to
CO_1	Understand the basic concepts of the analog communication systems.
CO_2	Apply elementary concepts for the Analog communication devices.
CO_3	Analyze various analog continuous wave modulation and demodulation techniques including AM, FM and PM.
CO_4	Compute modulation index, bandwidth and power requirements for various analog modulation schemes including AM, FM and evaluate the performance of the communication system in the presence of noise.
CO_5	Design and Analyze a project using Analog modulation techniques.

CO-PO Mapping

[illegible]

Course Content

S. No	Unit/chapter title	Content	Number of hours	Skills Developed
1.	Unit-I Noise and Transmission lines	Noise-Introduction, internal- Thermal Noise, white noise, Shot noise, partition noise, external noises-Atmospheric noise, extraterrestrial noise, industrial noise, signal to noise ratio and noise figure, equivalent noise temperature-numerical examples. Transmission lines - types and equivalent circuit of T-lines, primary and secondary constants. Reflection co-efficient, VSWR and CSWR-numerical examples. Ionosphere and its effects, Propagation of waves-ground wave, sky wave and space wave propagations, Multi-hop Propagation.	12 Hrs	Cognitive/ Employable
2.	Unit-II Analog Modulation techniques	Block diagram of electronic communication system. modulation-need for modulation, types of modulation-AM, FM & PM. AM - representation, modulation index, expression for instantaneous voltage(Derivation), power relations in AM, frequency spectrum, DSBFC, DSBSC and SSBSC (mention only), AM collector modulator, balanced modulator using diodes, Limitations of AM, Numerical examples on AM. FM - definition, modulation index, FM-waveforms, expression for instantaneous voltage (expression only), frequency spectrum diagram, bandwidth requirements, frequency deviation and carrier swing, FM generator-varactor diode modulator. Block diagram of AM transmitter and FM transmitter with AFC,	12 Hrs	Cognitive/ Employabl/, Analytical Skills

		qualitative study of pre-emphasis. Comparison of AM and FM, numerical examples on FM.		
3.	Unit-III Radio Receivers	Demodulation- AM detection – principles of detection, linear diode and Transistor detector-circuits, principle of working and waveforms. FM detector – principle, slope detector-circuit, working. Introduction to radio receiver, tuned radio frequency receiver, super heterodyne receiver, mixer, local oscillator, intermediate frequency amplifier, automatic gain control, automatic frequency control, AM super heterodyne receiver– principle, block diagram, function of each stage with waveform. FM super heterodyne receiver– principle, block diagram, function of each stage with waveform, qualitative study of de-emphasis. Characteristics of radio receivers-qualitative study of sensitivity, selectivity, signal to noise ratio, fidelity, stability, image frequency and its rejection.	12 Hrs	Cognitive/ Employable/Analytical Skills
4.	Unit-IV Antennas	Introduction, Basic Antenna Parameters - gain, directive gain, power gain, bandwidth, beam width, polarization, efficiency, radiation resistance, total effective resistance, beam Area, Radiation Intensity, Directivity, Resolution, Antenna Apertures, Effective Height-numerical examples. Radiation mechanism in antenna, resonant antennas-radiation pattern and current distribution for different lengths, non - resonant antenna, derivation for the power radiated by antenna and expression for radiation resistance-numerical examples. Ungrounded and grounded antennas, effect of antenna height. Folded dipole, Qualitative study of yagi-uda antenna, parabolic antenna, helical antenna and loopantenna, micro strip antenna.	12 Hrs	Cognitive/Employable/ Analytical Skills

5.	Unit-V Television	Introduction To Basic Television Systems, Characteristics of Human Eye, Brightness, Perception, Persistence of Vision Scanning, Aspect Ratio, Flicker, The Keel Factor, Resolution Horizontal and Vertical Resolution. Scanning-sequential scanning, interlaced scanning, T.V. camera tube (vidicon), composite video signal – blanking and synchronizing pulses, vestigial side band transmission, TV systems and standards – comparison between American and European systems-numerical examples. Block diagrams of monochrome TV transmitter and receiver. Basic principles of colour TV, primary and secondary colours, Colour combinations, chromo and luminance processing as per PAL system. Colour TV receiver (PAL), Qualitative study of Flat Panel Display TV, LCD TV, LED TV, HDTV, 3D TV, OLED TV, Plasma Screen TV, New Era Projection TV.	12	Cognitive/ Employable/ Analytical Skills

Books for Reference:

1. Gulati, R R. *Modern Television Practice : Principles, Technology and Servicing*. New Delhi, India, New Age International Publishers, 2006.
2. Haykin, Simon. *Communication Systems*. New York ; Toronto : Wiley, 22 Mar. 1994.
3. Hudson, Jack, and Gerald Luecke. *Basic Communications Electronics : Analog Electronic Devices and Circuits ; How They Work and How They Are Used to Create Communication Systems* ;Niles, Ill., Master Publ, 2005.
4. Kennedy, George. *Electronic Communication Systems [By] George Kennedy*. Mcgraw Hill, 1985.
5. Proakis, John G, and Masoud Salehi. *Fundamentals of Communication Systems*. Boston, Pearson, 2014.
6. Roddy, Dennis. *Electronic Communications*. Pearson Education India, 1977.
7. Taub, Herbert. *Principles of Communication Systems*. 1985.
8. Bruce Carlson, A. (2010). *Communication system*. Tata McGraw-Hill Education.
9. Frenzel, L. E. (2015). *Principles of electronic communication systems* (4th ed.). McGraw-Hill Professional.
10. Stern, H. P. E., & Mahmoud, S. A. (2004). *Communication systems: Analysis and design*. Prentice Hall.

S21 EL 4.2: ELECTRONICS COMMUNICATION – I – LAB**PRACTICAL****Total Teaching Hours: 60****No. of Hours per Week: 4****(2 credits)**

Sl. No.	Unit/chapter title	Content	Number of hours	Skills developed
1.	Module 1	Amplitude modulator & demodulator	04 Hrs	Research/ Analytical/ Employable Skills
2.	Module 2	FM modulator using IC 8038	04 Hrs	Research/ Analytical/ Employable Skills
3.	Module 3	Pre emphasis and de emphasis	04 Hrs	Research/ Analytical/ Employable Skills
4.	Module 4	Threeway audio cross over network	04 Hrs	Research/ Analytical/ Employable Skills
5.	Module 5	IF amplifier	04 Hrs	Research/ Analytical/ Employable Skills
6.	Module 6	Frequency mixer	04 Hrs	Research/ Analytical/ Employable Skills
7.	Module 7	Frequency multiplier	04 Hrs	Research/ Analytical/ Employable Skills
8.	Module 8	Study of sensitivity, selectivity & Fidelity of an AM radio receiver	04 Hrs	Research/ Analytical/ Employable Skills
9.	Module 9	Class C tuned amplifier	04 Hrs	Research/ Analytical/ Employable Skills
10.	Module 10	Time division Multiplexing	04 Hrs	Research/ Analytical/ Employable Skills

***Minimum of EIGHT Experiments to be performed excluding demonstration experiments**

S21 OE 4.5: MOBILE APPLICATION DEVELOPMENT**THEORY****Total Teaching Hours: 45****No. of Hours per Week: 03****(3 credits)**

CObj	Course Objectives
CObj_1	To learn the characteristics of mobile applications
CObj_2	To learn the characteristics of mobile applications
CObj_3	To study about the design aspects of mobile application

CO	Course Outcomes
	After completion of this subject, students should be able to:
CO_1	Understand the characteristics of mobile applications
CO_2	Design and implement the user interfaces for mobile applications
CO_3	Design the mobile applications that is aware of the resource constraints of mobile devices
CO_4	Develop advanced mobile applications that accesses the databases and the web
CO_5	Develop useful mobile applications in the current scenario using Google Android Studio

Course Content

S. No	Unit/chapter title	Content	Number of hours	Skills Developed
1.	Unit-I Introduction	Mobile Applications – Characteristics and Benefits – Frameworks and Tools – Introduction to Java – Classes and Objects – Inheritance – Packages and Interfaces – Strings – I/O – Event handling.	9 Hrs	Cognitive/ Employable
2.	Unit-II User Interface	Generic UI Development – Multimodal and Multichannel UI – Designing the right UI– Introduction to XML –XML basics – Attributes – DTD - XML schema – Screen Elements and Layouts.	9 Hrs	Cognitive/ Employable
3.	Unit-III Tools	Google Android Platform – Android Application Architecture – Android Studio – Android Widgets and Menus – Event handling – Packaging and Deployment - Apple iPhone Platform	9 Hrs	Cognitive/ Employable
4.	Unit-IV Application Design Application Development	Memory Management – Design patterns for limited memory – Work flow for Application. Development – Techniques for composing Applications – Intents and Services – Fragments – Graphics – Animation. Storing and Retrieving data – Communication via the Web – Notification and Alarms – Telephony – Location based services – Apps with Firebase Real Time Database – Project on respective Discipline.	18 Hrs	1. EMP 2. SKD 3. EDP Cognitive/ Employable

Books for References:

1. Mednieks, Z., Dornin, L., Meike, B., & Nakamura, M. (2011). —*Programming Android*.
2. Meier, R., & Wiley, W. (2010). *Professional Android 2 Application Development*.
3. Professional mobile Application Development paperback, 2012 Jeff Mcherter (Author). (2012). *Jeff Mcherter (Author), Scott Gowell (Author)*.
4. Share Conder, L. (n.d.). *Android Wireless Application Development*. Pearson.
5. Spath, P., & Friesen, J. (2020). *Learn java for android development: Migrating java SE programming skills to mobile development* (4th ed.). APress.
6. Tim Duckett, Apress 8. *iOS Programming: The Big Nerd Ranch Guide Paperback*. (2012). Christian Keur.
7. Wei, -Meng. (2009). Beginning iPhone SDK Programming with Objective-C. In *Stefan Poslad, - Ubiquitous Computing: Smart Devices, Environments and interactions*. Wiley.



MATRIX AND SYLLABUS

For the Programme B.Sc. (Electronics/Computer Science)

Electronics

NEP Based Curriculum (2021 onwards)

V Semester

NEP- Curriculum Framework for Approval

B.Sc. (Electronics/Computer Science) - Matrix for V Semester (w.e.f. 2023-24 onwards)

V SEMESTER							
Code	Course Code	Course	Teaching hours	Course Components			Credits
				L	T	P	
DSC5	S21 EL 5.1	Microcontroller 8051 and PIC – (Theory)	60	4	-	-	4
DSC5	S21 EL 5.2	Microcontroller 8051 and PIC – Lab- (Practical)	60	-	-	4	2
DSC6	S21 EL 6.1	Electronics Communication – II- (Theory)	60	4	-	-	4
DSC6	S21 EL 6.2	Electronics Communication – II – Lab- (Practical)	60	-	-	4	2
DSC5	S21 CS 5.1	Database Management System- (Theory)	60	4	-	-	4
DSC5	S21 CS 5.2	Database Management System Lab- (Practical)	60	4	-	-	4
DSC6	S21 CS 6.1	Artificial Intelligence- (Theory)	60	-	-	4	2
DSC6	S21 CS 6.2	Artificial Intelligence Lab- (Practical)	60	-	-	4	2
SEC-SB	21SBC 5.1	R-Programming – A practical approach	45	1	-	2	2
Total							26

Note 1:

DSC - Discipline-Specific Course

DSE – Discipline-Specific Elective

SEC - VB Skill Enhancement Course -Value Based

SEC - SB Skill Enhancement Course -Skill Based

Note 2:

The DSE and Vocational courses are programme specific and may vary depending on programme offered.

Continuous Internal Assessment – Scheme of Evaluation**For Theory Courses****End Semester Examination: 60%****Continuous Internal Assessment: 40%**

Activities (CIA: 40 Marks)	Proposed and Approved Scheme		Total Marks (40)
	IA-1	IA-2	
Session Test Maximum Marks	30	30	
1. Weightage (Marks)	10	10	20
2. Assignment (Marks)	20		20
i. Writing	10		
ii.Quiz / Presentation / Creating diagrams /charts / Classwork / Case study / Viva / Field work etc.	05		
iii. Classroom participation	05		
Total			40

For Practical Courses**End Semester Examination: 50%****Continuous Internal Assessment: 50%****CIA (25 marks) + End Semester Exam (25 marks)**

Activities	Total Marks
1. Lab Performance	10
2. Observation record	05
3. Internal exam	10
Total	25

S21 EL 5.1: MICROCONTROLLER 8051 AND PIC

THEORY

Total Teaching Hours: 60

No. of Hours per Week: 4

(4 credits)

CObj	Course Objectives
CObj_1	To familiarize with the concepts of programming using Microcontroller
CObj_2	To Gain knowledge of programming of 8051 with C
CObj_3	To Gain knowledge to interface LCD, Keyboard, ADC ,DAC etc

CO	Course Outcomes
	After completion of this module, students should be able to
CO_1	Understand extensively on interfacing the external devices to the controllers and PICs.
CO_2	Apply knowledge and demonstrate programming proficiency using the various addressing modes and data transfer instructions of the target microcontroller.
CO_3	Analyze assembly language programs; select appropriate assemble into machine a cross assembler utility of microcontroller.
CO_4	Evaluate assembly language programs and download the machine code that will provide solutions real-world control problems.
CO_5	Design electrical circuitry to the Microcontroller I/O ports in order to interface the processor to external deviceswith the help of the interfacing devices.

CO-PO Mapping

[illegible]

Course Content

S. No	Unit/chapter title	Content	Number of hours	Skills Developed
1.	Unit-I Introduction to Microprocessor & Microcontroller	Introduction and Basic block diagram of Microprocessor, 8085 architecture, and Basic block diagram of Microcontroller, Comparison of microcontroller with microprocessors, Comparison of 8bit, 16 bit and 32 bit microcontrollers. MICROCONTROLLER 8051- architecture - internal block diagram, key features of 8051, pin diagram, memory organization, Internal RAM memory, Internal ROM. General purpose data memory, special purpose/function registers, external memory.	10 Hrs	Cognitive/ Employable/ Analytical Skills
	Activity 1	Function of 8051 IC pins	02 Hrs	
2.	Unit-II 8051- Instruction set	Addressing modes–immediate addressing, register addressing, direct and indirect addressing. Data transfer instructions – internal data move, external data move, code memory read-only data move, Push and Pop and data exchange instructions. Logical Instructions – byte level logical operations, bit level logical operations, rotate and swap operations. Arithmetic Instructions – flags, incrementing and decrementing, addition, subtraction, multiplication and division, decimal arithmetic, simple programs in assembly language. Jump and call instructions – jump and call program range, jumps, calls and subroutines, interrupts and returns, simple example programs in assembly language.	12 Hrs	Cognitive/ Employable/ Analytical Skills

	Activity 2	Writing basic programs using 8051 Instructions	02 Hrs	
3.	Unit-III 8051 – Interrupts	Interrupts – IE, IP, time flag interrupts, serial port interrupt, external interrupts, reset, interrupt control, interrupt priority, interrupt destinations & software generated interrupts.	18 Hrs	Cognitive/ Employable/ Analytical Skills
	Programming 8051 using C	Counters and timers – 8051 oscillator and clock, program counter, TCON, TMOD, timer counter interrupts timer modes of operation. Input / output ports and circuits/ configurations, serial data input / output – SCON, PCON, serial data transmission modes.		Cognitive/ Employable/ Analytical Skills
	Activity 3	Example programs in C.	02 Hrs	
4.	Unit-IV Interfacing with 8051	Basic interfacing concepts and interrupts, Programming 8051 interrupts, programming Timer interrupts, programming the external hardware interrupts. Schematic diagrams and basic concepts of Interfacing of 8051 to keyboard, seven segment display, stepper motor, DAC, ADC and traffic light controller circuits. Core features of PIC microcontrollers, overview of various PIC microcontroller series. PIC 16F877A-features, pin diagram, I/O ports, interfacing with LCD.	12 Hrs	Cognitive/ Employable/ Analytical Skills
	Activity 4	List out the PIC Microcontrollers ICs and its applications.	02 Hrs	

Books for Reference:

1. Barrett, Steven F, and Daniel J Pack. *Microcontroller Programming and Interfacing: Texas Instruments MSP430*. San Rafael, California Morgan & Claypool Publishers, 2011.
2. Deshmukh, Ajay V. *Microcontrollers: Theory and Applications*. New Delhi, Tata Mcgraw-Hill, 2005.
3. Mazidi. *The 8051 Microcontroller and Embedded Systems Using Assembly and C, 2/E*. Pearson Education India, 1 Sept. 2007.
4. Muhammad Ali Mazidi, et al. *The 8051 Microcontroller and Embedded Systems*. Pearson Higher Ed, 20 Mar. 2014.
5. Muhammad Ali Mazidi, and Janice Gillispie Mazidi, *The 8051 Microcontroller and Embedded Systems*. 2000.
6. Raj Kamal, *Microcontrollers : Architecture, Programming, Interfacing and System Design*. New Delhi, Pearson, 2012.

7. Bates, M. P. (2011). *PIC Microcontrollers: An Introduction to Microelectronics* (3rd ed.). Newnes.
8. MacKenzie, I. S. (1998). *The 8051 Microcontroller* (3rd ed.). Pearson.
9. Morton, J. (2005). *The PIC microcontroller: Your personal introductory course* (3rd ed.). Newnes.
10. Phan, R. C.-W., & MacKenzie, I. S. (2006). *The 8051 microcontroller: United States edition* (4th ed.). Pearson.

Web Resources:

1. <https://www.electronicshub.org>
2. <https://www.electronics-tutorials>
3. <https://circuitdigest.com>
4. <https://www.circuitstoday.com>

S21 EL 5.1: MICROCONTROLLER 8051 AND PIC-LAB**PRACTICAL****Total Teaching Hours: 60****No. of Hours per Week: 4****(2 credits)**

Sl. No.	Unit/chapter title	Content	Number of hours	Skills developed
1.	Module 1	Program to find whether the given data is palindrome.	4 Hrs	Research/ Analytical/ Employable Skills
2.	Module 2	Program to arrange the numbers in ascending order.	4 Hrs	Research/ Analytical/ Employable Skills
3.	Module 3	Program to arrange the numbers in descending order.	4 Hrs	Research/ Analytical/ Employable Skills
4.	Module 4	Program to interchange Two one – byte numbers.	4 Hrs	Research/ Analytical/ Employable Skills
5.	Module 5	Program to interchange N one – byte numbers.	4 Hrs	Research/ Analytical/ Employable Skills
6.	Module 6	I/o Port Programming: interfacing LED & LCD	4 Hrs	Research/ Analytical/ Employable Skills
7.	Module 7	Interfacing of traffic light controller with 8051	4 Hrs	Research/ Analytical/ Employable Skills
8.	Module 8	Interfacing of DAC with 8051 and generating waveforms.	4 Hrs	Research/ Analytical/ Employable Skills
9.	Module 9	Interfacing of elevator with 8051.	4 Hrs	Research/ Analytical/ Employable Skills
10.	Module 10	Interfacing of 7-segment display with 8051.	4 Hrs	Research/ Analytical/ Employable Skills
11.	Module 11	Interfacing ADC with 8051.	4 Hrs	Research/ Analytical/ Employable Skills
12.	Module 12	Mini Project	16 Hrs	Research/ Analytical/ Employable Skills

***Minimum of EIGHT Experiments to be performed excluding demonstration experiments**

S21 EL 6.1: ELECTRONICS COMMUNICATION – II**THEORY****Total Teaching Hours: 60****No. of Hours per Week: 4****(4 credits)**

CObj	Course Objectives
CObj_1	To understand the Digital communication system and its applications.
CObj_2	To demonstrate Microwave and Optical fibre communication
CObj_3	To illustrate the concept of cellular communication and wireless LANs

CO	Course Outcomes
	After completion of this subject, students should be able to:
CO_1	Understand the basic concepts of the digital and wireless communication systems.
CO_2	Apply fundamental aspects of digital and wireless communication devices
CO_3	Analyze various digital wave modulation and demodulation techniques, Applegate diagram, OFCs and wireless communication devices
CO_4	Evaluate the fibre loss, handoff rate and selection of microwave or opto-electronic devices for an appropriate application
CO_5	Design and fabricate communication devices.

CO-PO Mapping

[illegible]

Course Content

S. No	Unit/chapter title	Content	Number of hours	Skills developed
1	Unit-I Digital communication	Introduction to pulse and digital communications, digital radio, sampling theorem (only statements), types- PAM, PWM, PPM, PCM – quantization, advantages and applications, digital modulations (FSK, PSK, and ASK). Advantage and disadvantages of digital transmission, characteristics of data transmission circuits – Shannon limit for information capacity (qualitative), bandwidth requirements, data transmission speed, noise, cross talk, echo suppressors, distortion and equalizer,	12 Hrs	Cognitive/ Employability/ Analytical Skills
	Activity 1	MODEM– modes, classification, interfacing (RS232).	03	
2	Unit-II Microwave devices	Microwave spectrum, Features of microwaves, advantages & applications, Two cavity klystron amplifier, Reflex klystron oscillator, 8 cavity Magnetron : (construction, principle, working, diagram, Applegate diagram, applications & limitation), Gunn diode.	12 Hrs	Cognitive/ Employability/ Analytical Skills
	Activity 2	IMPATT diode: (construction, principle, working, diagram, Applegate diagram, applications & limitation)	03 Hrs	
3	Unit-III Optical Fiber Communication	Introduction – need for OFC. Block diagram of OFC system. Fiber optic cables, light propagation through fiber – step index fiber, graded index fiber, Snell's law, numerical aperture (derivation). Types of optical fiber cables, light sources – requirements, LEDs and semiconductor laser diodes. Photo detectors – PN, PIN and avalanche photodiodes.	12 Hrs	Cognitive/ Employability/ Analytical Skills
	Activity 3	Losses in optical fibers – Rayleigh scattering, absorption, leaky modes, bending, joint junction losses. Advantages and disadvantages of OFC over metallic cables.	03 Hrs	

4	Unit-IV Cellular Communication and Wireless LANs	Concept of cellular mobile communication – cell and cell splitting, frequency bands used in cellular communication, absolute RF channel numbers (ARFCN), frequency reuse, roaming and hand off, authentication of the SIM card of the subscribers, IMEI number, concept of data encryption, architecture (block diagram GSM architecture) of cellular mobile communication network, OFDMA technology. (qualitative)	12 Hrs	Cognitive/ Employability/ Analytical Skills
	Activity 4	OFDMA overview, simplified block diagram of cellular phone handset, 2G, 3G and 4G- LTE concepts.	03 Hrs	

Books for Reference:

1. Frenzel, Louis. *Principles of Electronic Communication Systems*. McGraw-Hill Education, 26 Jan. 2007.
2. Haykin, Simon, and Michael Moher. *Communication Systems*. John Wiley & Sons, 1 June 2009.
3. Kennedy, George. *Electronic Communication Systems [By] George Kennedy*. Mcgraw Hill, 1985.
4. Proakis, John G, and Masoud Salehi. *Fundamentals of Communication Systems*. Boston, Pearson, 2014.
5. Roddy, Dennis. *Electronic Communications*. Pearson Education India, 1977.
6. Taub, Herbert. *Principles of Communication Systems*. 1985.
7. Tomasi, Wayne. *Advanced Electronic Communications Systems*. 1998.
8. Tse, David, and Pramod Viswanath. *Fundamentals of Wireless Communication*. Cambridge Up, Cambridge, 2013.
9. Proakis, J. G. (2000). *Digital Communication* (4th ed.). McGraw Hill Higher Education.
10. Stark, W. (2023). *Introduction to digital communications*. Cambridge University Press.

Web Resources:

1. <https://www.electronicshub.org>
2. <https://www.electronics-tutorials>
3. <https://circuitdigest.com>
4. <https://www.circuitstoday.com>

Journals:

1. *Nature Electronics*
2. *Electronics for you*

S21 EL 6.2: ELECTRONICS COMMUNICATION – II LAB**PRACTICAL****Total Teaching Hours: 60****No. of Hours per Week: 4****(2 credits)**

Sl. No.	Unit/chapter title	Content	Number of hours	Skills developed
1.	Module 1	Design and study the working of ASK modulator and Demodulator	4 Hrs	Research/ Analytical/ Employable Skills
2.	Module 2	Design and study the working of PWM	4 Hrs	Research/ Analytical/ Employable Skills
3.	Module 3	Design and study the PAM modulator and demodulator	4 Hrs	Research/ Analytical/ Employable Skills
4.	Module 4	Band Elimination Filter	4 Hrs	Research/ Analytical/ Employable Skills
5.	Module 5	Two stage RC coupled Amplifier-Determination of mid - band gain of individual stages, overall gain and the concept of loading effect.	4 Hrs	Research/ Analytical/ Employable Skills
6.	Module 6	Design and study the working of PLL using IC 565	4 Hrs	Research/ Analytical/ Employable Skills
7.	Module 7	Frequency multiplier	4 Hrs	Research/ Analytical/ Employable Skills
8.	Module 8	Study the working of FSK modulation using kit	4 Hrs	Research/ Analytical/ Employable Skills
9.	Module 9	Study the working of BPSK modulator using kit	4 Hrs	Research/ Analytical/ Employable Skills
10.	Module 10	Study the working of QPSK modulator using kit	4 Hrs	Research/ Analytical/ Employable Skills
11.	Module 11	Study the characteristics of OFC using kit	4 Hrs	Research/ Analytical/ Employable Skills
12.	Module 12	Mini Project	16 Hrs	Research/ Analytical/ Employable Skills

***Minimum of EIGHT Experiments to be performed excluding demonstration experiments**



MATRIX AND SYLLABUS

For the Programme B.Sc. (Electronics/Computer Science)

Electronics

NEP Based Curriculum (2021 onwards)

VI Semester

NEP- Curriculum Framework for Approval

B.Sc. (Electronics/Computer Science) - Matrix for VI Semester (w.e.f. 2023-24 onwards)

VI SEMESTER							
Code	Course Code	Course	Teaching hours	Course Components			Credits
				L	T	P	
DSC7	S21 EL 7.1	Electronics Instrumentation (Theory)	60	4	-	-	4
DSC7	S21 EL 7.2	Electronics Instrumentation Lab (Practical)	60	-	-	4	2
DSC8	S21 EL 8.1	Internet Of Things (IOT) – (Theory)	60	4	-	-	4
DSC8	S21 EL 8.2	Internet Of Things (IOT) Lab (Practical)	60	-	-	4	2
DSC7	S21 CS 7.1	Python Programming (Theory)	60	4	-	-	4
DSC7	S21 CS 7.2	Python Programming Lab (Practical)	60	4	-	-	4
DSC8	S21 CS 8.2	Computer Networks (Theory)	60	-	-	4	2
DSC8	S21 CS 8.2	Project Lab (Practical)	60	-	-	4	2
SEC- SB	21SBC 6.1	Professional & Business Communication	45	1	-	2	2
TOTAL							26

Note 1:

DSC - Discipline-Specific Course

DSE – Discipline-Specific Elective

SEC - VB Skill Enhancement Course -Value Based

SEC - SB Skill Enhancement Course -Skill Based

Note 2:

The DSE and Vocational courses are programme specific and may vary depending on programme offered.

Continuous Internal Assessment – Scheme of Evaluation

For Theory Courses

End Semester Examination: 60%

Continuous Internal Assessment: 40%

Activities (CIA: 40 Marks)	Proposed and Approved Scheme		Total Marks (40)
	IA-1	IA-2	
Session Test Maximum Marks	30	30	
1. Weightage (Marks)	10	10	20
2. Assignment (Marks)	20		20
i. Writing	10		
ii.Quiz / Presentation / Creating diagrams /charts / Classwork / Case study / Viva / Field work etc.	05		
iii. Classroom participation	05		
Total			40

For Practical Courses

End Semester Examination: 50%

Continuous Internal Assessment: 50%

CIA (25 marks) + End Semester Exam (25 marks)

Activities	Total Marks
1. Lab Performance	10
2. Observation record	05
3. Internal exam	10
Total	25

S21 EL 7.1: ELECTRONICS INSTRUMENTATION

THEORY

Total Teaching Hours: 60

No. of Hours per Week: 4

(4 credits)

CObj	Course Objectives
CObj_1	To understand the Electronics Instrumentation and applications.
CObj_2	To demonstrate Power devices, PLC & Transducers
CObj_3	To illustrate the concept measurement of various parameters

CO	Course Outcomes
	After completion of this subject, students should be able to:
CO_1	Understanding-depth on electronic instrumentation in various Control systems.
CO_2	Apply the circuitry skills in development of power electronic devices.
CO_3	Analyze various parameters that are required for control systems.
CO_4	Evaluate various parameters in electronic instrumentation and arrive at solutions for real-time problems involving power electronics and control systems.
CO_5	Design and develop electronic instruments and control systems.

CO-PO Mapping

[illegible]

Course Content

S. No	Unit/chapter title	Content	Number of hours	Skills Developed
1	Unit-I Introduction to Transducer	Introduction-Electrical Transducer, Classification, Active, Passive, Mechanical, Electrical, their comparison. Basic requirements of Transducer, Principle and working of following types: Displacement transducers - Resistive (Potentiometric displacement transducer) Capacitive (Principle, Op-Amp circuit configuration, AC Servo bridge arrangement), Inductive (LVDT- Principle and characteristics, RVDT-Principle and characteristics).	10 Hrs	Cognitive/Employable/ Analytical Skills
	Activity 1	Digital transducer- Introduction-Principles of transduction, Variable Resistance devices, Variable Inductance, Variable Capacitance, Digital transducer. Applications.	02 Hrs	
2	Unit-II PLC	PLC-Definition, classification, need and benefits of PLC in automation. Description of different parts of PLC: CPU- function, scanning cycle, speed of execution, power supply-block diagram and function of each block. Memory-function and organization of ROM and RAM.	10 Hrs	Cognitive/Employable/ Analytical Skills
	Activity 2	Input and output modules-function, different input and output modules.	02 Hrs	
3	Unit-III Basic Concept of Measurement	Introduction- System configuration, generalized instrumentation systems block diagram representation, Problem analysis, basic Characteristics of measuring devices- static (accuracy, sensitivity, linearity, precision, resolution, threshold, range, hysteresis, deadband, backlash, drift), impedance matching and loading, dynamic characteristics (types, fidelity, speed of response, dynamic error). Definition of errors- systematic errors, instrumental errors, environmental errors, random errors, loading errors, random errors, source of errors in measuring instruments, Uncertainties types, propagation of uncertainties). Strain Measurement: Introduction- Factors affecting Strain measurements. Types of Strain Gauge (Mechanical, Optical and Electrical), Types of	15 Hrs	Cognitive/Employable/ Analytical Skills

		Electrical strain gauges (Wire Gauges, Foil gauges, Semiconductor strain gauge), Properties of the strain gauges (Gauge Sensitivity, Linearity, Temperature effects, current carrying capacity)		
	Activity 3	Measurement of the parameters Temperature Measurement-Introduction, Temperature scales, Mechanical Temperature Sensor, Vapour Pressure Thermometer, Resistance Thermometer Circuits, Principles used in Thermistors, Thermocouples	03 Hrs	
4	Unit-IV Power Electronics	Introduction to Thyristor, Thyristor turn ON methods- Gate triggering, forward voltage triggering, dv/dt triggering, temperature triggering, and light triggering (concept only). Thyristor firing circuits-resistor, resistor-capacitance firing circuits, Thyristor commutation techniques-Class A, Class B, Class C. Series and parallel operations of Thyristor. Pressure Measurement-Introduction-pressure sensing elastic element-Diaphragms, Capsule, Bordon Tube Bellows. Transduction Methods-Potentiometric Devices, Strain gauge Transducer, Force-balance transducer.	15 Hrs	Cognitive/Employable/ Analytical Skills
	Activity 4	Thyristor family members-PUT, SUS, SCS, light activated Thyristor, GTO.	03 Hrs	

Books for Reference:

1. A. James Diefenderfer, and Brian E Holton. *Principles of Electronic Instrumentation*. Cengage Learning, 1994.
2. Bell, David A. *Electronic Instrumentation and Measurements*. Prentice Hall, 1994.
3. Buchla, David, and Wayne McLachlan. *Applied Electronic Instrumentation and Measurement*. Prentice Hall, 1992.
4. Carr, Joseph J. *How to Design and Build Electronic Instrumentation*. 1986.
5. Collier, Michael, and Jade Zheng. *Electronic Instrumentation and Measurement*. 1 May 2014.
6. Cram101 Textbook Reviews. *Study guide for Principles of Electronic Instrumentation by Holton, Diefenderfer &, ISBN 9780030747090*. Academic Internet Pub Incorporated, 1 May 2011.
7. Buchla, D. M., & McLachlan, W. (1991). *Electronic Instrumentation and Measurement*. Prentice-Hall.
8. Joshi, J. G. (n.d.). *Electronic measurements and instrumentation*. KHANNA PUBLISHING HOUSE.
9. Oliver, B. M. (1971). *Electronic Measurements and Instrumentation*. McGraw-Hill.
10. Sachan. (2019). *Fundamentals of electronic measurement & instrumentation*. Independently Published.

Web Resources:

1. <https://www.electronicshub.org>
2. <https://www.electronics-tutorials>
3. <https://circuitdigest.com>

S21 EL 7.2: ELECTRONICS INSTRUMENTATION– LAB**PRACTICAL****Total Teaching Hours: 60****No. of Hours per Week: 4****(2 credits)**

S. No	Module title	Number of Hours	Skills Developed
1.	Construction and study the VI characteristics of Diac	4 Hrs	Cognitive/ Analytical Skills
2.	Construction and study the VI characteristics of SCR	4 Hrs	Cognitive/ Analytical Skills
3.	Construction and study the firing of SCR using UJT	4 Hrs	Cognitive/ Analytical Skills
4.	Construction and study the VI characteristics of solar cell	4 Hrs	Cognitive/ Analytical Skills
5.	Construction and study the loading effect of potentiometer	4 Hrs	Cognitive/ Analytical Skills
6.	Study of the characteristics of strain gauge	4 Hrs	Cognitive,/Employable/Analytical Skills
7.	Study of the characteristics of load cell	4 Hrs	Cognitive,/Employable/Analytical Skills
8.	Study of the characteristics of thermistor	4 Hrs	Cognitive,/Employable/Analytical Skills
9.	Study of the characteristics of thermocouple	4 Hrs	Cognitive,/Employable/Analytical Skills
10.	Study of the piezo electric transducer	4 Hrs	Cognitive,/Employable/Analytical Skills
11.	Study of preamplifier circuit	4 Hrs	Cognitive,/Employable/Analytical Skills
12.	Mini Project	16 Hrs	Cognitive,/Employable/Analytical Skills

***Minimum of EIGHT Experiments to be performed excluding Mini project**

S21 EL 8.1: INTERNET OF THINGS (IOT)

THEORY

Total Teaching Hours: 60

No. of Hours per Week: 4

(4 credits)

CObj	Course Objectives
CObj_1	To understand the Internet of Things (IOT)
CObj_2	To demonstrate of sensors, Actuators, IOT methodology, Physical devices and Endpoints
CObj_3	To illustrate the security of IOT

CO	Course Outcomes
	After completion of this subject, students should be able to:
CO_1	Understand the fundamental concepts of Internet of Things.
CO_2	Apply the core skills in development of various electronic gadgets.
CO_3	Analyze circuitry skills on various sensors, actuators, security devices.
CO_4	Evaluate the application potential of IoT devices using Arduino and Raspberry Pi
CO_5	Implement and fabricateIoT devices through interfacing of sensors with Arduino/Raspberry Pi.

CO-PO Mapping

[illegible]

Course Content

S. No	Unit/chapter title	Content	Number of hours	Skills Developed
1	Unit-I Introduction to Internet of Things	Introduction to Internet of Things- Definition and Characteristics of IoT, Physical Design of IoT – IoT Protocols, IoT communication models, IoT Communication APIs, IoT enabled Technologies – Wireless Sensor Networks, Cloud Computing, Embedded Systems, IoT Levels and Templates.	12 Hrs	Cognitive/ Employable/Analytical Skills
	Activity 1	Identify various IoT models and Identify the Block diagram and workflow	03 Hrs	
2	Unit-II Sensors, Actuators	Sensor & Actuators: Overview of Sensors working, Analog and Digital Sensors, Interfacing of Temperature, Humidity, Motion, Light and Gas Sensor with Arduino, Interfacing of Actuators with Arduino, Interfacing of Relay Switch and Servo Motor with Arduino, Domain Specific IoTs – Home, City, Environment, Energy, Agriculture and Industry.	12 Hrs	Cognitive/ Employable/Analytical Skills
	Activity 2	IoT System assembly with various Sensors	03 Hrs	
3	Unit-III IoT Platforms Design Methodology, IoT Physical Devices and Endpoints	IoT Platforms Design Methodology: Introduction - IoT Design Methodology. IoT Physical Devices and Endpoints- Introduction to Arduino and Raspberry Pi- Installation, Interfaces (serial, SPI, I2C) Controlling Hardware- Connecting LED, Buzzer, Switching High Power devices with transistors and Controlling AC Power devices with Relays.	12 Hrs	Cognitive/ Employable/Analytical Skills
	Activity 3	Define an interface procedure and control the peripheral from cloud.	03 Hrs	
4	Unit-I IOT Security	Attack, Defense, and Network Robustness of Internet of Things, Malware Propagation and Control in the Internet of Things, Privacy Preservation Data Dissemination, Trust and Trust Models for the IoT, Authentication in	12 Hrs	Cognitive/ Employable/Analytical Skills

		IoT, Computational Security for the IoT, Security Protocols for IoT Access Networks Security Testing		
	Activity 4	IOT security – Encrypting the data	03 Hrs	

Books for Reference:

1. Greengard, Samuel. *The Internet of Things*. Cambridge, Massachusetts, The Mit Press, 2021.
2. Guerrieri, Antonio, et al. *Management of Cyber Physical Objects in the Future Internet of Things : Methods, Architectures and Applications*. Cham, Springer, 2016.
3. Hanes, David, et al. *IoT Fundamentals*. Cisco Press, 30 May 2017.
4. *Internet of Things : A Hands on Approach*. S.L., Vpt, 2014.
5. Olivier Hersent, et al. *The Internet of Things*. John Wiley & Sons, 19 Dec. 2011.
6. Raj Kamal. *Internet of Things : Architecture and Design Principles*. Chennai, India, Mc Graw Hill India, 2017.
7. Waher, Peter. *Learning Internet of Things : Explore and Learn about Internet of Things with the Help of Engaging and Enlightening Tutorials Designed for Raspberry Pi*. Birmingham, Mumbai, Packt Publishing, 2015.
8. Fattahi, A. (2022). *IoT product design and development: Best practices for industrial, consumer, and business applications*. John Wiley & Sons.
9. Hernandez, R. J. (2022). *Building IoT Visualizations using Grafana: Power up your IoT projects and monitor with Prometheus, Libre NMS, and Elasticsearch*. Packt Publishing.
10. Soni, V. (2021). *IoT for beginners: Explore IoT architecture, working principles, IoT devices, and various real IoT projects: Explore IoT architecture, working principles, IoT devices, and various real IoT projects (English edition)*. Bpb Publications.

Web Resources:

1. <https://www.electronicshub.org>
2. <https://www.electronics-tutorials>
3. <https://circuitdigest.com>
4. <https://www.circuitstoday.com>

Journals:

1. *Nature Electronics*
2. *Electronics for you*

**S21 EL 8.2: INTERNET OF THINGS (IOT) LAB
PRACTICAL**

Total Teaching Hours: 60

No. of Hours per Week: 4

(2 credits)

S. No	Unit/chapter title	Number of hours	Skills Developed
1.	Sense the Available Networks Using Arduino	4 Hrs	Cognitive/ Analytical Skills
2.	Measure the Distance Using Ultrasonic Sensor and Make Led Blink Using Arduino	4 Hrs	Cognitive/ Analytical Skills
3.	Detect the Vibration of an Object Using Arduino	4 Hrs	Cognitive/ Analytical Skills
4.	Connect with the Available Wi-Fi Using Arduino	4 Hrs	Cognitive/ Analytical Skills
5.	Sense a Finger When it is Placed on Board Using Arduino	4 Hrs	Cognitive/ Analytical Skills
6.	Temperature Notification Using Arduino	4 Hrs	Cognitive/Employable /Analytical Skills
7.	LDR to Vary the Light Intensity of LED Using Arduino	4 Hrs	Cognitive/Employable /Analytical Skills
8.	MySQL Database Installation in Raspberry Pi	4 Hrs	Cognitive/Employable /Analytical Skills
9.	SQL Queries by Fetching Data from Database in Raspberry Pi	4 Hrs	Cognitive/Employable /Analytical Skills
10.	Switch Light On and Off Based on the Input of User Using Raspberry Pi	4 Hrs	Cognitive/Employable /Analytical Skills
11.	Weather reporting system based on Raspberry Pi	4 Hrs	Cognitive/Employable /Analytical Skills
12.	Mini Project	16 Hrs	Cognitive/Employable /Analytical Skills

***Minimum of EIGHT Experiments to be performed excluding Mini project**

Department of Physical Sciences
Mathematics



MATRIX AND SYLLABUS

For the Programme B.Sc. (Mathematics/ Computer Science)

Mathematics

NEP Based Curriculum (2021 onwards)

I Semester

PEOs	PROGRAMME EDUCATIONAL OBJECTIVES
PEO1	To instill a strong foundation of fundamental concepts in Mathematics and associated courses and demonstrate an independent thinking ability and knowledge to apply in various domains
PEO2	To impart knowledge on analyzing complex scientific problems and develop solutions using the principles of Mathematics and associated courses
PEO3	To develop robust communication skills as well as social, ethical and professional values and collaborate effectively with team members belonging to various domains
PEO4	To inculcate strong interest in research and focus on solving problems with the methods imbibed from various disciplines of study
PEO5	To develop entrepreneurs/Mathematics& Physics professionals by inculcating the practice of life-long learning for continuous personal enrichment and professional development

POs	PROGRAMME OUTCOMES
PO1	Scientific knowledge: Apply the knowledge of Mathematics and associated courses to solve problems in various fields of science both in industry and research
PO2	Problem analysis: Identify, formulate and analyze complex scientific problems and develop substantiated solutions using the principles of Mathematics and associated courses
PO3	Ethics, Individual and teamwork: Acquire strong oral and written communication skills and function effectively as an individual, and as a member or leader in diverse teams in multidisciplinary scenarios by maintaining professional ethics, responsibilities and norms of scientific practice
PO4	Research interest: Apply the techniques embraced from various disciplines and develop solutions to the research problems which would benefit mankind
PO5	Life-long learning: Become competent to engage in independent and life-long learning and become successful entrepreneurs or professionals

PO_ID	PROGRAMME SPECIFIC OUTCOMES
PSO1	By the end of the program students will gain an in depth knowledge, insight, communication skills in Mathematics and able to solve problems in Mathematics by critical thinking and analytical reasoning
PSO2	Students would have developed self-learning and ethical reasoning in solving problems of Mathematics and solve the same using FOSS tools
PSO3	Ability to apply appropriate methods, techniques to solve problems that occur in research and lifelong learning related to Mathematics
PSO4	Develop core competency to design, implement and evaluate a computational system to meet desired needs within realistic constraints
PSO5	Apply the computing and Mathematical knowledge as well as standard software engineering practices and strategies to develop applications in various domains

AT THE END OF YEAR	EXIT AWARD	OUTCOMES ACHIEVED	CREDITS
1 st Year	Certificate in Science	PO1, PO2, PO3	50
2 nd Year	Diploma in Science	PO1, PO2, PO3, PO4, PO5	100
3 rd Year	Bachelor's Degree in Science	PO1, PO2, PO3, PO4, PO5	148
4 th Year	Honours Degree in Mathematics	PO1, PO2, PO3, PO4, PO5	190

NEP- Curriculum Framework for Approval

BSc (Mathematics& Computer Science)- Course Matrix for I Semester (w.e.f. 2021-22 Onwards)

I Semester							
Code	Course Code	Course	Teaching Hours	Course Components			Credits
				L	T	P	
AECC	S21KN 1.1/ S21HN 1.1/ S21AE 1.1	Language I (Kannada/Hindi/Additional English)	45	3	1	-	3
AECC	S21GE 1.1	Language II (Generic English)	60	3	1	-	3
DSC1	S21MA1.1	Algebra-I, Calculus-I (Theory)	60	4	-	-	4
DSC 1	S21MA1.2	Algebra-I, Calculus-I Lab using FOSS tools (Practical)	60	-	-	4	2
DSC 1	S21CS1.1	Problem Solving Techniques using C	60	3	1	-	4
DSC 1	S21CS1.2	LAB: C Programming	60	-	-	3	2
OE-1	S21OE/ B21OE	Open Elective - Mathematics for All-I/Business Statistics/Office Automation and Design	45	-	3	-	3
SEC-SB	21SBC 1.1	Digital Fluency-I	30	1	-	2	2
SEC-VB	21VBC 1.1	Health and Well-being	30	-	-	2	1
SEC-VB	21VBC 1.2	Yoga	30	-	-	2	1
Total							25

Note 1:

AECC- Ability Enhancement Compulsory Course

DSC - Discipline-Specific Course

OE- Open elective (course offered by the department to students of other stream)

DSE – Discipline-Specific Elective

SEC - VB Skill Enhancement Course -Value Based

SEC - SB Skill Enhancement Course -Skill Based

Continuous Internal Assessment – Scheme of Evaluation

For Theory Courses

End Semester Examination: 60%

Continuous Internal Assessment: 40%

Activities (CIA: 40 Marks)	Proposed and Approved Scheme		Total Marks (40)
	IA-1	IA-2	
Session Test Maximum Marks	30	30	
1. Weightage (Marks)	10	10	20
2. Assignment (Marks)	20		20
i. Writing	10		
ii.Quiz / Presentation / Creating diagrams /charts / Classwork / Case study / Viva / Field work etc.	05		
iii. Classroom participation	05		
Total			40

S21 MA1.1: ALGEBRA-I AND CALCULUS-I

THEORY

Total Teaching Hours: 60

No. of Hours per Week: 4

(4 credits)

CObj	Course Objectives
CObj_1	To equip students with knowledge and insight in Algebra-I, Calculus-I and related fields.
CObj_2	To develop the ability to utilize the Mathematical problem-solving methods and software applications in addressing practical issues
CObj_3	To apply Mathematical problems and solutions in a variety of contexts related to science, technology, business, and industry

CO	Course Outcomes
	After completing the course students will be able to
CO_1	Understand the concepts of Matrices, Polar Co-ordinates, Limits, Continuity, Differentiability, Mean Value Theorem and Successive Differentiation.
CO_2	Apply the concepts of matrices, Polar Co-ordinates, limits and successive differentiation in solving the problems.
CO_3	Analyse the intermediate value theorems and evaluate limit of a function using L'Hospital rule.
CO_4	Evaluate system of linear equations, the system of homogeneous and non-homogeneous linear m equations in n variables by using the concept of rank, eigen values and eigen vectors.
CO_5	Acquire the techniques of differentiation of function with real variables and sketch curves in Cartesian, polar and pedal equations.

CO-PO Mapping

	PO_1	PO_2	PO_3	PO_4	PO_5	PSO_1	PSO_2	PSO_3	PSO_4	PSO_5
CO_1	*	*	*			*	*			*
CO_2	*	*	*		*	*	*			*
CO_3	*	*	*		*	*	*			*
CO_4	*	*	*		*	*	*		*	*
CO_5	*	*	*			*	*		*	*

Sl. No.	Unit/chapter title	Content	Number of hours	Skills developed
1	Unit- I Matrices	Recapitulation: Symmetric and Skew Symmetric matrices, Algebra of Matrices, Inverse of a matrix by elementary operations; Cayley-Hamilton theorem (Without Proof), Verification of Cayley-Hamilton theorem. Row and column reduction to Echelon form. Rank of a matrix; Solution of system of linear equations; Criteria for existence of non-trivial solutions of homogeneous system of linear equations. Solution of non-homogeneous system of linear equations. Eigen values and Eigen vectors of square matrices of order 2 and 3, Finding A-1, A-2, A2, A3 and A4 using Cayley-Hamilton theorem.	15 Hrs	Transferrable Skills 1.EMP 2.SKD 3.EDP
2	Unit- II Polar Co-ordinates	Polar coordinates, angle between the radius vector and tangent. Angle of intersection of two curves (polar forms), length of perpendicular from pole to the tangent, pedal equations. Derivative of an arc in Cartesian, parametric and polar forms, curvature of plane curve-radius of curvature formula in Cartesian, parametric and polar and pedal forms- center of curvature, asymptotes	12 Hrs	Cognitive & Analytical Skills 1.EMP 2.SKD 3.EDP
3	Unit- III Limits, Continuity, Differentiability and Mean Value Theorem	Limits, Continuity, Differentiability, and properties. Properties of continuous functions. Intermediate value theorem, Rolle's Theorem, Lagrange's Mean Value theorem, Cauchy's Mean value theorem and examples. Taylor's theorem, Maclaurin's series (without proof), Indeterminate forms and evaluation of limits using L'Hospital rule	15Hrs	Cognitive & Analytical Skills 1.EMP 2.SKD 3.EDP

4	Unit- IV Successive Differentiation	nth Derivatives of Standard functions e^{ax+b} , $(ax + b)^n$, $\log(ax+b)$, $\sin(ax+b)$, $\cos(ax+b)$, $e^{ax}\sin(bx+c)$, $e^{ax}\cos(bx+c)$, Leibnitz theorem and its applications. Extended polar coordinates singular and multiple points. Tracing of curves (standard curves)	15Hrs	Transferrable Skills 1.EMP 2.SKD 3.EDP

Books for Reference:

1. N.S.GopalaKrishnan, (1986) University Algebra-New Age International(P)Limited
2. BSVatsa, (2007)Theory of Matrices-New Age International Publishers.
3. A R Vasista (2014) Matrices Krishna Prakashana Mandir.
4. ShantiNarayan, (2005), Differential Calculus-S.Chand&Company, NewDelhi.
5. Debasish Sengupta, (2019), Applications of Calculus,Books and Allied(P)Ltd.
6. LipmanBers,Holt,(1976) Calculus–Rinehart&Winston.
7. SNarayanan&T.K.ManicavachogamPillay, (2009) Calculus-S.ViswanathanPvt.Ltd.,vol.I&II.
8. FrankAyresandElliottMendelson, Schaum'sOutlineofCalculus-5thed.USA:Mc.Graw.

Web Resources:

- 1.<http://www.nptelvideos.in/2012/11/mathematics.html>
2. <https://www.my-mooc.com/en/categorie/mathematics>
3. <http://0cw.mit.edu/courses/mathematics/>
4. www.scilab.org.
5. wxmaxima.sourceforge.net

S21 MA 1.2: ALGEBRA-I, CALCULUS-I LAB**PRACTICAL****Total Teaching Hours: 60****No. of Hours per Week: 4****(2 credits)**

Sl. No.	Unit/chapter title	Content	Number of hours	Skills developed
1	Matrices	Introduction to Scilab/Maxima. 1. Some simple programs in Scilab/Maxima. 2. Matrices-Algebra of Matrices. 3. Computation of Rank of matrix and Row reduced Echelon form. 4. Computation of Inverse of a Matrix using Cayley-Hamilton theorem. 5. Solving the system of homogeneous and non-homogeneous linear algebraic equations.	18Hrs	Analytical/Cognitive Skills 1.EMP 2.SKD 3.EDP
2	Polar Co-ordinates	6. Finding the angle between the radius vector and the tangent, angle between two curves. 7. Finding the radius of curvature of the given curve.	06Hrs	Cognitive & Analytical Skills 1.EMP 2.SKD 3.EDP
3	Limits, Continuity, Differentiability and Mean Value Theorem	8. Verification of Mean value theorems. 9. Finding the Taylor's and Maclaurin's expansions of the given functions. 10. Indeterminate forms and evaluating limits using L'Hospital rule.	09Hrs	Cognitive & Analytical Skills 1.EMP 2.SKD 3.EDP
4	Successive Differentiation	11. Tracing of standard curves. 12. Finding the nth Derivative of e^{ax+b} , $(ax+b)^n$, $\log(ax+b)$, $\sin(ax+b)$, $\cos(ax+b)$, $e^{ax}\sin(bx+c)$, $e^{ax}\cos(bx+c)$.	06Hrs	Transferrable Skills 1.EMP 2.SKD 3.EDP

Web Resources:

1. www.scilab.org.
2. wxmaxima.sourceforge.net

S21 OE: MATHEMATICS FOR ALL-I**THEORY****Total Teaching Hours: 45****No. of Hours per Week: 3****(3 credits)**

CObj	Course Objectives
CObj_1	To equip students with knowledge and insight in Algebra, Percentages, Ratio & Proportions.
CObj_2	To develop the ability to utilize the Mathematical problem-solving methods to solve related real world problems.
CObj_3	To apply Mathematical model and solve problems in a variety of contexts related to science, technology, business and industry.

CO	Course Outcomes
	After completion of the course, students will be able to
CO_1	Gain a knowledge of basic concepts of algebra, matrices and percentages, ratio and proportions.
CO_2	Demonstrate a working knowledge of set notation, matrices, percentage, ratio and proportions
CO_3	Apply the concepts of algebra, matrices, percentages, ratio and proportions to real world problems.
CO_4	The ability to analyze the real world problems.
CO_5	Solve the problems related to algebra, matrices, percentages, ratio and proportions.

Course Content

Sl. No.	Unit/chapter title	Content	Number of hours	Skills developed
1	Algebra	Set theory and simple applications of Venn Diagram, relations, functions, indices, logarithms, permutations and combinations. Examples on commercial mathematics.	15Hrs	Transferrable Skills 1.EMP 2.SKD 3.EDP
2	Matrices	Definition of a matrix; types of matrices; algebra of matrices. Determinants; calculations of values of determinants upto third order; Adjoint of a matrix, elementary row and column operations, inverse of a square matrix, solution of a system of linear equations having unique solution and involving 2 and 3 variables only using Cramer's Rule. Examples on commercial mathematics.	15Hrs	Cognitive & Analytical Skills 1.EMP 2.SKD 3.EDP
3	Percentage, Ratios and Proportions	Percentages: Definition, calculation of percentage, Ratio – Types of ratios, Duplicate, triplicate and sub-duplicate of a ratio, Proportions – Definitions, properties, cross product property and reciprocal property, united proportions, continued proportions, compound proportions, Examples on commercial mathematics.	15Hrs	Cognitive & Analytical Skills 1.EMP 2.SKD 3.EDP

Books for Reference:

1. Allel R. G. A, (1962) Basic Mathematics Macmillan, NewDelhi.
2. Dowling, E.T., (2011)Schaum's Series, Mathematics for Economics, McGraw Hill, London.
3. Vohra, N.D., (2017)Quantitative Techniques in Management, Tata McGraw Hill, NewDelhi.
4. Soni R.S., (1996) Business Mathematics, Pitamber Publishing House, Delhi.
5. K. Selvakumar Mathematics for Commerce, Notion Press Chennai
6. Dinesh Khattar & S.R. Arora. (2001).Business Mathematics with Applications S.Chand Publishing NewDelhi

S21 OE: BUSINESS STATISTICS

THEORY

Total Teaching Hours: 45

No. of Hours per Week: 3

(3 credits)

CObj	Course Objectives
CObj_1	Introduce basics of statistics within a financial context.
CObj_2	To enable students to use statistical techniques for analysis and interpretation of business data.
CObj_3	To apply Statistical methods and solve problems in a variety of contexts related to business and industry

CO	Course Outcomes
	After completion of the course, students will be able to
CO_1	Acquire knowledge to Frame and formulate management decision problems
CO_2	Understand the basic concepts of underlying quantitative analysis
CO_3	Identify types of data, visualization, analysis and interpretation
CO_4	Apply suitable Statistical methods for the real world problems
CO_5	Evaluate suitable test procedures for the given data set

Course Content

Sl. No.	Unit/chapter title	Content	Number of hours	Skills developed
1	Statistical Data and Descriptive Statistics	Nature and Classification of data: univariate, bivariate and multivariate data; time-series and cross-sectional data. Measures of Central Tendency: mathematical averages including arithmetic mean geometric mean and harmonic mean, properties and applications. Positional Averages Mode and Median (and other partition values including quartiles, deciles, and percentiles). Measures of Variation: absolute and relative. Range, quartile deviation, mean deviation, standard deviation, and their coefficients, Properties of standard deviation/variance Skewness: Meaning, Measurement using Karl Pearson and Bowley's measures; Concept of Kurtosis.	12Hrs	Transferrable/ Analytical Skills 1.EMP 2.SKD 3.EDP
2	Simple Correlation and Regression Analysis	Correlation Analysis: Meaning of Correlation: simple, multiple and partial; linear and non-linear, Correlation and Causation, Scatter diagram, Pearson's co-efficient of correlation; calculation and properties (Proof not required). Correlation and Probable error; Rank Correlation. Regression Analysis: Principle of least squares and regression lines, Regression equations and estimation; Properties of regression coefficients; Relationship between Correlation and Regression coefficients; Standard Error of Estimate and its use in interpreting the results.	11Hrs	Transferable/ Cognitive/Analytical Skills 1.EMP 2.SKD 3.EDP

3	Index Numbers	Definition, Problems involved in the construction of index numbers, methods of constructing index numbers of prices and quantities, simple aggregate and price relatives method, weighted aggregate and weighted average of relatives method, important types of weighted index numbers: Laspeyre's, Paasche's, Bowley's, Marshall Edgeworth, Fisher's, method of obtaining price and quantity index numbers, tests consistency of index numbers, time reversal test and factor reversal test for index numbers, Uses and limitations of index numbers. Consumer price index number: Problems involved in the construction of cost-of-living index number, advantages and disadvantages, Aggregative expenditure method and Family budget method for the construction of consumer price index numbers. Applications of Cost-of-Living Index numbers. Definition and measurement of Inflation rate - CPI and GNP Deflator.	11Hrs	Cognitive / Analytical Skills 1.EMP 2.SKD 3.EDP
4	Time Series Analysis	Introduction, definition and components of Time series, illustrations, Additive, Multiplicative and mixed models, analysis of time series, methods of studying time series: Secular trend, method of moving averages, least squares method - linear, quadratic, exponential trend fittings to the data. Seasonal variation - definition, illustrations, measurements, simple average method, ratio to moving average method, ratio of trend method, link relatives method, Cyclical variation- definition, distinction from seasonal variation, Irregular variation- definition, illustrations.	11Hrs	Cognitive /Analytical Skills 1.EMP 2.SKD 3.EDP

Books for Reference:

1. Levin, Richard, David S. Rubin, Sanjay Rastogi, and HM Siddiqui. (2017). Statistics for Management. (7th edition). Pearson Education.
2. David M. Levine, Mark L. Berenson, Timothy C. Krehbiel, P. K. Viswanathan, (2009) Business Statistics: A First Course, (5th edition) Pearson Education.
3. Siegel Andrew F. (2016). Practical Business Statistics. (7th edition) McGraw Hill Education.
4. Gupta, S.P., and Archana Agarwal. (2016) Business Statistics, (10th revised edition) Sultan Chand and Sons, New Delhi.
5. Vohra N. D. (2021), Business Statistics, McGraw Hill Education.
6. Murray R Spiegel, Larry J. Stephens, Narinder Kumar. Statistics (Schaum's Outline Series), (2nd edition) McGraw Hill Education.
7. Gupta, S.C. (2018) Fundamentals of Statistics. (7th edition), Himalaya Publishing House.
8. Anderson, Sweeney, and Williams, Statistics for Students of Economics and Business, (14th edition). Cengage Learning.



MATRIX AND SYLLABUS

For the Programme B.Sc. (Mathematics/ Computer Science)

Mathematics

NEP Based Curriculum (2021 onwards)

II Semester

NEP- Curriculum Framework for Approval

BSc (Mathematics, Computer Science) - Course Matrix for II Semester (w.e.f. 2022-23 Onwards)

II Semester							
Code	Course Code	Course	Teaching Hours	Course Components			Credits
				L	T	P	
AECC	S21KN 2.1/ S21HN 2.1/ S21AE 2.1	Language I (Kannada/Hindi/Additional English)	45	3	1	-	3
AECC	S21GE 2.1	Language II (Generic English)	60	3	1	-	3
AECC	21SBC 2.1	Environmental Studies	45	2	1	-	3
DSC2	S21MA2.1	Algebra-II, Calculus-II (Theory)	60	4	-	-	4
DSC2	S21MA2.2	Algebra-II, Calculus-II Lab using FOSS tools (Practical)	60	-	-	4	2
DSC2	S21CS2.1	Data Structures (Theory)	60	4	-	-	4
DSC2	S21CS2.2	Data Structures Lab (Practical)	60	-	-	4	2
OE-2	S21OE/ B21OE	Mathematics for All- II/Biostatistics /Cyber Space	45	2	1	-	3
SEC-VB	21VBC 2.1	NCC/NSS/Cultural	30	-	-	2	1
SEC-VB	21VBC 2.2	Sports	30	-	-	2	1
Total							26

Note 1:

AECC- Ability Enhancement Compulsory Course

DSC - Discipline-Specific Course

OE- Open elective (course offered by the department to students of other stream)

SEC - VB Skill Enhancement Course -Value Based

SEC - SB Skill Enhancement Course -Skill Based

Continuous Internal Assessment – Scheme of Evaluation

For Theory Courses

End Semester Examination: 60%

Continuous Internal Assessment: 40%

Activities (CIA: 40 Marks)	Proposed and Approved Scheme		Total Marks (40)
	IA-1	IA-2	
Session Test Maximum Marks	30	30	
1. Weightage (Marks)	10	10	20
2. Assignment (Marks)	20		20
i. Writing	10		
ii. Quiz / Presentation / Creating diagrams /charts / Classwork / Case study / Viva / Field work etc.	05		
iii. Classroom participation	05		
Total			40

S21 MA 2.1: ALGEBRA-II AND CALCULUS-II

THEORY

Total Teaching Hours: 60

No. of Hours per Week: 4

(4 credits)

CObj	Course Objectives
CObj_1	To equip students with knowledge and insight in Algebra-II, Calculus-II and related fields.
CObj_2	To develop the ability to utilize the Mathematical problem solving methods and software applications in addressing practical issues
CObj_3	To apply Mathematical problems and solutions in a variety of contexts related to science, technology, business and industry

CO	Course Outcomes
	After completing the course students will be able to
CO_1	Understand the concepts of mathematical objects called Groups, partial differentiation, Jacobian, Taylor's series, integral calculus, line integral, double integral, triple integral.
CO_2	Acquire skills of problem-solving techniques in Groups, partial differentiation, Jacobian, Taylor's series, integral calculus.
CO_3	Apply the concepts of integral calculus, partial differentiation and the extreme values of functions of two variables to solve the problems.
CO_4	Analyse fundamental concepts of groups, the significance of the notions of Cosets, normal subgroups and factor groups.
CO_5	Evaluate partial differentiation, Taylor's series and the extreme values of functions of two variables, area, volume and surface area.

CO-PO Mapping:

	PO_1	PO_2	PO_3	PO_4	PO_5	PSO_1	PSO_2	PSO_3	PSO_4	PSO_5
CO_1	*	*	*			*	*			*
CO_2	*	*	*			*	*		*	*
CO_3	*	*	*			*	*			*
CO_4	*	*	*		*	*	*			*
CO_5	*	*	*		*	*	*		*	*

Course Content

Sl. No.	Unit/chapter title	Content	Number of hours	Skills developed
1	Groups	Definition of a group with examples and properties, problems. Subgroups, center of groups, order of an element of a group and its related theorems, cyclic groups, Coset decomposition, Factor groups, Lagrange's theorem and its consequences. Fundamentals of congruence, Fermat's theorem and Euler's ϕ function.	15Hrs	Transferrable Skills 1.EMP 2.SKD 3.EDP
2	Partial Derivatives	Functions of two or more variables-explicit and implicit functions, partial derivatives. Homogeneous functions- Euler's theorem, total derivatives, differentiation of implicit and composite functions, Jacobians and standard properties and illustrative examples. Taylor's and Maclaurin's series for functions of two variables, Maxima-Minima of functions of two variables.	15Hrs	Cognitive & Analytical Skills 1.EMP 2.SKD 3.EDP
3	Integral Calculus	Recapitulation of integration of some standard functions and definite integrals. Reduction formulae: Reduction formulae for $\int \sin^n x dx$, $\int \cos^n x dx$, $\int \tan^n x dx$, $\int \cot^n x dx$, $\int \sec^n x dx$, $\int \operatorname{cosec}^n x dx$, $\int \sin^m x \cos^n x dx$ with definite limit. <i>Differentiation</i> under integral sign by Leibnitz rule. <i>Applications of Integral Calculus: Computation of</i>	15Hrs	Transferrable Skills 1.EMP 2.SKD 3.EDP

		length of arc, plane area and surface area and volume of solids of revolutions for standard curves in Cartesian and Polar forms.		
4	Integral Calculus	Line integral: Definition of line integral and basic properties, examples on evaluation of line integrals. Double integral: Definition of Double integrals and its conversion to iterated integrals. Evaluation of double integrals by changing the order of integration and change of variables. Computation of plane surface areas, volume underneath a surface of revolution using double integral. Triple integral: Definition of triple integrals and evaluation-change of variables, volume as triple integral.	15Hrs	Cognitive / Analytical Skills 1.EMP 2.SKD 3.EDP

Books for Reference:

1. IN Herstein, (2006), Topics in Algebra ,Wiley Eastern Ltd., New Delhi.
2. Bernard & Child,Arihant , Higher algebra, , ISBN: 9350943199/9789350943199.
3. Sharma and Vasista ,(2019),Modern Algebra, , Krishna Prakashan Mandir, Meerut, U.P.
4. Shanti Narayan ,(1942),Differential Calculus , S. Chand & Company, NewDelhi.
5. Shanti Narayan and P K Mittal,(2005)Integral Calculus, (35th edition)S. Chand and Co.Pvt. Ltd.,
6. Frank Ayres and Elliott Mendelson ,(2008), Schaum's Outline Series, , 5th ed. USA: Mc.GrawHill.
7. Vijay K Khanna and S K Bhambri, (2013)A Course in Abstract Algebra, (5th edition).Vikas Publications.
8. G K Ranganath,(2015).Text Book of B.Sc. Mathematics, S Chand & Company.
9. G B Gururajachar,(2020).Text Book of B.Sc. Mathematics, Himalaya Publications.

Web Resources:

1. <http://www.nptelvideos.in/2012/11/mathematics.html>
2. <https://www.my-mooc.com/en/categorie/mathematics>
3. <http://0cw.mit.edu/courses/mathematics/>
4. www.scilab.org.
5. wxmaxima.sourceforge.net

S21 MA2.2: ALGEBRA-II AND CALCULUS-II LAB**PRACTICAL****Total Teaching Hours: 60****No. of Hours per Week: 4****(2 credits)**

Sl. No.	Unit/chapter title	Content	Number of hours	Skills developed
1	Groups	Introduction to Scilab/Maxima programs to second semester. 1. Program to construct Cayley's table and test abelian for given finite set. 2. Program to find all possible cosets of the given finite group. 3. Program to find generators and corresponding possible subgroups of acyclic group.	12Hrs	Analytical/Employable Skills 1.EMP 2.SKD 3.EDP
2	Partial Derivatives	4. Programs to verification of Lagrange's theorem with suitable examples. 5. Program to verify the Euler's ϕ function for a given finite group. 6. Program to verify the Euler's theorem and its extension. 7. Program to find Jacobian 8. Programs to construct series using Maclaurin's expansion for functions of two variables.	15Hrs	Cognitive / Analytical Skills 1.EMP 2.SKD 3.EDP
3	Integral Calculus	9. Program to evaluate the given reduction formula with or without limits. 10. Program to evaluate the surface area, volume of solid of revolutions for standard curves	06Hrs	Cognitive /Analytical Skills 1.EMP 2.SKD 3.EDP
4	Integral Calculus	11. Program to evaluate line integral. 12. Program to evaluate double integral. Program to evaluate triple integral.	09Hrs	Transferrable Skills 1.EMP 2.SKD 3.EDP

S21 OE: MATHEMATICS FOR ALL-II

THEORY

Total Teaching Hours: 45

No. of Hours per Week: 3

(3 credits)

CObj_ID	Course Objectives
CObj_1	To equip students with knowledge and insight in Mathematical Logic, Commercial Arithmetic's and Measures of Central Tendency.
CObj_2	To develop the ability to utilize the Mathematical problem solving methods to solve related real world problems
CObj_3	To apply Mathematical model and solve problems in a variety of contexts related to science, technology, business and industry

CO_ID	Course Outcomes
	After completion of the course, students will be able to
CO_1	Understand the concept in science, technology, business and industry.
CO_2	Evaluate the legal, social and economic environment of science, technology, business and industry.
CO_3	Apply decision-support tools to science, technology, business and industry in decision making.
CO_4	Analyse and apply the knowledge of business concepts and functions in an integrated manner.
CO_5	Do analysis, presentation and interpretation of numerical data in real world problems.

Course Content

Sl. No.	Unit/chapter title	Content	Number of hours	Skills developed
1	Mathematical Logic	Proposition, truth values, logical connectives, truth table, tautology and contradiction, logical equivalence, negations, converse, inverse and contra positive of conditional proposition and example on commercial mathematics.	15Hrs	Transferrable Skills 1.EMP 2.SKD 3.EDP
2	Commercial Arithmetic	Interest: Concept of Present value and Future value, Simple interest, Compound interest, Nominal and Effective rate of interest, Examples and Problems Annuity: Ordinary Annuity, Sinking Fund, Annuity due, Present Value and Future Value of Annuity, Equated Monthly Installments (EMI) by Interest of Reducing Balance and Flat Interest methods, Examples and Problems.	15Hrs	Cognitive/ Analytical Skills 1.EMP 2.SKD 3.EDP
3	Measures of central Tendency and Dispersion	Frequency distribution: Raw data, attributes and variables, Classification of data, frequency distribution, cumulative frequency distribution, Histogram and give curves. Requisites of ideal measures of central tendency, Arithmetic Mean, Median and Mode for ungrouped and grouped data. Combined mean, Merits and demerits of measures of central tendency, Geometric mean: definition, merits and demerits, Harmonic mean: definition, merits and demerits, Choice of A.M., G.M. and H.M. Concept of dispersion, Measures of dispersion: Range, Variance, Standard deviation(SD) for grouped and ungrouped data, combined SD, Measures of relative dispersion: Coefficient of range, coefficient of variation. Examples and problems.	15Hrs	Cognitive / Analytical Skills 1.EMP 2.SKD 3.EDP

Books for Reference:

1. S.A. Bari,(1984),Practical Business Mathematics, New Literature Publishing Company New Delhi
2. K. Selva kumar ,Mathematics for Commerce, Notion Press Chennai
3. Dinesh Khattar & S. R. Arora ,(2001).Business Mathematics with Applications, S. Chand Publishing New Delhi
4. N. G. Das & Dr. J. K. Das ,(2020)Business Mathematics and Statistics, (1stedition)McGraw Hill New Delhi
5. M. K. Bhowal, (2009).Fundamentals of Business Mathematics, Asian Books Pvt. Ltd New Delhi
6. Martin Anthony and Norman,(1996).Mathematics for Economics and Finance: Methods and Modelling, (1st edition) Biggs Cambridge University Press Cambridge
7. Ahmad Nazri Wahidudin ,Financial Mathematics and its Applications, Ventus Publishing APS Denmark
8. Gupta S.C. and Kapoor V.K,(2014).Fundamentals of Mathematical Statistics,(12th edition) Sultan Chand and Sons, New Delhi.
9. Gupta S.P., (2012) Statistical Methods, Sultan Chand and Sons, New Delhi.
10. Mukhopadhyaya Parimal ,Applied Statistics, New Central Book Agency Pvt. Ltd. Calcutta.
11. Gun A.M., Gupta, M.K. and Das guptaB.(2013),Fundamentals of Statistics,. World Press Calcutta.

S21 OE: BIOSTATISTICS

THEORY

Total Teaching Hours: 45

No. of Hours per Week: 3

(3 credits)

CObj	Course Objectives
CObj_1	To enable the students to identify the variables of biological studies and explore the tools of classification and presentation.
CObj_2	To study the probability notion, models and their applications in the study of biological phenomenon.
CObj_3	To acquire knowledge on sampling distribution and testing of hypotheses.

CO	Course Outcomes After completion of the course, students will be able to
CO_1	Acquire knowledge to Frame and formulate Biological decision problems
CO_2	Understand the basic concepts underlying quantitative analysis of Biological data
CO_3	Identify types of Biological data, visualization, analysis and interpretation
CO_4	Employ suitable test procedures for the given Biological data set
CO_5	Apply suitable Statistical methods for the real world problems of Biological data

Course Content

Sl. No.	Unit/chapter title	Content	Number of hours	Skills developed
1	Introduction to Bio-Statistics	Definition and scope of Statistics. Scales of Measurement: nominal, ordinal, interval and ratio. Collection, classification and tabulation of data, construction of frequency table for grouped and ungrouped data, graphical representation of data by Histogram, Polygon, Ogive curves and Pie diagram.	11Hrs	Transferrable/ Analytical Skills 1.EMP 2.SKD 3.EDP
2	Descriptive Statistics	Measures of Central Tendency: Arithmetic mean, Median and Mode- definition, properties, merits and limitations. Measures of Dispersion: Range, Standard deviation and Coefficient of Variation. Correlation and Regression Analysis: Relation between two variables, definition of correlation, types of correlation, Scatter diagram, Karl-Pearson's coefficient of linear correlation and its properties, Spearman's Rank Correlation coefficient. Regression- Simple linear regression, fitting of regression equations by method of Least Squares, linear regression coefficients and their properties.	12Hrs	Transferable/ Cognitive/ Analytical Skills 1.EMP 2.SKD 3.EDP
3	Probability and Distributions	Probability: Random experiment, sample space, events-mutually exclusive and exhaustive events. Classical, statistical and axiomatic definitions of probability, addition and multiplication theorems, Bayes' theorem (only statements). Discrete and continuous random variables, probability mass and density functions, distribution functions, expectation of a random variable. Standard univariate distributions: Binomial, Poisson and Normal distributions (Elementary properties and applications only).	11Hrs	Cognitive / Analytical Skills 1.EMP 2.SKD 3.EDP
4	Sampling Distributions and Statistical Inference	Concepts of random sample and statistic, distribution of sample mean from a normal population, Chi-square, t and F distributions (No derivations) and their applications. Estimation of population mean, population standard deviation and population proportion	11Hrs	Cognitive / Analytical Skills 1.EMP 2.SKD 3.EDP

		from the sample counter parts. Statistical Hypothesis - null and alternative hypothesis, simple and composite hypothesis. Type I and Type II errors, size, level of significance, power test, critical region, P-value and its interpretation. Test for single mean, equality of two means, single variance, equality of two variances for normal Populations, Test for proportions.		

Books for Reference:

1. Dutta, N. K. (2004), Fundamentals of Biostatistics, Kanishka Publishers.
2. Gurumani N. (2005), An Introduction to Biostatistics, MJP Publishers.
3. Daniel, W. W. (2007), Biostatistics - A Foundation for Analysis in the Health Sciences, Wiley
4. Rao. K V. (2007). Biostatistics - A Manual of Statistical Methods for use in Health Nutrition And Anthropology
5. Pagano, M. and Gauvreau, K. (2007), Principles of Biostatistics.
6. Rosner Bernard(2010), Fundamentals of Biostatistics, 6th Edition, Duxbury.



MATRIX AND SYLLABUS

For the Programme B.Sc. (Mathematics/ Computer Science)

Mathematics

NEP Based Curriculum (2021 onwards)

III Semester

NEP- Curriculum Framework for Approval

BSc (Mathematics, Computer Science) - Course Matrix for III Semester (w.e.f. 2022-23 Onwards)

III Semester							
Code	Course Code	Course	Teaching Hours	Course Components			Credits
				L	T	P	
AECC	S21KN 3.1/ S21HN 3.1/ S21AE 3.1	Language I (Kannada/Hindi/Additional English)	45	3	1	-	3
AECC	S21GE 3.1	Language II (Generic English)	60	3	1	-	3
DSC3	S21MA3.1	Ordinary Differential Equations and Real Analysis-I (Theory)	60	4	-	-	4
DSC3	S21MA 3.2	Ordinary Differential Equations and Real Analysis-I Lab using FOSS tools (Practical)	60	-	-	4	2
DSC3	S21CS3.1	Object Oriented Programming using Java (Theory)	60	4	-	-	4
DSC3	S21CS3.2	Java Lab (Practical)	60	-	-	4	2
OE-3	S21OE/ B21OE	Quantitative Mathematics-I/Computer Fundamentals and Programming Concepts in C	45	2	1	-	3
SEC- SB	21SBC 3 .1	Digital fluency-II	30	1	-	2	2
SEC-VB	21VBC 3.1	NCC/NSS/Cultural	30	-	-	2	1
SEC-VB	21VBC 3.2	Sports	30	-	-	2	1
Total							25

Note 1:

AECC- Ability Enhancement Compulsory Course

DSC - Discipline-Specific Course

OE- Open elective (course offered by the department to students of other stream)

SEC - VB Skill Enhancement Course -Value Based

SEC - SB Skill Enhancement Course -Skill Based

Continuous Internal Assessment – Scheme of Evaluation

For Theory Courses

End Semester Examination: 60%

Continuous Internal Assessment: 40%

Activities (CIA: 40 Marks)	Proposed and Approved Scheme		Total Marks (40)
	IA-1	IA-2	
Session Test Maximum Marks	30	30	
1. Weightage (Marks)	10	10	20
2. Assignment (Marks)	20		20
i. Writing	10		
ii. Quiz / Presentation / Creating diagrams /charts / Classwork / Case study / Viva / Field work etc.	05		
iii. Classroom participation	05		
Total			40

S21 MA 3.1: ORDINARY DIFFERENTIAL EQUATIONS AND REAL ANALYSIS-I**THEORY****Total Teaching Hours: 60****No. of Hours per Week: 4****(4 credits)**

CObj	Course Objectives
CObj_1	To equip students with knowledge and insight in Differential equations and Real Analysis.
CObj_2	To provide basic subject knowledge of Mathematical applications in Differential equations and Real Analysis.
CObj_3	To develop the ability to use computer software as an aid and as a tool to study and solve problems in Mathematics.

CO	Course Outcomes
	After completion of the course, students will be able to
CO1	Remember and understand the concepts of Ordinary differential equations, sequences and series.
CO2	Analyse and use the relevant methods in solving the given problem on Ordinary differential equations, sequences and series.
CO3	Apply the concepts to solve problems on Ordinary differential equations, nature of sequences and series.
CO4	Evaluating the problem after analysing and applying suitable methods on Ordinary differential equations, sequences and series.
CO5	Give an appropriate conclusion for the given problem on Ordinary differential equations, sequences and series.

CO-PO Mapping (PSOs applicable for B.Sc. and B.A. Programmes)

	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	*	*				*	*			
CO2	*	*	*			*	*	*		
CO3	*	*	*			*	*	*	*	
CO4	*	*	*	*		*	*	*	*	
CO5	*	*	*	*	*	*	*	*	*	*

Course Content

Sl. No.	Unit/chapter title	Content	Number of hours	Skills developed
1	Differential Equations-I	Recapitulation of solution of a differential equation, variable separable method and reducible to variable separable methods. i) a) Linear equations- Bernoulli's equations and those reducible to these equations b) Exact equations and reducible to exact with standard integrating factors ii. Equations of first order and higher degree – nonlinear first order, higher degree solvable for p - solvable for y - solvable for x - Clairaut's equation singular solution - Geometric meaning. iii. Orthogonal trajectories in Cartesian and polar forms.	15Hrs	Transferrable/ Analytical Skills 1.EMP 2.SKD 3.EDP
2	Differential Equations-II	Second and higher order ordinary linear differential equations with constant coefficients complementary function-particular integrals (standard types)-Cauchy-Euler differential equation. Total and simultaneous differential equation. Solutions of second order ordinary linear differential equations with variable coefficients by the following methods: (i) When a part of complementary function is given	15Hrs	Transferrable/ Analytical Skills 1.EMP 2.SKD

		(ii) Changing the independent variable (iii) Changing the dependent variable (iv) Variation of parameters (v) When the equation is exact.		
3	Real Analysis-I	Sequences: Definition of a sequence, bounded sequences, limit of a sequence-algebra of limits. Convergent, divergent and oscillatory sequences, monotonic sequences and their properties. Cauchy's criterion, Nature of the sequences	15Hrs	Transferrable/ Analytical/ Cognitive Skills 1.EMP 2.SKD 3.EDP
4	Real Analysis-I	Series: Definition of Convergence-divergence-oscillation, properties of convergent Series, properties of convergent Series of positive terms, geometric series, Test for convergence of series - p-series -comparison tests, Cauchy root test, De'alembert's ratio test, Raabe's tests. - problems. Absolute-conditional convergence-De'alembert's test for absolute convergence-Alternating series (without proof) Summation of series - binomial, exponential and logarithmic series.	15 Hrs	Transferrable/ Analytical/ Cognitive Skills 1.EMP 2.SKD 3.EDP

Books for Reference:

1. M D Raisinghania, (2014), Ordinary and Partial Differential Equations, S Chand and Co. Pvt. Ltd.
2. F Ayres, (2010), Schaum's outline of theory and problems of Differential Equations, 1sted. USA: McGraw-Hill.
3. S Narayanan and T K Manicavachogam Pillay, (1981) Differential Equations: S V Publishers Private Ltd.
4. G F Simmons, (Oct 1991) Differential equation with Applications and historical notes: McGraw-Hill Publishing Company.
5. Richard R Goldberg, (1970), Methods of Real Analysis, Indian ed. New Delhi, India: Oxford and IBH Publishing Co.,
6. S.C. Malik and Savita Arora, (1992), Mathematical Analysis, 2nd ed. New Delhi, India: New Age international (P) Ltd.

Web Resources:

1. www.scilab.org.
2. wxmaxima.sourceforge.net
3. www.geogebra.org
4. <http://www.themathpage.com/>
5. <http://www.abstractmath.org/>
6. <http://www.fourier-series.com/>
7. <http://mathworld.wolfram.com/>
8. <http://www.princeton.edu/~rvdb>
9. <http://www.zweigmedia.com/RealWorld/Summary4.html>
10. <http://ocw.mit.edu/courses/mathematics/>
11. <http://planetmath.org/encyclopedia/TopicsOnCalculus.html>
12. <http://ocw.mit.edu/OcwWeb/Mathematics/18-01Fall-2005/CourseHome/index.htm>

13. <http://mathworld.wolfram.com/Calculus.html>
14. <http://ocw.mit.edu/courses/mathematics/>
15. <http://www.univie.ac.at/future.media/moe/galerie.html>
16. <http://tutorial.math.lamar.edu/classes/de/de.aspx>
17. <http://www.sosmath.com/diffeq/diffeq.html>
18. http://www.analyzemath.com/calculus/Differential_Equations/applications.html

S21 MA3.2: ORDINARY DIFFERENTIAL EQUATIONS AND REAL ANALYSIS-I LAB**PRACTICAL****Total Teaching Hours: 60****No. of Hours per Week: 4****(2 credits)**

Sl. No.	Unit/chapter title	Content	Number of hours	Skills developed
1	Differential Equations-I	1. Introduction to Scilab/Maxima for differential equations. 2. Solution of Differential equation using Scilab/Maxima and plotting the solution-I. 3. Solution of Differential equation using Scilab/Maxima and plotting the solution-II. 4. Solution of Differential equation using Scilab/Maxima and plotting the solution-III.	16Hrs	Analytical/Employable Skills 1.EMP 2.SKD 3.EDP
2	Differential Equations-II	5. Solution of Differential equation using Scilab/Maxima and plotting the solution-IV. 6. Finding complementary function and particular integral of constant coefficient second and higher order ordinary differential equations using Scilab/Maxima. 7. Finding complementary function and particular integral of constant coefficient second and higher order ordinary differential equations using Scilab/Maxima.	12Hrs	Cognitive /Analytical Skills 1.EMP 2.SKD 3.EDP
3	Real Analysis-I	8. Introduction to Scilab/Maxima for sequences and series 9. Illustration of convergent, divergent and oscillatory sequences using Scilab/Maxima. 10. Illustration of convergent, divergent and oscillatory series using Scilab/Maxima. 11. Scilab/Maxima programs to find the sum of the series and its radius of convergence 12. Using Cauchy's criterion to determine convergence of a sequence (simple examples). 13. Using D'Alembert's and Raabe's tests on the sequence of partial sums of the series to determine convergence of a series. 14. Testing the convergence of binomial,	28Hrs	Cognitive / Analytical Skills 1.EMP 2.SKD 3.EDP

		exponential and logarithmic series and finding the sum.		

S21 OE: QUANTITATIVE MATHEMATICS

THEORY

Total Teaching Hours: 45

No. of Hours per Week: 3

(3 credits)

CObj	Course Objectives
CObj_1	To equip students with knowledge and insight in Number system.
CObj_2	To provide basic knowledge of Time and work for competitive exams.
CObj_3	To develop the ability solving problems related to data interpretation.

CO	Course Outcomes Students will be able to
CO1	Understand the basic concepts of number system, time and work , data interpretation.
CO2	Demonstrate a working knowledge of number system, time and work , data interpretation.
CO3	Apply the concepts of number system, time and work , data interpretation. to real world problems.
CO4	The ability to analyze the real world problems
CO5	Solve the problems related to number system, time and work , data interpretation.

Course Content

Sl. No.	Unit/chapter title	Content	Number of hours	Skills developed
1	NumberSystem	Numbers Property – Simplification – Divisibility – HCF and LCM – Decimal Fractions – Square roots and Cube Roots – Logarithms – Antilogarithms - Surds and indices	10 Hrs	Transferrable/ Analytical /Employable Skills1.EMP 2.SKD 3.EDP
2	Time & Work	Time and Work, Problems on ages, Calendar, Clock, Pipes and Cistern, Time and Distance, Problems of Train, Boats and Streams.	15Hrs	Transferrable/ Analytical /Employable Skills 1.EMP 2.SKD 3.EDP
3	Data Interpretation	Data interpretation-Tabulation-Bar graphs-Pie charts-Line graphs, odd man out series-number series-letter series, codes, relationships, classification, word analogy-applied analogy, verbal classification, reasoning, logical diagrams.	20 Hrs	Transferrable/ Analytical /Employable Skills 1.EMP 2.SKD 3.EDP

Books for Reference:

1. R.S. Aggarwal, 2012, Quantitative Aptitude, S. Chand & Company, New Delhi.
2. Arun Sharma, (2021)Quantitative Aptitude for CAT, 8th edition.
3. Survesh K Verma,(2023), Quantitative Aptitude Quantum CAT.



MATRIX AND SYLLABUS

For the Programme B.Sc. (Mathematics/ Computer Science)

Mathematics

NEP Based Curriculum (2021 onwards)

IV Semester

NEP- Curriculum Framework for Approval

BSc (Mathematics, Computer Science) - Course Matrix for IV Semester (w.e.f. 2022-23 Onwards)

IV Semester							
Code	Course Code	Course	Teaching Hours	Course Components			Credits
				L	T	P	
AECC	S21KN 4.1/ S21HN4.1/ S21AE 4.1	Language I (Kannada/Hindi/Additional English)	45	3	1	-	3
AECC	S21GE4.1	Language II (Generic English)	60	3	1	-	3
AECC	21SBC 4.1	Constitution of India	45	2	1	-	3
DSC4	S21MA 4.1	Partial Differential Equations and Integral Transform (Theory)	60	4	-	-	4
DSC4	S21MA 4.2	Partial Differential Equations and Integral Transform – Lab using FOSS tools (Practical)	60	-	-	4	2
DSC4	S21CS4.1	Operating Systems (Theory)	60	4	-	-	4
DSC4	S21CS4.2	UNIX Lab (Practical)	60	-	-	4	2
OE-4	S21OE/ B21OE	Quantitative Mathematics-II/Web Designing	45	3	-	-	3
SEC-VB	21VBC 4.1	Sports	30	-	-	2	1
SEC-VB	21VBC 4.2	NCC/NSS/Cultural	30	-	-	2	1
Total							26

Note 1:

AECC- Ability Enhancement Compulsory Course

DSC - Discipline-Specific Course

OE- Open elective (course offered by the department to students of other stream)

SEC - VB Skill Enhancement Course -Value Based

SEC - SB Skill Enhancement Course -Skill Based

Continuous Internal Assessment – Scheme of Evaluation

For Theory Courses

End Semester Examination: 60%

Continuous Internal Assessment: 40%

Activities (CIA: 40 Marks)	Proposed and Approved Scheme		Total Marks (40)
	IA-1	IA-2	
Session Test Maximum Marks	30	30	
1. Weightage (Marks)	10	10	20
2. Assignment (Marks)	20		20
i. Writing	10		
ii.Quiz / Presentation / Creating diagrams /charts / Classwork / Case study / Viva / Field work etc.	05		
iii. Classroom participation	05		
Total			40

**S21 MA4.1: PARTIAL DIFFERENTIAL EQUATIONS AND INTEGRAL TRANSFORM
THEORY**

Total Teaching Hours: 60

No. of Hours per Week: 4

(4 credits)

CObj	Course Objectives
CObj_1	To master the ideas and techniques in Partial Differential equations, Fourier series, Fourier Transforms and Laplace transforms - its applications to differential equations.
CObj_2	To develop the mathematical skills of the students in the field of partial differential equations.
CObj_3	To develop the ability to utilize the Mathematical problem solving methods through FOSS tools in addressing practical issues.

CO	Course Outcomes
	After completion of the course, students will be able to
CO1	Remember and understand the concepts of Fourier series, Fourier transforms, Laplace transforms and Partial differential equations.
CO2	Analyse and use the relevant methods in solving the given problem on Fourier series, Fourier transforms, Laplace transforms and Partial differential equations.
CO3	Apply the concepts to solve problems on Fourier series, Fourier transforms, Laplace transforms and Partial differential equations
CO4	Evaluating the problems on Fourier series, Fourier transforms, Laplace transforms and Partial differential equations.
CO5	Give an appropriate conclusion for the given problem on Fourier series, Fourier transforms, Laplace transforms and Partial differential equations

CO-PO Mapping

	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	*	*				*	*			
CO2	*	*	*			*	*	*		
CO3	*	*	*	*		*	*	*		
CO4	*	*	*	*	*	*	*	*	*	*
CO5	*	*	*	*	*	*	*	*	*	*

Course Content

Sl. No.	Unit/chapter title	Content	Number of hours	Skills developed
1	Integral Transforms: Fourier series	Trigonometric Fourier series of functions with period 2π and $2L$. Half range Fourier cosine and sine series.	08 Hrs	Transferrable/ Analytical Skills 1.EMP 2.SKD 3.EDP
2	Fourier Transforms	The Fourier integral, different forms of Fourier integral - problems, Complex Fourier transform, inverse transforms, self reciprocals, basic properties of Fourier transforms, linear, change of scale, shifting, modulation – Fourier transforms of derivative and the derivative of the transform – problems, Fourier sine and cosine transforms and inverse – self reciprocal – the derivatives (without theorems) – problems.	16 Hrs	Transferrable/ Analytical Skills 1.EMP 2.SKD 3.EDP
3	Laplace Transforms	Definition and basic properties-Laplace transforms of some common functions and standard results-Laplace transforms of periodic functions-Laplace transforms of derivatives and the integral of a function-Laplace transforms the Heaviside function and Dirac-delta function-convolution theorem (with proof)-Inverse Laplace transforms-Laplace transform method of solving ordinary linear differential equation of first and second orders with constant coefficients.	14 Hrs	Transferrable/ Analytical Skills 1.EMP 2.SKD 3.EDP

4	Partial Differential Equations	Total differential equations-Necessary condition for the equation $Pdx + Qdy + Rdz = 0$ to be integrable -Simultaneous equations of the form $\frac{dx}{P} = \frac{dy}{Q} = \frac{dz}{R}$. Formation of partial differential equation. Equations of First Order Lagrange's linear equation – Charpit's method, Standard types of first order non-linear partial differential equation (By known substitution). Solution of second order linear partial differential equations in two variables with constant coefficients by finding complementary function and particular integral Solution of one – dimensional heat equations, Solution of one – dimensional wave equations using Fourier series.	22 Hrs	Transferrable/ Analytical / Research/ Skills Evaluation/ Synthesis

Books for Reference:

1. M D Raisinghania, (2014), Ordinary and Partial Differential Equations, S Chand and Co.Pvt. Ltd.
2. K SankaraRao,(2017), Introduction to Partial Differential Equations, third edition, PHI learning private limited.
3. Frank Ayres and Elliott Mendelson, (2008), Schaum's Outline of Calculus, (5th ed.) USA: Mc. Graw Hill.
4. E Spiegel, (2009), Schaum's Outline of AdvancedCalculus, (5th ed.) USA: Mc. Graw Hill.
5. M D Raisinghania, (2013), Advanced Differential Equations, S Chand and Co. Pvt. Ltd.
6. G F Simmons, (oct 1991), Differential equation with Applications and historical notes, 2nded.: McGraw-Hill Publishing Company.
7. Vairamanickham, K. Ratchagar, Nirmala P. Tamilselvan.S (2015). Transforms and Partial Differential Equations. (3rded.). Scitech Publications Pvt. Ltd.
8. Spiegel. Murray. R. (1974). Schaum's Outline of Advanced Calculus. Mc Graw Hill.

Web Resources:

1. www.scilab.org.
2. wxmaxima.sourceforge.net
3. www.geogebra.org
4. <http://www.themathpage.com/>
5. <http://www.abstractmath.org/>
6. <http://www.fourier-series.com/>
7. <http://mathworld.wolfram.com/>
8. <http://www.princeton.edu/~rvdb>
9. <http://www.zweigmedia.com/RealWorld/Summary4.html>
10. <http://ocw.mit.edu/courses/mathematics/>
11. <http://planetmath.org/encyclopedia/TopicsOnCalculus.html>
12. <http://ocw.mit.edu/OcwWeb/Mathematics/18-01Fall->

S21 MA4.2: PARTIAL DIFFERENTIAL EQUATIONS AND INTEGRAL TRANSFORM LAB**PRACTICAL****Total Teaching Hours: 60****No. of Hours per Week: 4****(2 credits)**

Sl. No.	Unit/chapter title	Content	Number of hours	Skills developed
1	Integral Transforms: Fourier series	1. To plot periodic functions with period 2π and $2L$. 2. To find full range trigonometric Fourier series of some simple functions with period 2π and $2L$. 3. To find the half-range sine and cosine series of simple functions.	12Hrs	Analytical/Employable Skills 1.EMP 2.SKD 3.EDP
2	Fourier Transforms	4. Fourier integral of some standard functions. 5. Fourier Transforms of some standard functions.	8Hrs	Cognitive & Analytical Skills 1.EMP 2.SKD 3.EDP
3	Laplace Transforms	6. Finding the Laplace transforms of some standard functions. 7. Finding the inverse Laplace transform of simple functions. 8 Implementing Laplace transform method of solving ordinary linear differential equations of first and second order with constant coefficients.	12Hrs	Cognitive & Analytical Skills 1.EMP 2.SKD 3.EDP
4	Partial Differential Equations	9 Solutions to the problems on total and simultaneous differential equations. 10. Solutions to the problems on different types of Partial differential equations. 11. Solving second order linear partial differential equations in two variables with constant coefficient. 12. Solving some more second order linear partial differential equations in two variables with constant coefficient. 13. Solution of one dimensional heat equation using Fourier series. 14. Solution of one dimensional wave equation using Fourier series.	24Hrs	Cognitive & Analytical Skills 1.EMP 2.SKD 3.EDP

S21 OE: QUANTITATIVE MATHEMATICS-II**THEORY****Total Teaching Hours: 45****No. of Hours per Week: 3****(3 credits)**

CObj	Course Objectives
CObj_1	To equip students with knowledge and insight in Permutations and combinations.
CObj_2	To provide basic knowledge on Mensuration and set theory.
CObj_3	To develop the ability of solving problems related to bankers arithmetic.

CO	Course Outcomes
CO1	Understand the basic concepts of permutations, combinations, mensuration, set theory and bankers arithmetic.
CO2	Demonstrate a working knowledge of permutations, combinations, mensuration, set theory and bankers arithmetic.
CO3	Apply the concepts of permutations, combinations, mensuration, set theory and bankers arithmetic to real world problems.
CO4	Solve the problems related to permutations, combinations, mensuration, set theory and bankers arithmetic.
CO5	The ability to address the real world problems.

Course Content

Sl. No.	Unit/chapter title	Content	Number of hours	Skills developed
1	Permutations& Combinations	Permutations and combinations (Without proof) problems on permutations and combinations, Application problems	10 Hrs	Transferrable/ Analytical / Employable Skills 1.EMP 2.SKD 3.EDP
2	Mensuration & Set Theory	Area – Volume and surface Areas – Heights and Distances. Set theory – representation – types, operations and Venn diagrams - problems	15 Hrs	Transferrable/ Analytical/ Employable Skills 1.EMP 2.SKD 3.EDP
3	Bankers Arithmetic	Simple Interest – Compound Interest – Stocks and Shares – True Discount – Banker's discount. Averages – Percentage – Profit and Loss - Ratio and Proposition – Partnership –Allegation and mixture – Chain rule.	20 Hrs	Transferrable/ Analytical/ Employable Skills 1.EMP 2.SKD 3.EDP

Books for Reference:

1. R.S. Aggarwal,(2012), Quantitative Aptitude, S. Chand & Company, New Delhi.
2. Arun Sharma, (2021)Quantitative Aptitude for CAT, 8th edition.
3. Survesh K Verma,(2023), Quantitative Aptitude Quantum CAT.
4. G KRanganath, (2018),Business Mathematics,3rd edition.
5. Eugene Don PhD, Joel Lerner PhD, (2019), Schaum's Outline, 2nd edition.
6. Abhijit Guha, (2016), Quantitative Aptitude for all competitions, 6th revised edition.



MATRIX AND SYLLABUS

For the Programme B.Sc. (Mathematics/ Computer Science)

Mathematics

NEP Based Curriculum (2021 onwards)

V Semester

NEP- Curriculum Framework for Approval

BSc (Mathematics, Computer Science) - Course Matrix for V Semester (w.e.f. 2023-24 Onwards)

V SEMESTER							
Code	Course Code	Course	Teaching hours	Course Components			Credits
				L	T	P	
DSC5	S21MA 5.1	Real Analysis-II and Complex Analysis (Theory)	60	4	-	-	4
DSC5	S21MA 5.2	Real Analysis-II and Complex Analysis Lab using FOSS tools (Practical)	60	-	-	4	2
DSC6	S21MA 6.1	Algebra - III and Number Theory (Theory)	60	4	-	-	4
DSC6	S21MA 6.2	Algebra - III and Number Theory Lab using FOSS tools (Practical)	60	-	-	4	2
DSC5	S21CS5.1	Database Management System (Theory)	60	4	-	-	4
DSC5	S21CS5.2	Database Management System Lab (Practical)	60	-	-	4	2
DSC6	S21CS6.1	Artificial Intelligence (Theory)	60	4	-	-	4
DSC6	S21CS6.2	Artificial Intelligence Lab (Practical)	60	-	-	4	2
SEC-SB	21SBC 5.1	R-Programming-A Practical Approach	45	1	-	2	2
Total							26

Note 1:

DSC - Discipline-Specific Course

OE- Open elective (course offered by the department to students of other stream)

DSE – Discipline-Specific Elective

SEC - VB Skill Enhancement Course -Value Based

SEC - SB Skill Enhancement Course -Skill Based

Continuous Internal Assessment – Scheme of Evaluation

For Theory Courses

End Semester Examination: 60%

Continuous Internal Assessment: 40%

Activities (CIA: 40 Marks)	Proposed and Approved Scheme		Total Marks (40)
	IA-1	IA-2	
Session Test Maximum Marks	30	30	
1. Weightage (Marks)	10	10	20
2. Assignment (Marks)	20		20
i. Writing	10		
ii. Quiz / Presentation / Creating diagrams /charts / Classwork / Case study / Viva / Field work etc.	05		
iii. Classroom participation	05		
Total			40

S21 MA 5.1: REAL ANALYSIS-II AND COMPLEX ANALYSIS**THEORY****Total Teaching Hours: 60****No. of Hours per Week: 4****(4 credits)**

CObj	Course Objectives
CObj_1	To provide a deeper and rigorous understanding of the fundamental concept of arbitrary Series, Infinite Products and Riemann Integrals and Riemann-Stieltjes Integrals.
CObj_2	To introduce the fundamentals ideas of function of complex variables and developing a clear understanding of the fundamental concepts of complex analysis such as limit, continuity, differentiability of complex functions, analytic functions, complex integration and bilinear transformation.
CObj_3	To develop the ability to utilize the mathematical problem solving methods through FOSS tools in addressing practical issues.

CO	Course outcomes
	After completion of this Course, students should be able to
CO1	Acquire the facts and basic concepts of real and complex analysis
CO2	Understand the basic concepts of Real and Complex Analysis such as limits, continuity, and differentiability.
CO3	Apply the concepts of real and complex analysis in order to study theoretical development of different mathematical techniques.
CO4	The ability to analyze the nature of the sequences and series, Also solve bilinear transformation.
CO5	Design various Real and Complex analysis approach to address real world problems and develop programming skills using FOSS tools to implement the same.

CO-PO Mapping

	PO_1	PO_2	PO_3	PO_4	PO_5	PSO_1	PSO_2	PSO_3	PSO_4	PSO_5
CO_1	*	*	*							
CO_2	*	*	*							
CO_3	*	*	*	*		*	*	*	*	*
CO_4	*	*	*	*	*	*	*	*	*	*
CO_5	*	*	*	*	*	*	*	*	*	*

Sl. No.	Unit/chapter title	Content	Number of hours	Skills developed
1	UNIT-I Arbitrary Series and Infinite Products	Arbitrary Series : Abel's Lemma, Abel's Test, Dirichlet's Test, Insertion and Removal of Parentheses, Rearrangement of Terms-Dirichlet's Theorem, Riemann's Theorem. Infinite Products: Cauchy Product of two infinite series, Convergence of Infinite products, General Principle of Convergence of Infinite products, Weierstrass's Inequalities, Absolute Convergence of Infinite products.	15Hrs	Analytical skills / Logical skills/ creative thinking skills/ Cognitive skills/ Communicative skills/ Presentation skills 1.EMP 2.SKD 3.EDP
2	UNIT-II Riemann Integrals and Riemann-Stieltjes Integrals	Riemann Integrals: Definitions and existence of the integral, Linear properties of the integral, the integral as the limit of sums, Integration and Differentiation Riemann-Stieltjes Integrals: Definitions and existence of the integral, Linear properties of the integral, the integral as the limit of sums, Integration and Differentiation	15Hrs	Analytical skills / Logical skills/ creative thinking skills/ Cognitive skills/ Communicative skills/ Presentation skills 1.EMP 2.SKD 3.EDP

3	UNIT-III Differentiability of a complex function	Complex numbers-Cartesian and polar form-geometrical representation-complex-Plane-Euler's formula $ei\theta=\cos\theta+isin\theta$. Functions of a complex variable-limit,continuity and differentiability of a complex function. Analytic function Cauchy-Riemann equations in Cartesian and Polar forms-Sufficiency conditions for Analyticity (Cartesian form only)-Harmonic function-standard properties of analytic Functions-construction of analytic function when real or imaginary part is given-Milne-Thomson method.	15Hrs	Analytical skills / Logical skills/ creative thinking skills/ Cognitive skills/ Communicative skills/ Presentation skills 1.EMP 2.SKD 3.EDP
4	UNIT-IV Integreability of a complex function	Complex integration-the complex integration –properties-problems. Cauchy's Integral theorem-proof using Green's theorem- direct consequences. Cauchy's Integral formula with proof-Cauchy's generalized formula for the derivatives with proof and applications for evaluation of simple line integrals - Cauchy's inequality with proof –Liouville's theorem with proof. Fundamental theorem of algebra with proof. Transformations – conformal transformation – some elementary transformations namely Translation, rotation, magnification and inversion - examples. The bilinear transformation (B.T.)-cross ratio-invariant points of a B.T.-properties- (i) B.T. sets up a one to one correspondence between the extended z-plane and the extended w-plane. (ii) Preservation of cross ratio under a B.T. (iii) A B.T. transforms circles onto circles or straight lines. Problems on finding a B.T., and finding images under a B.T. and invariant points of a B.T. Discussion of transformations $w = z^2$, $w = \sin z$, $w = \cosh z$ and $w = ez$.	15Hrs	Analytical skills / Logical skills/ creative thinking skills/ Cognitive skills/ Communicative skills/ Presentation skills 1.EMP 2.SKD 3.EDP

Books for Reference:

1. N.P.Bali,(2007)Sequences and Infinite series, FireWall Media
- 2.S C Malik, Savita Arora, (2010) Mathematical Analysis, New age Publishers, Edition 2010
3. T. M. Apostol,(2004) Mathematical Analysis, New Delhi, Narosa, 2004
- 4.Anuradha Gupta: Complex Analysis, Ane's students edition, Ane Books pvt ltd.
5. L V Ahlfors, (1979)Complex Analysis, (3rd ed.): Mc Graw Hill.
6. W. Rudin (1983) Principles of Mathematical Analysis, McGraw Hill.
7. T. M. Apostol (2004) Mathematical Analysis, New Delhi, Narosa.
8. S Shanthinarayan (2012)Complex Analysis, S Chand Co. Pvt. Ltd..
9. R V Churchil & J W Brown,(1989)Complex Variables and Applications, (5th ed.),McGraw Hill Companies.

10. A R Vashista,(2012)Complex Analysis, Krishna Prakashana Mandir.
11. S. Goldberg:(1970) Methods of Real Analysis, Oxford & IBH.
12. J. Dieudonne:(1960) Treatise on Analysis, Vol. I, Academic Press.
13. Ajit Kumar, S. Kumaresan,(2014) Basic Course in Real Analysis,Taylor & Francis Group.

Web Resources:

1. <http://www.mathcs.org/analysis/reals/index.html>
2. <http://www.aMAp.cam.ac.uk/lab/people/sd/lectures/nummeth98/index.htm>

S21 MA 5.2: REAL ANALYSIS-II AND COMPLEX ANALYSIS LAB**PRACTICAL****Total Teaching Hours: 60****No. of Hours per Week: 4****(2 credits)**

Sl. No.	Unit/chapter title	Content	Number of hours	Skills developed
1	Unit I	1. Some problems on Abel's Test 2. Some problems on Dirichlet's Test 3. Some problems on Convergence of Infinite products	12Hrs	Transferable/Creative thinking/Cognitive /Analytical Skills 1.EMP 2.SKD 3.EDP
2	Unit II	4. Some problems on integral as the limit of sums 5. Some problems on Integration and Differentiation 6. Problems on Riemann- Stieltjes Integrals	12Hrs	Transferable/Creative thinking/Cognitive /Analytical Skills
3	Unit III	7. Some problems on Cauchy-Riemann equations. 8. Implementation of Milne-Thomson method of constructing analytic functions (simple examples). 9. Illustrating orthogonality of the surfaces obtained from the real and imaginary parts of an analytic function. 10. Verifying real and imaginary parts of an analytic function being harmonic.	16Hrs	Transferable/Creative thinking/Cognitive /Analytical Skills
4	Unit IV	11. Illustrating the angle preserving property in a transformation. 12. Illustrating that circles are transformed to circles by a bilinear transformation. 13. Examples connected with Cauchy's integral theorem. 14. Examples connected with Cauchy's integral formula.	20Hrs	Transferable/Creative thinking/Cognitive /Analytical Skills

Note: Atleast 10 lab programs to be completed

S21 MA6.1: ALGEBRA III AND NUMBER THEORY**THEORY****Total Teaching Hours: 60****No. of Hours per Week: 4****(4 credits)**

CObj	Course Objectives
CObj_1	To master the ideas and techniques in Groups, Rings, Integral domains, Fields.
CObj_2	To acquire knowledge of Elementary number theory
CObj_3	To develop the ability to utilize the mathematical problem solving methods through FOSS tools in addressing practical issues.

CO	Course outcomes
	After completion of this Course, students should be able to
CO1	Remember and understand the concepts of Group homomorphisms, Rings and Fields, Real number system, Congruences and Arithmetic functions.
CO2	Analyse and use the relevant method to solve problems on Group homomorphisms, Rings and Fields, Real number system, Congruence's and Arithmetic functions.
CO3	Apply suitable concepts to solve problems on Group homomorphisms, Rings and Fields, Real number system, Congruence's and Arithmetic functions.
CO4	Evaluating the problems on Group homomorphisms, Rings and Fields, Real number system, Congruence's and Arithmetic functions.
CO5	Give appropriate conclusion and create programs using FOSS tools for the given problem on Group homomorphisms, Rings and Fields, Real number system, Congruences and Arithmetic functions.

CO-PO Mapping

	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	*	*				*	*			
CO2	*	*	*			*	*	*		
CO3	*	*	*	*		*	*	*		
CO4	*	*	*	*	*	*	*	*	*	*
CO5	*	*	*	*	*	*	*	*	*	*

Sl. No.	Unit/chapter title	Content	Number of hours	Skills developed
1	UNIT-I Group Homomorphism	Recapitulation of subgroups and properties. Normal subgroups, standard properties-examples and problems-quotient group-Homomorphism and Isomorphism of groups-Kernel and image of a homomorphism-Normality of the kernel- Fundamental theorem of homomorphism-properties related to isomorphism, permutation groups-Cayley's theorem	15Hrs	Analytical skills / Logical skills/ creative thinking skills/ Cognitive skills/ Communicative skills/ Presentation skills 1.EMP 2.SKD 3.EDP
2	UNIT-II Rings & Fields	Rings, Types of Rings properties of rings – Rings of integers modulo n –Subrings – Ideals , Principal, Prime and Maximal ideals in a commutative ring –examples and standard properties following the definition – Homomorphism, Isomorphism – Properties – Quotient rings – Integral Domain- Fields – properties following the definition – Fundamental Theorem of Homomorphism of Rings -Every field is an integral domain – Every finite integral domain is a field – Problems.	15Hrs	Analytical skills / Logical skills/ creative thinking skills/ Cognitive skills/ Communicative skills/ Presentation skills 1.EMP 2.SKD 3.EDP

3	UNIT-III Real number system	Recapitulation of number system Countable and uncountable sets, standard theorems, real line, bounded sets, supremum and infimum of a set, completeness properties of real numbers, Archimedean property of real numbers, intervals, neighbourhood of a point, open sets, closed sets, limit points and Bolzano-Weierstrass theorem (statement only).	15Hrs	Analytical skills / Logical skills/ creative thinking skills/ Cognitive skills/ Communicative skills/ Presentation skills 1.EMP 2.SKD 3.EDP
4	UNIT-IV Congruences and Arithmetic Functions	Congruences: Definition, Fundamental theorem of Arithmetic, Basic properties, Euler's Phi function, Fermat's, Euler's, and Wilson's theorem and Chinese remainder theorem Arithmetic Functions: Arithmetic Functions, Multiplicative functions-definitions and basic examples. The Moebius function, Moebius inversion formula. The number of divisors and sum of divisors functions, Perfect numbers, Characterization of even perfect numbers.	15Hrs	Analytical skills / Logical skills/ creative thinking skills/ Cognitive skills/ Communicative skills/ Presentation skills 1.EMP 2.SKD 3.EDP

Books for Reference:

1. Herstein I.N.(2016) Topics in Algebra,(2nd Edition), Wiley India.
2. Vashista,(1980).A First Course in Modern Algebra,(11th ed.): Krishna Prakasan Mandir G
3. T. M. Apostol:(2004) Mathematical Analysis, New Delhi, Narosa H
4. David M Burton: Elementary number theory,(7th edition) Tata Mc Graw Hill K
5. Ajay kumar Chaudhuri,(2009) Introduction to Number Theory, NCBA J
6. Surjeet Singh and Qazi Zameeruddin,(2006) Modern Algebra, (8th edition), Vikas Publishing House.
7. N. Jacobson,(2009) Basic Algebra-I, (2nd Revised edition), Dover Publications K
8. M. Artin :(2011) Algebra, (Second Edition), Prentice Hall of India K
9. Derek F. Holt, Bettina Eick and Eamonn A. O'Brien.(2005) Handbook of computational group theory, Chapman & Hall/CRC Press
10. J. B. Fraleigh :(2002) A first course in abstract algebra, 7thed., Addison-Wesley Longman
Bourbaki and Chandler,(2010) Schaum's outline series on groups
11. John B Fraleigh,(1990)A First course in Abstract Algebra, 3rd ed.: Narosa Publishing House
12. R Balakrishnan and N Ramabhadran,(1991) A Textbook of Modern Algebra, 1st edition, Vikas publishing house pvt. Ltd.

Web Resources:

1. <http://www.themathpage.com/>
2. <http://www.abstractmath.org/>

S21 MA6.2: ALGEBRA III AND NUMBER THEORY LAB**PRACTICAL****Total Teaching Hours: 60****No. of Hours per Week: 4****(2 credits)**

Sl. No.	Unit/chapter title	Content	Number of hours	Skills developed
1	Unit I	1. Illustrating homomorphism and isomorphism of groups. 2. Verification of Normality of a given subgroup. 3. Verifying Cayley's theorem and homomorphism of groups. 4. Verifying isomorphism of groups.	16Hrs	Transferable/ Creative thinking/ Cognitive / Analytical Skills 1.EMP 2.SKD 3.EDP
2	Unit II	5. Examples on different types of rings. 6. Examples on integral domains and fields. 7. Examples on subrings, ideals and subrings which are not ideals. 8. Homomorphism and isomorphism of rings-illustrative examples.	16Hrs	Transferable/ Creative thinking/ Cognitive / Analytical Skills
3	Unit III	9. Verification of Fermat's theorem 10.Verification of Euler's theorem	12Hrs	Transferable/ Creative thinking/ Cognitive / Analytical Skills
4	Unit IV	11. Programs to find Euler's Phi value 12. To find the number of divisors, sum of divisors, perfect numbers and even perfect numbers	8Hrs	Transferable/ Creative thinking/ Cognitive / Analytical Skills

Note: Atleast 10 lab programs to be completed



MATRIX AND SYLLABUS

For the Programme B.Sc. (Mathematics/ Computer Science)

Mathematics

NEP Based Curriculum (2021 onwards)

VI Semester

NEP- Curriculum Framework for Approval

BSc (Mathematics, Computer Science) - Course Matrix for VI Semester (w.e.f. 2023-24 Onwards)

VI SEMESTER							
Code	Course Code	Course	Teaching hours	Course Components			Credits
				L	T	P	
DSC7	S21MA 7.1	Linear Algebra and Vector Calculus (Theory)	60	4	-	-	4
DSC7	S21MA 7.2	Linear Algebra and Vector Calculus Lab using FOSS tools (Practical)	60	-	-	4	2
DSC8	S21MA 8.1	Numerical Analysis	60	4	-	-	4
DSC8	S21 MA 8.2	Numerical Analysis Lab using FOSS tools (Practical)	60	-	-	4	2
DSC7	S21CS7.1	Python Programming (Theory)	60	4	-	-	4
DSC7	S21CS7.2	Python Programming Lab (Practical)	60	-	-	4	2
DSC8	S21CS8.1	Computer Networks (Theory)	60	4	-	-	4
DSC8	S21CS8.2	Project Lab	60	-	-	4	2
SEC- SB	21SBC 6.1	Professional & Business Communication	45	1	-	2	2
TOTAL							26

Note 1:

DSC - Discipline-Specific Course

OE- Open elective (course offered by the department to students of other stream)

DSE – Discipline-Specific Elective

SEC - SB Skill Enhancement Course -Skill Based

Continuous Internal Assessment – Scheme of Evaluation

For Theory Courses

End Semester Examination: 60%

Continuous Internal Assessment: 40%

Activities (CIA: 40 Marks)	Proposed and Approved Scheme		Total Marks (40)
	IA-1	IA-2	
Session Test Maximum Marks	30	30	
1. Weightage (Marks)	10	10	20
2. Assignment (Marks)	20		20
i. Writing	10		
ii. Quiz / Presentation / Creating diagrams /charts / Classwork / Case study / Viva / Field work etc.	05		
iii. Classroom participation	05		
Total			40

**S21 MA7.1: LINEAR ALGEBRA AND VECTOR CALCULUS
THEORY**

Total Teaching Hours: 60

**No. of Hours per Week: 4
(4 credits)**

CObj	Course Objectives
CObj_1	To acquire knowledge of Vector space, subspace, basis, dimension and to verify Rank nullity theorem, linear transformations on vector spaces.
CObj_2	To motivate the students to gain knowledge about gradient, curl, Laplacian, directional derivatives, orthogonal curvilinear coordinates and vector integration.
CObj_3	To develop the ability to utilize the mathematical problem solving methods through FOSS tools in addressing practical issues.

CO	Course outcomes
	After completion of this module, students should be able to
CO1	Remember and understand various concepts of Vector spaces, linear transforms, Vector calculus, Orthogonal curvilinear coordinates and Integral theorems.
CO2	Analyse and use the relevant concepts to solve problems on Vector spaces, linear transforms, Vector calculus, Orthogonal curvilinear coordinates and Integral theorems.
CO3	Apply appropriate methods to solve problems on Vector spaces, linear transforms, Vector calculus, Orthogonal curvilinear coordinates and Integral theorems.
CO4	Evaluating the problems on Vector spaces, linear transforms, Vector calculus, Orthogonal curvilinear coordinates and Integral theorems.
CO5	Give an appropriate conclusion and create programs using FOSS tools for the given problem on Vector spaces, linear transforms, Vector calculus, Orthogonal curvilinear coordinates and Integral theorems.

CO-PO Mapping

	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	*	*				*	*			
CO2	*	*	*			*	*	*		
CO3	*	*	*	*		*	*	*		
CO4	*	*	*	*	*	*	*	*	*	*
CO5	*	*	*	*	*	*	*	*	*	*

Sl. No.	Unit/chapter title	Content	Number of hours	Skills developed
1	UNIT-I Linear Algebra - I	Vector space – Examples – Properties – Subspaces – criterion for a subset to be a subspace – linear span of a set - linear combination – linear independent and dependent subsets – Basis and dimensions– Standard properties – Examples illustrating concepts and results.	15Hrs	Analytical skills / Logical skills/ creative thinking skills/ Cognitive skills/ Communicative skills/ Presentation skills 1.EMP 2.SKD 3.EDP
2	UNIT-II Linear Algebra - I	Linear transformations – properties – matrix of a linear transformation – change of basis – range and kernel – rank and nullity – Rank – Nullity theorem – Non-singular and singular linear transformations - Standard properties – Examples.	15Hrs	Analytical skills / Logical skills/ creative thinking skills/ Cognitive skills/ Communicative skills/ Presentation skills 1.EMP 2.SKD 3.EDP

3	UNIT-III Vector Calculus-I	Differential Calculus Of Scalar And Vector Fields: Scalar field – gradient of a scalar field, geometrical meaning – directional derivative – Maximum directional derivative – Angle between two surfaces - vector field– divergence and curl of a vector field – solenoidal and irrotational fields – scalar and vector potentials – Laplacian of a scalar field – vector identities. Standard properties, Harmonic functions, Problems.	15Hrs	Analytical skills / Logical skills/ creative thinking skills/ Cognitive skills/ Communicative skills/ Presentation skills 1.EMP 2.SKD 3.EDP
4	UNIT-IV Vector Calculus-II	Definition of orthogonal curvilinear coordinates. Fundamental vectors or base vectors, Scale factors or material factors - quadratic differential form. Spherical curvilinear system: Cartesian, Cylindrical – conversion of Cylindrical to orthogonal Spherical polar coordinates. Theorem: The Spherical coordinate system is orthogonal curvilinear coordinate system and problems on conversions of one system to another. Vector integral theorems: Green's theorem (with proof), Direct consequences of the theorem. Divergence theorem (with proof) – Direct consequences of the theorem. The Stoke's theorem (without proof)- Direct consequences of the theorem.	15Hrs	Analytical skills / Logical skills/ creative thinking skills/ Cognitive skills/ Communicative skills/ Presentation skills 1.EMP 2.SKD 3.EDP

Books for Reference:

1. R.Gupta, (2016) Vector Calculus, Firewall Media
2. Seymour, Lipschutz(2017) Schaums Outlines: Linear Algebra-: TATA Mc Graw Hill Edn(Third Edition)
3. P N Chatterji: (2014) Vector Calculus:Rajhans Prakashan Mandir
4. Murray R Spiegel, Seymour, Lipschutz Dennis Spellman:(2017) Schaum's Outlines vector Analysis- Second Edn: Mc Graw Hill Edn(India) Pvt. Ltd.
5. K.Hoffman and R.Kunze,(1991) Linear Algebra, Pearson Education(India),(2003).Prentice-Hallof India.
6. I. N. Herstein,(2006) Topics in Algebra, 2nd Ed., John Wiley & Sons.
7. S. Freidberg. A Insel, and L Spence (2009) Linear Algebra, Fourth Edition, PHI.
8. J.GilbertandL.Gilbert,(1995) Linear Algebra andMatrixtheory,AcademicPress.
9. S. Lang,(1989) Linear Algebra, Springer-Verlag, New York.

10. M. Artin,(1994) Algebra, Prentice Hall of India.
11. G.Strang:(2003)LinearAlgebraanditsApplications,Brooks/ColeLtd.,NewDelhi,ThirdEdition.
12. L. Hogben (2006)-Handbook of Linear Algebra-Chapman and Hall-CRC.
13. Krishnamoorthy V K and Mainra V P and Arora J L, An Introduction to Linear Algebra, Reprint. New Delhi, India: Affiliated East West Press Pvt. Ltd., 2003.
14. M. D. Raisinghania, (2013), Vector Calculus, S Chand Co. Pvt. Ltd.
15. B Spain,(1994) Vector Analysis, ELBS.
16. D E Bournes and, P C Kendall,(1996) Vector Analysis, ELBS.
17. Shanthi Narayan and P K Mittal,(2014) Differential Calculus, Reprint. New Delhi: S Chand and Co. Pvt. Ltd.

Web Resources:

1. <http://ocw.mit.edu/courses/mathematics/>
2. <http://tutorial.math.lamar.edu/classes/de/de.aspx>

S21 MA7.2: LINEAR ALGEBRA AND VECTOR CALCULUS LAB**PRACTICAL****Total Teaching Hours: 60****No. of Hours per Week: 4****(2 credits)**

Sl. No.	Unit/chapter title	Content	Number of hours	Skills developed
1	Unit I	1. Expressing a vector as a linear combination of given set of vectors. 2. Examples on linear dependence and independence of vectors. 3. Basis and Dimension – illustrative examples.	12Hrs	Transferable/Creative thinking/Cognitive/Analytical Skills 1.EMP 2.SKD 3.EDP
2	Unit II	4. Verifying whether a given transformation is linear. 5. Finding matrix of a linear transformation. 6. Finding the linear transformation of a matrix. 7. Problems on rank and nullity.	16Hrs	Transferable/Creative thinking/Cognitive/Analytical Skills 1.EMP 2.SKD 3.EDP
3	Unit III	8. Finding gradient, divergence of scalar and vector point function. 9. Finding curl and Laplacian vector point function. . 10. Verifying Vector identities.	12Hrs	Transferable/Creative thinking/Cognitive/Analytical Skills 1.EMP 2.SKD 3.EDP
4	Unit IV	11. Expressions for differential vector operators in Cartesian coordinates, cylindrical coordinates and spherical coordinates. 12. Verifying Green's theorem. 13. Verifying Gauss' Divergence Theorem. 14. Verifying Stoke's theorem.	20Hrs	Transferable/Creative thinking/Cognitive/Analytical Skills 1.EMP 2.SKD 3.EDP

Note: Atleast 10 lab programs to be completed

S21 MA8.1: NUMERICAL ANALYSIS

THEORY

Total Teaching Hours: 60

No. of Hours per Week: 4

(4 credits)

CObj	Course Objectives
CObj_1	To develop Mathematical skills of the students in the areas of Numerical methods in finite differences, interpolation, numerical integration and to solve Algebraic, transcendental and simultaneous equations.
CObj_2	To design and analyses of techniques to give Numerical differentiation, Numerical integration and ordinary differential equations.
CObj_3	To develop the ability to utilize the mathematical problem solving methods through FOSS tools in addressing practical issues.

CO	Course outcomes
	After completion of this module, students should be able to
CO1	Understanding of various numerical techniques used for solving mathematical problems.
CO2	Apply numerical algorithms for finding an optimal solution.
CO3	Analyze numerical techniques for solving real world problems.
CO4	Evaluate the real world problems using numerical methods.
CO5	Appraise real world engineering and scientific problem using numerical methods.

CO-PO Mapping

	PO_1	PO_2	PO_3	PO_4	PO_5	PSO_1	PSO_2	PSO_3	PSO_4	PSO_5
CO_1	*	*	*		*					
CO_2	*	*	*	*	*	*	*	*	*	*
CO_3	*	*	*	*	*	*	*			
CO_4	*	*	*		*	*	*	*	*	*
CO_5	*	*	*	*	*	*	*	*	*	*

Sl. No.	Unit/chapter title	Content	Number of hours	Skills developed
1	UNIT-I Numerical Analysis-I	Finite differences: – Definition and properties of $\Delta, \nabla, \delta, \mu$ and E, the relation between them – The nth differences of a polynomial, Factorial notations, separation of symbols, divided differences and related theorems. Newton – Gregory forward and backward interpolation formulae – Lagrange's and Newton's interpolation formulae for unequal intervals - Inverse interpolation.	15Hrs	Analytical skills / Logical skills/ creative thinking skills/ Cognitive skills/ Communicative skills/ Presentation skills 1.EMP 2.SKD 3.EDP
2	UNIT-II Numerical Analysis-II	Numerical solutions of algebraic and Transcendental equations – method of successive bisection, method of false position, Newton-Raphson method. Solving simultaneous equations - Gauss Elimination method, Gauss Crout-Dolittle method, Gauss-Jacobi, Gauss-Seidel methods. Computation of largest and smallest Eigen values of a square matrix by power method.	15Hrs	Analytical skills / Logical skills/ creative thinking skills/ Cognitive skills/ Communicative skills/ Presentation skills 1.EMP 2.SKD

				3.EDP
3	UNIT-III Numerical Analysis-III	Numerical differentiation: Newton's Forward and Backward difference formula to compute the derivative, Derivative using Stirling's formula to find maxima and minima of the functions for given tabular values Numerical Integration and error analysis: Quadrature formula – Trapezoidal rule - Simpson's 1/3 and 3/8 rule and Weddle's rule and problems and error analysis.	15Hrs	Analytical skills / Logical skills/ creative thinking skills/ Cognitive skills/ Communicative skills/ Presentation skills 1.EMP 2.SKD 3.EDP
4	UNIT-IV Numerical Analysis-IV	Numerical solution of ordinary differential equations: Initial value problems- Picard's and Taylor series methods – Euler's Method-Modified Euler's method- Runge Kutta methods of second and fourth order – Multistep method-The Adams - Moulton method	15Hrs	Analytical skills / Logical skills/ creative thinking skills/ Cognitive skills/ Communicative skills/ Presentation skills 1.EMP 2.SKD 3.EDP

Books for Reference:

1. P Kandasamy, K Thilagavathy and K Gunavathy, (2022). Numerical Methods, S Chand publications, (New edition)
2. M K Jain, SRK Iyengar, R K Jain, (2012) Numerical methods for scientific and Engineering computation, New age International pvt ltd.
3. Venkataraman M K (1999), Numerical methods in Science and Engineering, The National publishing company, Madras
4. S S Sastry, (2012), Introductory methods of Numerical Analysis, Prentice Hall of India.
5. M K Jain: (1979), Numerical solution of differential equations, Wiley Eastern, (2nd Edition).
6. Richard L. Burden, J. Douglas Faires: (2010) Numerical Analysis-CENGAGE Learning- (9th edition)
7. J.W Thomas: (1998), Numerical partial differential equations: finite difference methods, Springer,

(2nd Edition).

Web Resources:

1. <http://www.aMAp.cam.ac.uk/lab/people/sd/lectures/nummeth98/index.htm>
2. <http://math.fullerton.edu/mathews/numerical.html>
3. <http://www.onesmartclick.com/engineering/numerical-methods.html>

S21 MA8.2: NUMERICAL ANALYSIS LAB**PRACTICAL****Total Teaching Hours: 60****No. of Hours per Week: 4****(2 credits)**

Sl. No.	Unit/chapter title	Content	Number of hours	Skills developed
1	Unit I	1. Scilab/Maxima programs on Newton-Gregory forward Interpolation formula. 2. Scilab/Maxima programs on Newton-Gregory backward Interpolation formula. 3. Scilab/Maxima programs on Lagrange's Interpolation formula.	12Hrs	Transferable/Creative thinking/Cognitive / Analytical Skills 1.EMP 2.SKD 3.EDP
2	Unit II	4.Solving algebraic equation (Bisection method). 5. Solving algebraic equation (Regula-Falsi and Newton-Raphson methods). 6. Solving system of equations (Jacobi and Gauss-Seidel methods). 7. Solving for largest eigen value by Power method.	16Hrs	Transferable/Creative thinking/Cognitive / Analytical Skills 1.EMP 2.SKD 3.EDP
3	Unit III	8. Scilab/Maxima programs Numerical Differentiation. 9. Scilab/Maxima programs to evaluate integrals using Trapezoidal rule 10. Scilab/Maxima programs to evaluate integrals using Simpson's 1/3rd and 3/8th rule. 11. Scilab/Maxima programs to evaluate integrals using Weddle's rule	16Hrs	Transferable/Creative thinking/Cognitive / Analytical Skills 1.EMP 2.SKD 3.EDP
4	Unit IV	12. Solving problems on Taylor series method 13. Solving ordinary differential equation by modified Euler's method. 14. Solving ordinary differential equation by Runge-Kutta method of 4th order	16Hrs	Transferable/Creative thinking/Cognitive / Analytical Skills 1.EMP 2.SKD 3.EDP

Note: Atleast 10 lab programs to be completed