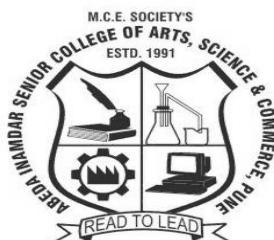


M.C.E. SOCIETY'S
ABEDA INAMDAR SENIOR COLLEGE OF ARTS, SCIENCE,
AND COMMERCE (AUTONOMOUS), PUNE – 411 001
POST GRADUATE DEPARTMENT OF CHEMISTRY AND RESEARCH CENTER



Syllabus for
M. Sc. Part – I (Biochemistry)
As per NEP-2020
From Academic Year 2026-2027

Board of Studies (Chemistry)
Post Graduate Department of Chemistry and Research Center
Abeda Inamdar Senior College of Arts, Science and Commerce,
Pune - 411001

New Syllabus as per NEP- 2020 [w. e. f. 2026-27]

Structure of M. Sc. Biochemistry

Basic structure (Framework) of the proposed postgraduate syllabus for the two years M. Sc. Biochemistry in the Abeda Inamdar Senior College, Pune (Autonomous) affiliated to Savitribai Phule Pune University, Pune as per NEP-2020 pattern.

Semester wise credit distribution for two-year Post Graduate program after three years B. Sc. is as below –

Semester	Mandatory	Elective	RM	FP/OJT	RP	Total
I	08 (T) + 06 (P)	2 (T) + 2 (T/P)	04	--	--	22
II	08 (T) + 06 (P)	2 (T) + 2 (T/P)	--	04	--	22
III	10 (T) + 04 (P)	2 (T) + 2 (T/P)	--	--	04	22
IV	08 (T) + 04 (P)	2 (T) + 2 (T/P)	--	--	06	22
Total	54	16	04	04	10	88

T = Theory, P = Practical, RM = Research Methodology, FP = Field Project,
OJT = On Job Training RP = Research Project

Semester wise credit distribution for one year Post Graduate program after four years B. Sc.

Semester	Mandatory	Elective	RM	FP/OJT	RP	Total
III	10 (T) + 04 (P)	2 (T) + 2 (T/P)	--	--	04	22
IV	08 (T) + 04 (P)	2 (T) + 2 (T/P)	--	--	06	22
Total	26	08	--	--	10	44

Eligibility: As per Savitribai Phule Pune University and UGC Guidelines

- B. Sc. With Chemistry as Principle or Major subject.
- B. Sc. (Blended) Chemistry.
- B. Sc. Nanosciences and Nanotechnology
- B. Pharmacy
- If seats are available, admission should be given to students who have passed B. Sc. in Botany, Zoology, Microbiology and Biotechnology.

M. Sc. Programme Objectives and Outcomes

Programme Objectives: The M.Sc. Biochemistry program is designed to impart theoretical and experimental knowledge about living organisms' biomolecules and biochemical processes. The program extends its aims to provide the biochemistry-based skills to students for identifying scientific issues, developing hypotheses based on literature, designing and conducting

experiments, and utilizing experimental results for sustainable human betterment.

Programme Outcomes: After completion of M.Sc. Biochemistry programme, students will be able to:

- PO1:** Apply fundamental and advanced knowledge of biochemistry and allied life sciences.
- PO2:** Identify, analyze, and solve biochemical problems using scientific reasoning.
- PO3:** Design, perform, and interpret experiments in laboratory and field settings.
- PO4:** Use modern biochemical, biophysical, analytical, and computational tools effectively.
- PO5:** Communicate scientific information effectively.
- PO6:** Understand ethical and professional responsibilities.
- PO7:** Apply knowledge in clinical, industrial, environmental, and research areas.
- PO8:** Engage in lifelong learning and career development.

Programme Specific Outcome: After completion of the programme, students will be able to:

- PSO1:** Demonstrate knowledge of biomolecules, cell biology, molecular biology, and bioenergetics of living systems.
- PSO2:** Apply microbiological, biochemical, and biophysical techniques (spectroscopy, chromatography, centrifugation, etc.) in laboratory and research work.
- PSO3:** Analyze, interpret, and solve problems related to biochemical processes, metabolic pathways, and experimental data.
- PSO4:** Integrate interdisciplinary knowledge including chemistry, biology, biostatistics, and computational biology for solving real-world problems.
- PSO5:** Apply biochemical principles in clinical biochemistry, tissue culture, fermentation technology, and environmental applications.
- PSO6:** Develop skills in scientific communication, ethics, research methodology, and professional career development.

Programme Structure

The Master of Science in Biochemistry is a Two-Year Full-Time Course consisting of Four Semesters.

Semester I

Semester II

Semester III

Semester IV

Evaluation Pattern:

Guidelines for conduction of classes:

- a) A student has to attend one hour classroom teaching per week for one credit of theory and 2 hours' lab work/problem-solving session/ related activities per week for one credit of

practical. Practical sessions (lab work/problem-solving session/related activity) will be conducted in batches. A batch for such sessions will be of size maximum of 08 students.

- b) 4 Credit courses will have 60 lectures (48L + 12T) and 2 Credit courses will have 30 lectures (24L + 6T).
- c) The Department may conduct necessary lectures/workshops as a part of OJT.
- d) Each course of 4 credits will carry 100 marks and 2 credit courses will carry 50 marks.
- e) There will be Continuous Internal Evaluation (CIE) and Semester End Examination (SEE) for each course.

For Continuous Internal Evaluation (CIE), evaluation of theory courses will be done continuously.

Internal Evaluation (20 Marks) shall be based on the following components:

- a) One Mid-Semester Examination of 20 marks, converted to 10 marks.
- b) One or Two Class Tests of 15 marks each, converted to 5 marks.
- c) Class Assignments – 5 marks.
- d) One Presentation / Seminar / MCQ Test – 5 marks.
- e) One Group Discussion / Open Book Test – 5 or 10 marks, as applicable.
- f) A compulsory Mock Practical Examination and Viva Voce (for practical subjects).
- g) Internal marks for Journal / Project Report / Dissertation Report based on completion and certification.

The student has to obtain 40% marks in the combined examination of In-semester assessment and Semester-End assessment with a minimum passing of 40% in both these separately.

Programme structure for first year M. Sc. I Biochemistry

Sr. No.	Paper No.	Subject	Credit
SEMESTER – I			
1	26SMBC11MM	Biomolecules	2
2	26SMBC12MM	Fundamentals of Microbiology	2
3	26SMBC13MM	Cell Biology	2
4	26SMBC14MM	Biophysical Techniques	2
5	26SMBC15MM	Practical: Analytical Biochemistry – I	2
6	26SMBC16MM	Practical: Biophysical Techniques	2
7	26SMBC17MM	Practical: Microbiology Practical	2
Major Elective: Any One			
8a	26SMBC18MEA	Genetics	2
8b	26SMBC18MEB	Plant Biochemistry	2
Major Elective: Any One			
9a	26SMBC19MEA	Enzymology	2
9b	26SMBC19MEB	Nutrition Science	2
10	26SMBC11RM	Research Methodology	4
SEMESTER – II			
1	26SMBC21MM	Molecular Biology	2
2	26SMBC22MM	Bioenergetics and Metabolism	2
3	26SMBC23MM	Clinical Biochemistry	2
4	26SMBC24MM	Animal Tissue Culture	2
5	26SMBC25MM	Practical: Analytical Biochemistry – II	2
6	26SMBC26MM	Practical: Clinical Biochemistry	2
7	26SMBC27MM	Practical: Computational Biochemistry	2
Major Elective: Any One			
8a	26SMBC28MEA	Biostatistics	2
8b	26SMBC28MEB	Applied biology	2
Major Elective: Any One			
9a	26SMBC29MEA	Fermentation technology	2
9b	26SMBC29MEB	Bioremediation	2
10	26SMBC21FP	Field Project /On Job Training (OJT)	4



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SEMESTER – I

Course/ Paper Title	Biomolecules
Course Code	26SMBC11MM
Semester	I
No. of Credits	2 Credits, (30 Hours)

Aims & Objectives of the Course

Objectives
1. To study the chemical composition of living organisms and macromolecules.
2. To study the structure, properties and functions of carbohydrates, lipids, proteins etc.
3. To understand water's role in biochemical reactions and weak acid-base equilibria.
4. To learn techniques for studying protein structure, from primary to quaternary.

Course Outcomes

CO No.	Cognitive Level	Course Outcome
CO1	R1	Outline the molecular basis of life, composition of biomolecules, and properties of water.
CO2	U2	Describe classification, structure, properties, and biological functions of carbohydrates and their derivatives.
CO3	A4	Explain classification, structure, and biological significance of lipids and lipoproteins.
CO4	A4	Describe structure, functions, deficiency of vitamins, and role of coenzymes.
CO5	A3	Explain classification, properties, and reactions of amino acids and proteins.
CO6	E5	Evaluate protein structural organization and techniques used for protein analysis.

CO- PO and PSO Mapping Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	3	2	1	1	1	1	1	2	3	1	1	1	1	1
CO2	3	2	1	1	1	1	1	2	3	1	1	1	1	1
CO3	3	2	2	2	1	1	2	2	3	2	2	1	1	1
CO4	3	2	2	1	2	2	2	2	3	2	2	2	2	1
CO5	3	2	2	2	1	1	2	2	3	2	2	1	1	1
CO6	3	3	3	2	2	1	2	3	3	3	3	2	2	2
AVG	3	2.2	1.8	1.5	1.3	1.2	1.7	2.2	3	1.8	1.8	1.3	1.3	1.2

26SMBC11MM: Biomolecules (30 Hours)

Sr. No.	Name of the Topic	Hours
1	The Molecular Logic of Life: The chemical unity of diverse living organisms, composition of living matter. Macromolecules and their monomeric subunits. Properties of water: With interactions in aqueous systems. Ionization of water, weak acid weak bases.	02
2	Carbohydrates: Classification, basic chemical structure, general reactions and properties, biological significance, Sugar derivatives, deoxy sugars, amino sugars, and sugar acids.	06
3	Lipids: Classification, structure and function of major lipid subclasses-acylglycerols, Lipoproteins, chylomicrons, LDL, HDL and VLDL, rancidity. Formation of micelles, monolayers, bilayer, liposomes.	04
4	Vitamins and Co-enzymes: Classification, water soluble and fat-soluble vitamins. Structure, dietary requirements, deficiency conditions, coenzyme forms and their mechanism.	04
5	Proteins and Amino acids: Classification, Properties, reactions, rare amino acids. Protein classification: Reactions, functions, properties and Solid phase synthesis. Structural levels of protein: a. Primary Structure: Peptide bond, importance of primary structure. b. Secondary structure: X ray diffraction, alpha-helix, β - structure, β -helix, super secondary structure. c. Tertiary Structure: Forces stabilizing, unfolding/ refolding expt. Prediction of tertiary Structure d. Quaternary structure – hemoglobin. End group analysis, sequencing and peptide synthesis.	14

References:

1. Principles of Biochemistry, Lehninger CRS. Publication, 7th edition (2017).
2. Biochemistry, L. Stryer, W.H. Freeman, San Francisco (2008).
3. Schaum's Outline Series of Theory and Problems of Biochemistry, Philip W. Kuchel and G. B. Ralston. Int. Ed., McGraw-Hill Book Co.
4. Problem Approaches in Biochemistry. Wood and Hood.
5. Biochemistry by Voet and voet, 4th edition (2010).
6. Biochemistry by Zubay (1997).



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Course/ Paper Title	Fundamentals of Microbiology
Course Code	26SMBC12MM
Semester	I
No. of Credits	2 Credits, (30 Hours)

Aims & Objectives of the Course

Objectives
1. To understand microbial diversity.
2. To master microbial growth and cultivation techniques.
3. To explore microbial interactions and pathogenesis.
4. To apply microbiology in industry and environment.

Course Outcomes

CO No.	Cognitive Level	Course Outcome
CO1	R1	Identify different groups of microorganisms based on classification and characteristics.
CO2	U2	Describe microbial nutrition, growth, and culture techniques.
CO3	A4	Analyze microbial growth kinetics and factors affecting growth.
CO4	A4	Explain host-pathogen interactions, quorum sensing, and microbial virulence.
CO5	E5	Evaluate applications of microorganisms in industrial, environmental, and food sectors.

CO- PO and PSO Mapping Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	3	2	1	1	1	1	1	2	3	1	1	1	1	1
CO2	3	2	2	2	1	1	2	2	3	2	2	1	1	1
CO3	3	3	2	2	1	1	2	2	3	2	2	1	1	1
CO4	3	2	2	1	2	2	3	2	3	2	2	2	2	1
CO5	3	2	3	2	2	2	3	3	3	3	3	2	2	2
AVG	3	2.2	2.0	1.6	1.4	1.4	2.2	2.2	3	2.0	2.0	1.4	1.4	1.2

26SMBC12MM: Fundamentals of Microbiology (30 Hours)

Sr. No.	Name of the Topic	Hours
1	Overview of Microbial World: Bacterial taxonomy, Morphological and structural organization of microbes. Ultrastructure of Archaea, Eubacteria, Unicellular eukaryotes (Yeast) and Viruses (Bacterial, animal and tumour viruses).	08
2	Cultural Characteristics of Microorganisms: Microbial growth and nutrition, media formulation, Techniques for enumeration of microorganisms in soil and water, Pure culture and enrichment culture techniques for isolation of heterotrophs and autotrophs, Reproduction and growth, Growth kinetics, factors affecting growth, synchronous growth continuous culture, Strain development-mutation and selection of mutants	10
3	Microbial Interactions and Infection: Host-pathogen interactions, microbes infecting humans, veterinary animals and plants, pathogenicity islands and their role in bacterial virulence, quorum sensing Industrial applications: Ethanol production, Antibiotics (penicillin and streptomycin), Enzymes (amylase and lipase) and organic acids (citric acid and acetic acid). Food and Dairy Microbiology, Single Cell Protein and Probiotics, Environmental microbiology, Water treatment, Bacteriological analysis of water, Biobleaching, Bioremediation.	12

References:

1. Prescott's Microbiology by Joanne M. Willey, Linda Sherwood, and Christopher J. Woolverton
2. Microbiology: An Introduction by Gerard J. Tortora, Berdell R. Funke, and Christine L. Case
3. Brock Biology of Microorganisms by Michael T. Madigan, Kelly S. Bender, Daniel H. Buckley, W. Matthew Sattley, and David A. Stahl
4. Foundations in Microbiology by Kathleen Park Talaro and Barry Chess
5. Textbook of Microbiology by Ananthanarayan and Paniker



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Course/ Paper Title	Cell Biology
Course Code	26SMBC13MM
Semester	I
No. of Credits	2 Credits, (30 Hours)

Aims & Objectives of the Course

Objectives

1. To understand the historical milestones, principles of cell theory, and the structural and functional differences between prokaryotic and eukaryotic cells, as well as between plant and animal cells.
2. To study cellular organelles, their roles and involvement in key metabolic and biochemical processes.
3. To study the structure, composition, and transport mechanisms of the plasma membrane, as well as the organization and roles of the cytoskeleton and extracellular matrix in cellular and tissue-level functions.
4. To analyze the processes of mitosis and meiosis, the cell cycle and its regulation.
5. To explore the mechanisms of stem cell differentiation and tissue specialization to appreciate their importance in growth, development, and repair.

Course Outcomes

CO No.	Cognitive Level	Course Outcome
CO1	R1	Recall basic structure and components of prokaryotic and eukaryotic cells.
CO2	U2	Explain structure and function of cell organelles and membranes.
CO3	A4	Analyze cell cycle regulation and mechanisms of cell division.
CO4	A4	Explain cell signaling pathways and signal transduction mechanisms.
CO5	E5	Evaluate cellular processes such as apoptosis, differentiation, and cancer biology.

CO- PO and PSO Mapping Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	3	2	1	1	1	1	1	2	3	1	1	1	1	1
CO2	3	2	2	2	1	1	1	2	3	2	2	1	1	1
CO3	3	3	2	2	1	1	2	2	3	2	2	1	1	1
CO4	3	2	2	2	2	1	2	2	3	2	2	2	1	1
CO5	3	3	3	2	2	2	3	3	3	2	3	2	2	2
AVG	3	2.4	2.0	1.8	1.4	1.2	1.8	2.2	3	1.8	2.0	1.4	1.2	1.2

26SMBC13MM: Cell Biology (30 Hours)

Sr. No.	Name of the Topic	Hours
1	Milestones in the Development of Cell Biology: Cell theory, Cell as unit of life, basic properties of a cell. Prokaryotic and Eukaryotic cells, plant cell and Animal cell. Structure and integrity of cells, organelles of eukaryotic cell, sub cellular organization of activities.	05
2	Plasma Membrane: Structure and functions of plasma membrane, different models of plasma membrane, characteristics of fluid mosaic model, biochemical composition, lipid anchored membrane proteins, Role of plasma membrane in cell signaling. Transport mechanism, passive and active transport, co-transport, symport, antiport, uniport, ion channels, bulk transport, endocytosis, exocytosis, phagocytosis, pinocytosis. Role of clathrin, COPI and COPII in transport. Ca ²⁺ and Fe transport.	10
3	Cytoskeleton and Organization: microtubules, microfilaments and intermediary filaments. Structure and function of centrosomes. Structure and functions of cilia and flagella. Structure and function of nucleus and nucleolus. Morphology of chromosomes. Structure and functions of mitochondria, lysosome, endoplasmic reticulum, Golgi complex, and ribosomes. Transport from ER to Golgi complex, protein sorting in TGN, glycosylation in Golgi complex. Connective tissue: Collagen, elastin, other fibrous proteins, proteoglycans, fibronectin, other proteins of extracellular matrix.	10
4	Cell Division: mitosis and meiosis, similarities and differences, crossing over, cell cycle- different phases. Types of cells, stem cells, quiescent cells, cellular differentiation, types of tissues- epithelium, microvilli, basement membrane, structural features and characteristics.	05

References:

- Lodish, Harvey. Molecular cell biology. Macmillan, 2008.
- Cooper, G. M., and R. Hausman. "The Cell-A Molecular Approach, 2000."Sunderland (MA): Sinauer Associates, Inc, 2000.

3. Pollard, Thomas D., William C. Earnshaw, and Jennifer Lippincott-Schwartz. Cell biology. Elsevier Health Sciences, 2007.
4. Pelczar, M. J., E. C. S. Chan, and N. R. Krieg. Microbiology. Fifth edition, Tata Mcgraw-hill Publishing Company Ltd., New Delhi (2004).



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Course/ Paper Title	Biophysical Techniques
Course Code	26SMBC14MM
Semester	I
No. of Credits	2 (30 Hours)

Aims & Objectives of the Course

Objectives

1. To understand the principles and methodologies of electrophoresis, chromatography, spectroscopy and sedimentation techniques.
2. To recognize the importance of biophysical techniques in the analysis of biomolecules.
3. To acquire the skills to operate advanced instruments like HPLC, SDS-PAGE, and Ultracentrifugation.
4. To integrate biophysical concepts into research areas such as proteomics, genomics, and Drug discovery.

Course Outcomes

CO No.	Cognitive Level	Course Outcome
CO1	R1	Identify basic principles and instrumentation of biophysical techniques.
CO2	U2	Explain principles and applications of spectroscopy (UV-Visible, IR).
CO3	A3	Apply chromatographic and electrophoretic techniques for biomolecule separation.
CO4	A4	Analyze data obtained from centrifugation and advanced analytical techniques.
CO5	E5	Evaluate the use of biophysical techniques in structural and functional analysis of biomolecules.

CO- PO and PSO Mapping Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	3	2	1	2	1	1	1	2	3	2	1	1	1	1
CO2	3	2	2	3	1	1	1	2	3	3	2	1	1	1
CO3	3	2	3	3	2	1	2	2	3	3	3	1	1	1
CO4	3	3	3	3	2	1	2	2	3	3	3	2	1	1
CO5	3	3	3	3	2	2	2	3	3	3	3	2	2	2
AVG	3	2.4	2.4	2.8	1.6	1.2	1.6	2.2	3	2.8	2.4	1.4	1.2	1.2

26SMBC14MM: Biophysical Techniques (30 Hours)

Sr. No.	Title with Contents	Hours
1	Electrophoretic Techniques: Migration of an ion in an electric field, Factors affecting electrophoretic mobility, General principle of electrophoresis, Types of electrophoresis; moving boundary electrophoresis, Steady state electrophoresis and zone electrophoresis, Supporting media in electrophoresis; Agarose gels, paper, cellulose - acetate electrophoresis, polyacrylamide gels, Electrophoresis of proteins; SDS-PAGE, native PAGE, disc PAGE, gradient PAGE, Capillary electrophoresis, Isoelectric focussing, 2-D gel electrophoresis, Western blotting.	08
2	Chromatography Techniques: Introduction, Partition and adsorption principle, Paper chromatography and thin layer chromatography, Ion exchange chromatography; principle, method, major matrices, examples of cation and anion exchangers, applications, HPLC; Principle, Instrumentation, Separate modes; normal and reverse, detectors, Fast protein liquid chromatography (FPLC); Introduction, Principle and Applications.	08
3	Spectroscopy: UV and visible spectrophotometry; Principle, instrumentation and applications, Spectrofluorometry Structural Factors Which give Rise to Fluorescence; Fluorescence and Phosphorescence (Box); Instrumentation, Applications; Fluorescence Spectra and Study of Protein Structure, Extrinsic Fluorescence, Fluorescence and Energy Transfer.	08
4	Sedimentation: Theory, Preparatory and analytical ultracentrifuges, Density gradient centrifugation. Factors affecting sedimentation velocity, sedimentation coefficient, measurement of S, Zonal centrifugation, DNA analysis, Determination of molecular weight by sedimentation, diffusion and sedimentation equilibrium methods, Applications of sedimentation techniques with examples.	06

Reference Books:

1. Physical biochemistry by D. Freifelder 2 nd edition (1982).

2. Biochemical techniques by Wilson and Walker, Seventh edition, Cambridge University Press 2010.
3. Biophysical techniques by Upadhye and Upadhye, Himalaya Pub. House, (2009).
4. Electrophoresis Analytical chemistry by Open learning by Maureen Melvin.



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Course/ Paper Title	Practical: Analytical Biochemistry – I
Course Code	26SMBC15MM
Semester	I
No. of Credits	2 Credits, (60 Hours)

Aims & Objectives of the Course

Objectives

1. To analyse biomolecules like amino acids, proteins, carbohydrates, vitamins, and pigments.
2. To understand specific biochemical reactions for identification and estimation.
3. To acquire skills in separation, isolation, and quantitative estimation.
4. To relate theoretical biochemical concepts to practical applications.
5. To develop research-oriented laboratory skills.

Course Outcomes

CO No.	Cognitive Level	Course Outcome
CO1	A3	Perform qualitative and quantitative analysis of biomolecules such as carbohydrates, proteins, and lipids.
CO2	A3	Demonstrate preparation of standard solutions and calibration techniques in biochemical experiments.
CO3	A4	Analyze experimental data obtained from biochemical estimations and assays.
CO4	A4	Interpret results of biochemical tests and relate them to biological significance.
CO5	E5	Evaluate accuracy and precision of experimental results and laboratory procedures.

CO- PO and PSO Mapping Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	3	2	3	3	1	1	2	2	3	3	2	1	1	1
CO2	3	2	3	3	1	1	2	2	3	3	2	1	1	1
CO3	3	3	3	2	2	1	2	2	3	3	3	1	1	1
CO4	3	3	3	2	2	2	2	2	3	3	3	2	1	1
CO5	3	3	3	2	2	2	2	3	3	3	3	2	2	2
AVG	3	2.6	3	2.4	1.6	1.4	2.0	2.2	3	3	2.6	1.4	1.2	1.2

26SMBC15MM: Practical: Analytical Biochemistry – I (60 Hours)

S. No.	Name of the Experiment
	Perform any 12 experiments from the following –
1	Separation of amino acid mixture by Paper chromatography.
2	Estimation of amino acid by Ninhydrin method
3	Estimation of protein by Biuret method.
4	Estimation of protein by Lowry method.
5	Estimation of protein by Bradford method.
6	Specific reactions for Amino acids.
7	Estimation of sugar by Folin-Wu method.
8	Estimation of sugar by Ferricyanide method.
9	Estimation of sugar by DNSA method.
10	Identification of carbohydrate mixture with suitable tests.
11	Isolation of amino acid cystine from hair hydrolysate.
12	Isolation of Egg albumin and globulin.
13	Estimation of any vitamin B.
14	Estimation of chlorophylls from leaf.
15	Isolation of milk casein by isoelectric pH precipitation.
16	Isolation of Cholesterol and lecithin from egg.
17	Estimation of Vitamin C from lemon fruits.
18	Determination of alpha amino nitrogen of amino acid.
20	Determination of saponification value of fat
21	Determination of acid value of fat
22	Determination of iodine number of fat

References:

1. Practical Biochemistry: Principles and techniques: K. Wilson and J. Walker. (2006) 5th Edition.
2. Practical Biochemistry by David Plummer (2015) 3rd Edition.

3. Introductory Practical Biochemistry by S.K. Sawhney and R.Singh.
4. Practical Biochemistry by J. Jayaraman.
5. Biochemical methods by S. Sadasivam and A. Manickam (2010) New Age International, New Delhi.
6. Any relevant reference/procedure may be used.



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Course/ Paper Title	Practical: Biophysical techniques
Course Code	26SMBC16MM
Semester	I
No. of Credits	2 Credits, (60 L)

Aims & Objectives of the Course

Objectives

1. To acquire practical skills in gel filtration and ion exchange chromatography.
2. To learn methods like TLC, gel electrophoresis, and dialysis for biomolecule separation.
3. To understand absorption spectroscopy for nucleic acids and hemoglobin derivatives.
4. To utilize spectrofluorimetry for quantitative estimation of biomolecules.
5. Study sub-cellular fractionation and RBC membrane fragility.

Course Outcomes

CO No.	Cognitive Level	Course Outcome
CO1	A3	Operate instruments used in biophysical analysis such as spectrophotometers and centrifuges.
CO2	A3	Execute separation techniques including chromatography and electrophoresis.
CO3	A4	Examine spectral data obtained from analytical techniques.
CO4	A4	Correlate experimental results with structural and functional properties of biomolecules.
CO5	E5	Assess the suitability and limitations of biophysical techniques in biomolecular analysis.

CO- PO and PSO Mapping Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	3	2	3	3	1	1	2	2	3	3	2	1	1	1
CO2	3	2	3	3	1	1	2	2	3	3	2	1	1	1
CO3	3	3	3	3	2	1	2	2	3	3	3	1	1	1
CO4	3	3	3	3	2	2	2	2	3	3	3	2	1	1
CO5	3	3	3	3	2	2	2	3	3	3	3	2	2	2
AVG	3	2.6	3	3	1.6	1.4	2.0	2.2	3	3	2.6	1.4	1.2	1.2

26SMBC16MM: Practical: Biophysical techniques (60 Hours)

S. No.	Name of the Experiment
	Perform any 12 experiments from the following –
1	Determination of void volume of gel filtration chromatography column.
2	Separation of two components in a sample by gel filtration chromatography.
3	Separation and detection of plant pigments by using TLC.
4	Separation and detection of plant pigments by using Paper Chromatography.
5	Protein concentration determination by UV-Vis Spectrophotometry.
6	Separation of DNA by paper or agarose gel electrophoresis.
7	Dilution/ separation of given biomolecules by using Dialysis.
8	Concentrate the given biomolecule sample using Reverse dialysis.
9	Thermal denaturation of proteins monitored by UV-Vis Spectrophotometer
10	Separation of amino acids by Ion Exchange chromatography.
11	Verification of Lambert's Beer's Law and determination of molar extinction coefficient
12	Absorption spectrum of Nucleic acid and determination of its λ_{max} .
13	Absorption spectra of different hemoglobin derivatives.
14	Quantitative estimation by using Spectrofluorimeter.
15	Measurement of Refractive Index.
16	Sub- Cellular fractionation by sedimentation.
17	RBC membrane fragility.
18	pH metry: Acid base titration curves. Measurement of pKa of amino acids.
19	Determination of relative viscosity, Specific viscosity and intrinsic viscosity.
20	Determination of capacity of an ion exchange column.
21	Demonstration experiment on HPLC
22	Demonstration experiment on Gas chromatography.

Reference:

1. An introduction to practical Biochemistry – David T. Plummer, Tata Mc Graw Hill Co. Ltd., Bombay. (2015) 3rd Edition

2. Introductory Practical Biochemistry (2001). Ed. S.K. Sawhney and Randhir Singh.
3. Practical Biochemistry by Sadasivam and Manickam.
4. Practical Biochemistry, Principles and Techniques (1995). Ed. Keith Wilson and John Walker (2006) 5th Edition
5. Practical Biochemistry by J. Jayaraman
6. Practical Biochemistry by Shinde and Rao
7. Any relevant reference/procedure may be used.



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Abeda Inamdar Senior College

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NAAC accredited 'A' Grade

Course/ Paper Title	Practical: Microbiology
Course Code	26SMBC17MM
Semester	I
No. of Credits	2 Credits, (60 L)

Aims & Objectives of the Course

Objectives

1. To study the growth and control of bacteria.
2. To prepare media and isolate and cultivate microbes from various sources.
3. To learn the microscopic characteristic features of microbes.
4. To isolate and quantify various groups of microorganisms.
5. To study morphological, physiological and biochemical characterization of isolated bacterial cultures.

Course Outcomes

CO No.	Cognitive Level	Course Outcome
CO1	A3	Carry out aseptic techniques and microbial culture methods.
CO2	A3	Perform staining techniques and microscopic examination of microorganisms.
CO3	A4	Differentiate microorganisms based on morphological and biochemical characteristics.
CO4	A4	Interpret results of microbial growth patterns and biochemical tests.
CO5	E5	Appraise the role of microorganisms in environmental and industrial contexts.

CO- PO and PSO Mapping Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	3	2	3	3	1	1	2	2	3	3	2	1	1	1
CO2	3	2	3	3	1	1	2	2	3	3	2	1	1	1
CO3	3	3	3	2	2	1	2	2	3	3	3	1	1	1
CO4	3	3	3	2	2	2	2	2	3	3	3	2	1	1
CO5	3	2	3	2	2	2	3	3	3	3	3	2	2	2
AVG	3	2.4	3	2.4	1.6	1.4	2.2	2.2	3	3	2.6	1.4	1.2	1.2

26SMBC17MM: Practical: Microbiology (60 Hours)

S. No.	Name of the Experiment
Perform any 12 experiments from the following-	
1	Microbial Growth: Measurement of microbial growth (Compulsory) a) Total count by direct microscopy (yeast) b) Counting viable cells: serial dilution and spread plates c) Turbidometry d) Determination of generation time.
2	Microbiological analysis of food products
3	Microbiological examination of spoiled foods – Bacteria / Fungi
4	Screening of antibiotic producing organisms from soil.
5	Influence of Environment on Microorganisms; Factors affecting growth– pH, temperature, nutrients & salts.
6	Microbiology of water: Detection of coliforms in water - MPN Technique.
7	Isolation of coliphage from sewage.
8	Replica plating technique.
9	Extraction of Nucleic acids
10	Separation of proteins by Thin Layer chromatography
11	Detection of amylase, caseinase, catalase activity
12	Total viable count determination by pour plate method
13	Total viable count determination by spread plate method.
14	Microbial assay of vitamins.
15	Microbial assay of antibiotics.

Reference:

1. Textbook of Practical Microbiology by Ahuja Subhash Chandra Parija.
2. Prescott M (2005) Microbiology. 6th Edition, Tata McGraw – Hill, New Delhi
3. Robert F Boyd (1984). General Microbiology.
4. Monica Cheesbrough (2003). District laboratory Practice in Tropical Countries.
5. Satya Narayana U (2005). Biotechnology. 1st Edition, Published by Books and Allied (P) Ltd.

6. Practical Biochemistry by Shinde and Rao.
7. Any other relevant reference/procedure can be included.



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NAAC accredited 'A' Grade

Course/ Paper Title	Genetics
Course Code	26SMBC18MEA
Semester	I
No. of Credits	2 Credits, (30 Hours)

Aims & Objectives of the Course

Objectives

1. To understand how traits are inherited from one generation to the next.
2. To understand how genes and chromosomes function.
3. To understand how genetic disorders develop and what role genetic testing and counseling play in identifying, preventing and treating these disorders.
4. To understand the basic principles of inheritance at the molecular and cellular levels.
5. To understand the relationship between our genetic inheritance and our traits and behaviors.

Course Outcomes

CO No.	Cognitive Level	Course Outcome
CO1	R1	Define fundamental concepts of genes, alleles, and patterns of inheritance.
CO2	U2	Explain Mendelian and non-Mendelian inheritance patterns.
CO3	A3	Apply genetic principles to solve problems related to inheritance and linkage.
CO4	A4	Analyze chromosomal aberrations and gene mutations.
CO5	E5	Evaluate the role of genetics in disease and modern genetic applications.

CO- PO and PSO Mapping Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	3	2	1	1	1	1	1	2	3	1	1	1	1	1
CO2	3	2	2	1	1	1	1	2	3	1	2	1	1	1
CO3	3	3	2	2	1	1	2	2	3	2	2	1	1	1
CO4	3	3	2	2	2	1	2	2	3	2	3	1	1	1
CO5	3	3	3	2	2	2	3	3	3	2	3	2	2	2
AVG	3	2.6	2.0	1.6	1.4	1.2	1.8	2.2	3	1.6	2.2	1.2	1.2	1.2

26SMBC18MEA: Genetics (30 Hours)

Sr. No.	Name of the Topic	Hours
1	Law of Segregation: Mendel's experiments and reasons for success, monohybrid cross, reciprocal cross, Law of dominance, test cross, back cross b) Law of Independent Assortment – dihybrid cross, test cross, back cross. c) Pedigree analysis – autosomal pedigree, sex-linked pedigree	06
2	Sex-linked Inheritance in Man: X-linked inheritance (colour blindness, haemophilia), Y-linked traits, XY-linked inheritance, sex- influenced traits, sex-limited traits. Dosage compensation	02
3	Early Evidence for Linkage and Genetic Recombination: Chromosome theory of inheritance, Morgan's experimental crosses of white eye and miniature wings, Bateson and Punnett experiment on linkage. Cytological proof of crossing over – Stern's experiment in Drosophila, Creighton and McClintock evidence of crossing over in maize, factors affecting crossing over, theories of crossing over, types of crossing over . Detecting linkage through test cross – linkage groups	06
4	Fine Structure of Gene: Concept of Gene, a) Beadle and Tatum's One Gene One Enzyme Concept – one gene- one polypeptide hypothesis. b) rII locus in T4 phage - Benzer's experiments, Oliver experiment on lozenge locus in drosophila, complementation test. c) Modern Concept of Gene – classical, neoclassical and modern concepts..	04
5	Prokaryotic and Eukaryotic Model Systems in Genetic Analysis of Bacteriophage and E. Coli: a) Structure and Life Cycle of Bacteriophage – T4 bacteriophage, morphology, composition, model genetic system, applications b) E. coli as Model Organism – genetic manipulation, applications c) E. coli Genome - features and resources d) Yeast: Life cycle - mitotic cell cycle, mating and sporulation, Importance – model organism in genetics, cell and molecular biology, applications. e) Genome - features and resources	12

References:

1. An Introduction to Genetic Analysis, 7th edition Anthony JF Griffiths, Jeffrey H Miller, David T Suzuki, Richard C Lewontin, and William M Gelbart. New York: W. H. Freeman; 2000. ISBN-10: 0-7167-3520-2.

2. Genetics: A Conceptual Approach by Benjamin A Pierce (W.H. Freeman & Co. Ltd 2014 ISBN 13: 9781464109461).
3. Introduction to Genetics: A Molecular Approach T A Brown Edition: 1st Garland Science Taylor & Francis Group ISBN: 9780815365099
4. Concepts of Genetics by William S. Klug, Michael R. Cummings, Charlotte A. Spencer 2005 Benjamin- Cummings Publishing Company ISBN 0131918338 (ISBN13: 9780131918337)
5. Genetic Analysis: An Integrated Approach by Mark Frederick Sanders, John L. Bowman 2014 edition ISBN: 0321948904/ ISBN-13: 9780321948908.
6. Drosophila: A Laboratory Hand book by Michael Ashburner Cold Spring Harbor Laboratory Press, U.S.; 2nd ed. edition ISBN-13: 978-1936113699.
7. Theory and Problems of Genetics (Schaum's Outline Series) by William Stansfield McGraw Hill Book Company.



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NAAC accredited 'A' Grade

Course/ Paper Title	Plant Biochemistry
Course Code	26SMBC18MEB
Semester	I
No. of Credits	2 Credits, (30 Hours)

Aims & Objectives of the Course

Objectives

1. To understand photosynthesis and carbon metabolism.
2. To learn the role of plant hormones in growth and development.
3. To master nitrogen metabolism and secondary metabolite pathways.
4. To explore metabolic engineering and analytical techniques.
5. To comprehend plant immunity and defense mechanisms.

Course Outcomes

CO No.	Cognitive Level	Course Outcome
CO1	R1	List major biochemical components and metabolic processes in plants.
CO2	U2	Explain photosynthesis and its biochemical pathways.
CO3	A3	Apply knowledge of plant metabolism to nutrient assimilation and biosynthesis.
CO4	A4	Analyze plant secondary metabolites and their biological significance.
CO5	E5	Evaluate the role of plant biochemistry in agriculture, medicine, and industry.

CO- PO and PSO Mapping Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	3	2	1	1	1	1	1	2	3	1	1	1	1	1
CO2	3	2	2	1	1	1	1	2	3	1	2	1	1	1
CO3	3	2	2	2	1	1	2	2	3	2	2	1	1	1
CO4	3	3	2	2	2	1	2	2	3	2	3	2	1	1
CO5	3	3	3	2	2	2	3	3	3	2	3	2	2	2
AVG	3	2.4	2.0	1.6	1.4	1.2	1.8	2.2	3	1.6	2.2	1.4	1.2	1.2

26SMBC18MEB: Plant Biochemistry (30 Hours)

Sr. No.	Name of the Topic	Hours
1	Photosynthesis and Carbon Assimilation: Hill reaction, Photosystem I and photosystem II, Photophosphorylation, Light harvesting complexes, Nonphotochemical quenching, Photosynthesis inhibitors, Carboxylation, Structure and kinetics of RUBISCO, CO ₂ concentrating mechanisms, Storage and utilization of fixed carbon.	05
2	Plant Hormones: Structure and function of plant hormones- auxin, cytokinin, ethylene, abscisic acid, florigin, gibberellins, brassinosteroids, jasmonates, salicylic acid, nitric oxide, Steroid and peptide hormones	05
3	Nitrogen Metabolism and Secondary Metabolites: Nitrogen cycle, nitrogen fixation, assimilation of nitrate and ammonium ions. Secondary metabolite classes, Biosynthetic pathways and Regulatory enzymes - Shikimic acid pathway, Phenylpropanoid pathway, Polyketide synthesis, Alkaloids and cyanogenic glycosides, Acetate-mevalonate pathway, Methyl-erythritol Phosphate pathway, Prenyl transfer. Antimicrobial peptides.	06
4	Metabolic Engineering: Metabolite profiling-analytical and preparative chromatography, Brief descriptions on metabolite structure elucidation by NMR (one-dimensional and two-dimensional methods), UV-vis and IR spectroscopy, GC-MS, LC-MS, Biotechnological approaches for secondary metabolite production- strategies to increase productivity, Cell, Organ culture and hairy root culture, Optimization of conditions, Precursors, Elicitors, Growth and production kinetics Page bioreactors	08
5	Innate Immune Responses in Plants: Mechanism of pathogenesis, effectors, gene-for-gene resistance, Pathogen recognition and signal transduction, Systemic and induced defense mechanisms, Non-host resistance to pathogens	06

References:

1. Plant Biochemistry - PM Dey and JB Harborne

2. Plant Biochemistry - Gleason FK
3. Introduction to Plant Biochemistry – Goodwin
4. Plant Physiology - Salisbry
5. Plant Biochemistry and Molecular Biology - PJ Lea and RG Heagood



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NAAC accredited 'A' Grade

Course/ Paper Title	Enzymology
Course Code	26SMBC19MEA
Semester	I
No. of Credits	2 Credits, (30 Hours)

Aims & Objectives of the Course

Objectives	
1.	To understand enzyme nomenclature, classification, and structure.
2.	To explore enzyme kinetics and reaction mechanisms.
3.	To examine mechanisms of enzyme action.
4.	To understand enzyme regulation and allosteric behavior.
5.	To study coenzymes and multienzyme systems.

Course Outcomes

CO No.	Cognitive Level	Course Outcome
CO1	R1	Define basic concepts of enzymes, classification, and nomenclature.
CO2	U2	Explain enzyme structure, function, and mechanism of action.
CO3	A3	Apply enzyme kinetics to determine reaction rates and parameters.
CO4	A4	Analyze factors affecting enzyme activity and inhibition mechanisms.
CO5	E5	Evaluate applications of enzymes in clinical, industrial, and research fields.

CO- PO and PSO Mapping Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	3	2	1	1	1	1	1	2	3	1	1	1	1	1
CO2	3	2	2	1	1	1	1	2	3	1	2	1	1	1
CO3	3	3	2	2	1	1	2	2	3	2	2	1	1	1
CO4	3	3	2	2	2	1	2	2	3	2	3	1	1	1
CO5	3	3	3	2	2	2	3	3	3	2	3	2	2	2
AVG	3	2.6	2.0	1.6	1.4	1.2	1.8	2.2	3	1.6	2.2	1.2	1.2	1.2

26SMBC19MEA: Enzymology (30 Hours)

Sr. No.	Name of the Topic	Hours
1	<p>Introduction to Enzymology: Nomenclature and classification of enzymes. Definitions with examples of holoenzyme, apoenzyme, coenzymes, prosthetic groups, cofactors, activators, inhibitors, active site, metalloenzymes, isozymes, monomeric enzymes, oligomeric enzymes and multienzyme complexes. Units of enzyme activity (definition of IU, Katal), specific activity of enzyme, enzyme turnover. Ribozymes and abzymes.</p>	05
2	<p>Kinetics of Enzyme Action: Concept of ES complex, active site, specificity, derivation of Michaelis-Menten equation for uni- substrate reactions. Different plots for the determination of K_m & V_{max} and their physiological significances. Importance of K_{cat}/K_m. Kinetics of zero & first 20 order reactions. Significance and evaluation of energy of activation. Collision & transition state theories. Classification of multi substrate reactions with examples of each class. Derivation of the rate of expression for Ping Pong, random and ordered Bi-Bi mechanisms. Use of initial velocity, inhibition and exchange studies to differentiate between multi substrate reaction mechanism. Reversible and irreversible inhibition. Competitive, non-competitive, uncompetitive, linear-mixed type inhibitions and their kinetics, determination of K_i and numerical based on these. Suicide inhibitors. Sigmoidal kinetics – significance of sigmoidal behaviour, Allosteric enzymes and their regulation. Study of ATCase as typical allosteric enzyme.</p>	10
3	<p>Mechanism of Enzyme Action: Acid-base catalysis, covalent catalysis, proximity, orientation effect. Strain and distortion theory. Chemical modification of active site groups. Site directed mutagenesis of enzymes. Mechanism of action of chymotrypsin, lysozyme, triose phosphate isomerase and alcohol dehydrogenase.</p>	05
4	<p>Enzyme Regulation: General mechanisms of enzyme regulation, product inhibition. Reversible (glutamine synthase & phosphorylase) and irreversible (proteases) covalent modifications of enzymes. Mono cyclic and multicyclic cascade systems with specific examples. Feed back inhibition and feed forward stimulation. Allosteric enzymes, qualitative description of ‘concerted’ & ‘sequential’ models for allosteric enzymes. Half site reactivity, Flipflop mechanism, positive and negative co-operativity with special reference to aspartate transcarbamoylase & phosphofructokinase. Protein-ligand binding measurement, analysis of binding isotherms, Hill and Scatchard plots.</p>	05
5	<p>Multienzyme System: Occurrence, isolation & their properties: Mechanism of action and regulation of pyruvate dehydrogenase & fatty acid synthase complexes. Enzyme-enzyme interaction, multiple forms of enzymes with</p>	05

special reference to lactate dehydrogenase. 5 hrs Coenzymes: Structure and biological functions of NAD, NADP, FAD, FMN, TPP, THF, biotin, Coenzyme Q, ascorbic acid, lipoic acid and PLP .	
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References:

1. Fundamentals of Enzymology: Cell and Molecular Biology of Catalytic Proteins (Paperback) by Nicholas C. Price and Lewis Stevens. Oxford University Press.
2. Advances in Enzymology: by Alton Meister. John Wiley and Sons Inc.
3. Lehninger Principles of Biochemistry 4th Ed by David L. Nelson and Michael M. Cox, WH Freeman and Company.
4. Principles of Biochemistry by Geoffrey Zubay. Publisher: McGraw Hill
5. Biochemistry: Biomolecules, Mechanisms of Enzyme Action and Metabolism Vol 1 (Hardcover) by D Voet. John Wiley and Sons.
6. Enzymatic Reaction Mechanisms by Perry A. Frey and Adrian D. Hegeman. Oxford University Press.
7. Comprehensive Enzyme Kinetics by Vladimir Leskovac. Publisher: Kluwer Academic / Plenum Publishers.
8. Enzyme Kinetics: A Modern Approach by Alejandro G. Marangoni. Publisher: Wiley Blackwell.
9. Enzyme Kinetics and Mechanisms by Kenneth B. Taylor. Kluwer Academic Publishers.
10. Enzymes: Biochemistry, Biotechnology and Clinical Chemistry by Trevor Palmer.



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NAAC accredited 'A' Grade

Course/ Paper Title	Nutrition Science
Course Code	26SMBC19MEB
Semester	I
No. of Credits	2 Credits, (30 Hours)

Aims & Objectives of the Course

Objectives

1. To study body composition, food value, and energy content.
2. To understand protein requirements, quality, and metabolism.
3. To explore dietary lipids and the role of minerals.
4. To understand carbohydrate types and energy metabolism.
5. To understand nutrient digestion, absorption, and related disorders.

Course Outcomes

CO No.	Cognitive Level	Course Outcome
CO1	R1	List major nutrients and their functions in human health.
CO2	U2	Explain digestion, absorption, and metabolism of nutrients.
CO3	A3	Apply nutritional principles to diet planning and balanced nutrition.
CO4	A4	Analyze nutritional deficiencies and their impact on health.
CO5	E5	Evaluate the role of nutrition in disease prevention and management.

CO- PO and PSO Mapping Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	3	2	1	1	1	1	2	2	3	1	1	1	2	1
CO2	3	2	2	1	1	1	2	2	3	1	2	1	2	1
CO3	3	3	2	2	1	1	2	2	3	2	2	2	2	1
CO4	3	3	2	2	2	2	3	2	3	2	3	2	3	1
CO5	3	3	3	2	2	2	3	3	3	2	3	2	3	2
AVG	3	2.6	2.0	1.6	1.4	1.4	2.4	2.2	3	1.6	2.2	1.6	2.4	1.2

26SMBC19MEB: Nutrition Science (30 Hours)

Sr. No.	Name of the Topic	Hours
1	Basic Concepts of Nutrition Science: Introduction to nutrition, Nutrients and Malnutrition, The Food Guide Pyramid, Guidelines for Good Health, Composition of Human body. Nutritional value of foods, Energy content and its measurement in foods. Thermogenic effect of foods, Energy requirement and measurement of energy requirement: Direct and Indirect calorimetry. Factors affecting requirements BMR, SDA and physical activity. BMR and relation of temperature regulation to basal metabolism.	08
2	Carbohydrates and Lipids: Dietary requirements and source of carbohydrates, Classification, Available and Unavailable. Physico-chemical properties and the physiological role. Dietary requirements and source of lipids, Nutritional classification of dietary lipids, sources and their physiological functions.	04
3	Food Proteins: Requirements and allowances. Proteins as building material, amino acid inter relationships. Protein quality and methods of determination. Factors affecting protein metabolism, Nitrogen balance studies and factors affecting it. Protein and amino acid requirement at different stages of development.	06
4	Nutrients and Minerals: Role of Nutrients like Carbohydrates, Proteins, Fats, Water, Dietary Fibre (DF), Vitamins. Mineral Elements, Non-nutrient Components of Foods and their Importance, Phytochemicals, Nutraceuticals. Minerals: Nutritional significance. Dietary Macro elements, Calcium, Phosphorus, Magnesium. Trace Elements, Iron, Iodine, Zinc, Copper etc.	06
5	Nutritional Diseases: Protein energy malnutrition, starvation, obesity, vitamin deficiency disorders and biochemical basis of causation and diagnosis of nutritional anaemias. Disorders of Gastrointestinal tract, Liver, Biliary tract and Pancreas and Heart, Diabetes.	06

References:

1. Nutrition and Dietetics, 4th Edition by Shubhangini A Joshi, McGraw Hill Education (India) Private Limited, New Delhi.
2. Biochemistry, 4th Edition by Dr. U. Satyanarayana and Dr. U. Chakrapani, Reed Elsevier India Private Limited and Books and Allied (P) Ltd., New Delhi.
3. Fundamentals of Foods and Nutrition and added Diet Therapy 5th edition by Dr. Sumati R. Mudambi and Dr. M.V. Rajagopal, New Age International Pvt. Ltd., New Delhi
4. Essentials of food and nutrition M Swaminathan Vol. II, Applied aspects (1974), Ganesh Pub, Madras
5. Human biochemistry – James Orten and Otto Neuhaus, 10th ed , CV Mosby co London
6. Human nutrition and dietetics-Davidson and Passmore
7. Nutrition science by B. Srilakshmi



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Course/ Paper Title	Research Methodology in Chemistry
Course Code	26SMBC11RM
Semester	I
No. of Credits	4 Credits, (60 Hours)

Aims & Objectives of the Course

Objectives

1. To demonstrate the ability to choose methods appropriate to research aims and objectives.
2. To understand some basic concepts of research and its methodologies.
3. To identify appropriate research topics.
4. To select and define appropriate research problem and parameters.
5. To prepare a project proposal (to undertake a project).
6. To organize and conduct research (advanced project) in a more appropriate manner.

Course Outcomes

CO No.	Cognitive Level	Course Outcome
CO1	R1	Define basic concepts of research, types, and scientific methods.
CO2	U2	Explain research design, data collection methods, and sampling techniques.
CO3	A3	Apply statistical tools and software for data analysis.
CO4	A4	Analyze research data and interpret results using appropriate methods.
CO5	E5	Evaluate research findings and prepare scientific reports and presentations.

CO- PO and PSO Mapping Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	3	2	1	1	1	2	1	2	3	1	1	1	1	2
CO2	3	2	2	2	1	2	1	2	3	2	2	1	1	2
CO3	3	3	3	3	1	2	2	2	3	3	3	2	1	2
CO4	3	3	3	2	2	2	2	2	3	3	3	2	1	2
CO5	3	3	3	2	3	3	2	3	3	3	3	2	2	3
AVG	3	2.6	2.4	2.0	1.6	2.2	1.6	2.2	3	2.4	2.4	1.6	1.2	2.2

26SMBC11RM: Research Methodology in Chemistry (60 Hours)

Sr. No.	Name of the Topic	Hours
1	Introduction to Research methodology: Objective of research, motivation in research, types of research, Fundamental research, applied research, experimental research, interdisciplinary research, scientific methods of research, criteria of good research, and characteristics of good research.	04
2	Scope of Research and Ethics: Steps in scientific research: Introduction and Scope, Research problem: Identification, Selection, developing research title, Criteria for prioritizing topics for research, Prioritizing Topics for Research, Formulation of research objectives Research design: Components, Types and importance Research ethics, Institutional ethics committee, Plagiarism, Patenting and intellectual property rights.	05
3	Processes in research proposal development: Components of research proposal- Components of research proposal: 1. Title page 2. Summary/Abstract 3. Introduction/background 4. Statement of the problem 5. Literature review 6. Hypotheses/questions 7. Conceptual framework 8. Objective/aim of the study 9. Research methods, material, and procedure 10. Work plan 11. Budget 12. References 13. Appendices/annexes.	08
4	Literature search technique: Using SCOPUS, Google Scholar, PUBMED, Web of Science, science direct, Indian Citation Index, ResearchGate, and scifinder. Overview of the journal article: Selection of journals, Data bases and research metrics Databases: 1. Indexing databases 2. Citation databases: Web of Science, Scopus, UGC-Care List etc. Research Metrics: 1. Impact Factor of journal as per Journal Citation Report, SNIP, SJR, IPP, Cite Score 2. Metrics: h-index, g index, i10 index etc.	06
5	Presentation of Scientific findings, Scientific Report Writing: Publication Process: Types of technical documents- Full length research paper, Short/Brief communications, Letters to editor, Book chapter, Review, Conference report, Patents, dissertation. Components of a research publication: Title/Topic statement, Abstract/keywords, Aims and objectives, Hypothesis building, Rationale of the	08

	paper, Work plan, Materials and methodology, Results and discussion, Key issues and arguments, Acknowledgement, Conflict of interest statement, bibliography, Technical Resumes & Cover Letters. Softwares in Chemistry Data plotting Structure Drawing, GrammarCheckers and Sentence Correction Tools.	
6	Scientometrics: How to cite and how to do referencing Styles of referencing: APA, MLA, Oxford, Harvard, Chicago Annotated bibliography; Tools for citing and referencing: Grammarly, Endnote etc., Reference Management Software like Zotero, Mendeley, reference manager and others; Software for paper formatting like LaTeX/MSOffice, software for detection of Plagiarism.	05
7	Data Analysis and interpretation: Chemometrics. Analysis of variance (ANOVA), Measures of central tendency and dispersion - mean, median, mode, range, standard deviation and variance. Correlation and regression, Curve fitting, fitting of linear equations, simple linear cases, weighted linear case, analysis of residuals, General polynomial fitting, linearizing transformations, exponential function fit, r and its abuse. Basic aspects of multiple linear regression analysis. Types of errors and level of significance. Tests of significance – F & t tests, chi-square tests.	06
8	Publications Ethics: Definition, nature of moral judgements and reactions, Ethics with respect to science and research. Intellectual honesty and research integrity. Scientific misconducts: Falsification, Fabrication, and Plagiarism (FFP). Redundant publications: duplicate and overlapping publications. Selective reporting and misrepresentation of data. Publication ethics: definition, introduction, and importance. Conflicts of interest Publication misconduct: definition, concept, problems that lead to unethical behavior and vice versa Violation of publication ethics, authorship and contributorship Identification of publication misconduct, complaints and appeals Predatory publishers and journals.	04
9	Presentation and Communication skills: Tables, Figures and Pictures using Excel, PowerPoint slide preparation, Preparation of Posters, Electronic submission of manuscripts, oral and poster, Communication skills.	04
10	Chemistry Laboratory Practices: Safety practices in Chemical research: Safety aspects in Chemistry Good laboratory practices. Handling of various chemicals, solvents & glassware. Fires and fighting with fires. Hazardous substances, classification, and handling Safety Data Sheet. Chemical entries, MSDS, CAS numbers, dead stocks maintenance. Working conditions and equipment: cleaning and washing of required glassware, calibration of equipment, set up chemical reactions, condition, optimization of conditions-temperature, solvent, catalysis; equipment SOP, maintenance and repairing, waste managements. Maintaining data and observations- importance of	10

	recording observations in research laboratory notebook, which includes clear descriptions of original data, observations and experimental procedures and workup protocols, group discussion, discussion with guides, weekly/monthly/six monthly presentation of research progress.	
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References:

1. Best and Kahn, Research Methodology, PHI Limited.
2. Kothari, C. K., Research Methodology-Methods and Techniques, 2nd Ed., New Age International, New Delhi.
3. Kumar, R., Research Methodology - A Step-By-Step Guide for Beginners, Pearson Education, Delhi (2006).
4. Fundamentals of modern statistical methods by Rand R. Wilcoxon.
5. Power Analysis for Experimental research A Practical Guide for the Biological, Medical and Social Sciences by R. Barker Bausell, Yi-Fang Li Cambridge University Press.
6. Design of Experiments: Statistical Principles of Research Design and Analysis, by Robert O. Kuehl Brooks/Cole.
7. Panneerselvam R., Research Methodology, Prentice Hall of India, New Delhi, 2004
8. Montgomery, D. C., Design & Analysis of Experiments, 5th Ed., Wiley India (2007).



M. C. E. Society's

Abeda Inamdar Senior College

Of Arts, Science and Commerce, Camp, Pune-1

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NAAC accredited 'A' Grade

SEMESTER – II

Course/ Paper Title	Molecular Biology
Course Code	26SMBC21MM
Semester	II
No. of Credits	2 Credits, (30 Hours)

Aims & Objectives of the Course

Objectives

1. To understand the concept of central dogma of molecular biology.
2. To learn the process of replication of DNA, transcription and translation process in prokaryotes and eukaryotes.
3. To inculcate the knowledge of proteins and enzymes involved in transcription and translation and replication of DNA in prokaryotes and eukaryotes.

Course Outcomes

CO No.	Cognitive Level	Course Outcome
CO1	R1	Define fundamental concepts of DNA, RNA, and gene organization.
CO2	U2	Explain DNA replication, transcription, and translation mechanisms.
CO3	A3	Apply principles of gene expression and regulation in prokaryotes and eukaryotes.
CO4	A4	Analyze molecular mechanisms of mutations, DNA repair, and recombination.
CO5	E5	Evaluate modern molecular biology techniques and their applications.

CO- PO and PSO Mapping Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	3	2	1	1	1	1	1	2	3	1	1	1	1	1
CO2	3	2	2	1	1	1	1	2	3	1	2	1	1	1
CO3	3	3	2	2	1	1	2	2	3	2	2	2	1	1
CO4	3	3	2	2	2	1	2	2	3	2	3	2	1	1
CO5	3	3	3	2	2	2	3	3	3	2	3	2	2	2
AVG	3	2.6	2.0	1.6	1.4	1.2	1.8	2.2	3	1.6	2.2	1.6	1.2	1.2

26SMBC21MM: Molecular Biology (30 Hours)

Sr. No.	Name of the Topic	Hours
1	Introduction to molecular biology: Overview on Central dogma of molecular biology	02
2	Replication of DNA: Features of DNA replication, Semiconservative model of DNA (Messelson and Stahl's experiment), Types of DNA polymerases in prokaryotes and eukaryotes, Structure of DNA polymerase III of prokaryotes, Process of prokaryotic DNA replication, Overview of eukaryotic DNA replication- Pre-replication complex, its formation and activation.	10
3	Transcription of DNA: Features of transcription, Types of RNA polymerases in prokaryotes and eukaryotes, Upstream elements and downstream elements, Strong and weak promoters, Process of prokaryotic transcription, Overview of eukaryotic transcription, Post transcriptional modifications: 5' capping, 3' polyadenylation, intron removal.	08
4	Translation: Features of genetic code, Wobble hypothesis, structure and functions of t-RNA (Cloverleaf model), m-RNA and ribosomes and its subunits, types of RNA, Process of Prokaryotic translation and overview of eukaryotic translation, Post translational modifications- Example - glycosylation	10

References:

1. Peter J Russell, iGenetics: A Molecular approach, Benjamin Cummings Publishers, 3rd edition.
2. James D Watson, Tania Baker, - Molecular Biology of gene, Pearson Education, 6th Edition, 2008.
3. Principles of Biochemistry – Lehninger, Nelson and Cox, 7th edition (2017)
4. Jocelyn E. Krebs, Elliott S. Goldstein, Stephen T. Kilpatrick, - Lewin's Genes X, Jones and Barlet Publishers, 10th edition, 2009.
5. Harvey Lodish, Arnold Berk, Chris A. Kaiser, Monty Krieger, Anthony Bretscher, - Molecular Cell Biology, W H Freeman & Co.



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Abeda Inamdar Senior College

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NAAC accredited 'A' Grade

Course/ Paper Title	Bioenergetics and Metabolism
Course Code	26SMBC22MM
Semester	II
No. of Credits	2 Credits, (30 Hours)

Aims & Objectives of the Course

Objectives

1. To study the basics of metabolism and bioenergetics.
2. To learn thermodynamics, free energy, and ATP's role in energy transfer.
3. To explore glycolysis, citric acid cycle, and alternative pathways.
4. To study fatty acid oxidation, ketone body formation, and lipid biosynthesis.
5. To understand amino acid degradation, biosynthesis, and nucleotide metabolism.

Course Outcomes

CO No.	Cognitive Level	Course Outcome
CO1	R1	Outline basic concepts of bioenergetics, thermodynamics, and energy transformations in biological systems.
CO2	U2	Explain metabolic pathways of carbohydrates, lipids, and proteins.
CO3	A3	Apply principles of energy metabolism to ATP generation and utilization.
CO4	A4	Analyze regulation of metabolic pathways and enzyme control mechanisms.
CO5	E5	Evaluate integration of metabolic pathways under physiological and pathological conditions.

CO- PO and PSO Mapping Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	3	2	1	1	1	1	1	2	3	1	1	1	1	1
CO2	3	2	2	1	1	1	1	2	3	1	2	1	1	1
CO3	3	3	2	2	1	1	2	2	3	2	2	1	1	1
CO4	3	3	2	2	2	1	2	2	3	2	3	1	1	1
CO5	3	3	3	2	2	2	3	3	3	2	3	2	2	2
AVG	3	2.6	2.0	1.6	1.4	1.2	1.8	2.2	3	1.6	2.2	1.2	1.2	1.2

26SMBC22MM: Bioenergetics and Metabolism (30 Hours)

Sr. No.	Name of the Topic	Hours
1	<p>Bioenergetics and Carbohydrate Metabolism</p> <p>Bioenergetics: Laws of thermodynamics in biological systems, internal energy, enthalpy, entropy, concept of free energy, standard free energy change of biochemical reactions, redox potentials, high-energy compounds with special reference to ATP—structure, energy transfer role, and biological significance.</p> <p>Carbohydrate metabolism: Glycolysis, tricarboxylic acid (TCA) cycle, pentose phosphate pathway, glyoxylate cycle, and glucuronic acid pathway.</p> <p>Metabolic pathways of carbohydrate storage and mobilization: glycogenesis, glycogenolysis, and gluconeogenesis. Overview of ATP synthesis and its integration with metabolic pathways.</p>	10
2	<p>Lipid Metabolism</p> <p>Overview of lipid metabolism and energy dynamics.</p> <p>Fatty acid metabolism: β-oxidation of saturated and unsaturated fatty acids.</p> <p>Fatty acid biosynthesis: pathway, regulation, and key control points of lipid metabolism.</p> <p>Ketone bodies: formation (ketogenesis), transport, utilization (ketolysis), and their physiological significance during fasting and starvation.</p>	10
3	<p>Amino Acid and Protein Metabolism</p> <p>Amino acid metabolism: transamination, deamination, and decarboxylation reactions with biochemical significance.</p> <p>Nitrogen metabolism: urea cycle and its role in ammonia detoxification.</p> <p>Biosynthesis of amino acids: glycine, serine, cysteine, methionine, threonine, aromatic amino acids, and histidine.</p> <p>Specialized biomolecules: peptides, polyamines, porphyrins, gamma-glutamyl cycle, glutathione biosynthesis, and non-ribosomal peptide biosynthesis.</p>	10

References:

- Biochemistry – Lehninger, 7th edition (2017)
- Metabolic Pathways – Greenberg, 3rd edition (1970).

3. Biochemistry – G. Zubay, Addison Wesley Publ. (1983).
4. Biochemistry – Stryer (2002) 5th Edition W.H. Freeman and Co.
5. Harper's Biochemistry- 30th edition, (2015)



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Abeda Inamdar Senior College

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NAAC accredited 'A' Grade

Course/ Paper Title	Clinical Biochemistry
Course Code	26SMBC23MM
Semester	II
No. of Credits	2 Credits, (30 Hours)

Aims & Objectives of the Course

Objectives

1. To understand the biochemical basis of metabolic disorders.
2. To identify and analyze clinical symptoms and diagnostic methods.
3. To explore therapeutic approaches and management strategies.

Course Outcomes

CO No.	Cognitive Level	Course Outcome
CO1	R1	Define basic concepts of clinical biochemistry and diagnostic parameters.
CO2	U2	Explain biochemical composition of blood and urine under normal and abnormal conditions.
CO3	A3	Apply biochemical principles for analysis of clinical parameters and diagnostic tests.
CO4	A4	Analyze organ function tests and metabolic disorders.
CO5	E5	Evaluate clinical significance of biochemical markers in disease diagnosis.

CO- PO and PSO Mapping Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	3	2	1	1	1	1	2	2	3	1	1	1	2	1
CO2	3	2	2	1	1	1	2	2	3	1	2	1	2	1
CO3	3	3	2	2	1	1	3	2	3	2	2	1	3	1
CO4	3	3	2	2	2	1	3	2	3	2	3	1	3	1
CO5	3	3	3	2	2	2	3	3	3	2	3	2	3	2
AVG	3	2.6	2.0	1.6	1.4	1.2	2.6	2.2	3	1.6	2.2	1.2	2.6	1.2

26SMBC23MM: Clinical Biochemistry (30 Hours)

Sr. No.	Name of the Topic	Hours
1	Body Fluids: Introduction, Collection, Preservation, composition and functions of Blood, Urine, Faeces, CSF and Amniotic Fluid.	04
2	Blood: Composition, Functions, Blood Group Systems and Their Clinical Significance: Composition, ABO and Rh blood group systems, Bombay blood group, applications of blood groups, Disorders of hemoglobin - Thalassemia and sickle cell anemia. Anemias - microcytic, normocytic and macrocytic.	06
3	Biological Materials: Methods of estimation, normal range in blood serum, plasma and Urine of Glucose, Proteins, Urea, Uric acid, Creatinine, Cholesterol, ketone bodies, serum bilirubin, haemoglobin, Na, K, Ca by flame photometry and inorganic phosphate by colorimetry. Numerical problems based on these methods.	08
4	Metabolic Disorders: Clinical Assessment of Blood and Urine Sugar Levels: Factors Affecting Blood Glucose, Glycosylated Hemoglobin, and Carbohydrate Tolerance Tests – Procedures and Interpretation. Biochemical Foundations of Diabetes, Glycogen Storage Diseases, and Carbohydrate Metabolic Disorders. Abnormalities in lipid metabolism and corresponding therapeutic strategies, with emphasis on ketone bodies, ketosis, fatty liver, and atherosclerosis. Protein energy malnutrition, starvation, obesity and biochemical basis of causation and diagnosis of nutritional anaemias.	08
5	Overview of organ function: Organ function tests: a) Liver function tests. b) Kidney function tests. c) Thyroid function tests. d) Pancreatic function tests. e) Gastric function tests.	04

References:

1. Practical clinical Biochemistry, Harold Varley (4th Edition), CBS publishers and Distributers. New Delhi -110002.
2. Basic Concepts in Clinical Biochemistry: A Practical Guide by Vijay Kumar and Kiran Dip Gill, Springer Nature Singapore Pvt Ltd. 2018.
3. Nelson, David L., Albert L. Lehninger, and Michael M. Cox. Lehninger principles of biochemistry. Macmillan, 2008.
4. Textbook of Biochemistry with clinical correlations. Thomas M. Devlin.
5. Bishop, Michael L., Edward P. Fody, and Larry E. Schoeff, eds. Clinical Chemistry: Principles, Techniques, and Correlations. Lippincott Williams & Wilkins, 2013.
6. Bahr, Manson, and D. R. Bell. "Manson's Tropical Diseases."The English Languages Book Society, Billiere, Tindall and Cassell, Ltd (1996).
7. Lawrence A.K. Amedeo J. P. and Steven C.K. Clinical Chemistry
8. Clinical Biochemistry 5th Edition (2013) Allan Gaw Michael Murphy Rajeev Srivastava Robert Cowan Denis O'Reilly
9. Sembulingam, K and Sembulingam, P 6th Edition (2010). Essentials of Medical Physiology, fifth edition. Jaypae Brothers (p) ltd, New Delhi.
10. Carl A. Burtis, Edward R. Ashwood and David E. Bruns (eds): Tietz Textbook of

Clinical Chemistry and Molecular Diagnosis (5th edition) Elsevier, St. Louis, USA, 2012,
2238 pp, 909 illustrations. ISBN: 978-1-4160-6164-9



M. C. E. Society's

Abeda Inamdar Senior College

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NAAC accredited 'A' Grade

Course/ Paper Title	Animal Tissue Culture
Course Code	26SMBC24MM
Semester	II
No. of Credits	2 Credits, (30 Hours)

Aims & Objectives of the Course

Objectives

1. To understand the fundamental concepts and techniques of animal cell culture.
2. To learn the different types of tissue cultures.
3. To study the applications of animal cell culture in biomedical research.

Course Outcomes

CO No.	Cognitive Level	Course Outcome
CO1	R1	Define basic concepts and types of animal cell and tissue culture.
CO2	U2	Explain composition of culture media and growth requirements of animal cells.
CO3	A3	Apply aseptic techniques for maintenance and propagation of animal cell cultures.
CO4	A4	Analyze cell growth, viability, and contamination in culture systems.
CO5	E5	Evaluate applications of animal tissue culture in research, medicine, and biotechnology.

CO- PO and PSO Mapping Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	3	2	1	1	1	1	1	2	3	1	1	1	1	1
CO2	3	2	2	1	1	1	1	2	3	1	2	1	1	1
CO3	3	3	3	3	1	1	2	2	3	3	2	1	1	1
CO4	3	3	3	2	2	1	2	2	3	3	3	1	1	1
CO5	3	3	3	2	2	2	3	3	3	3	3	2	2	2
AVG	3	2.6	2.4	1.8	1.4	1.2	1.8	2.2	3	2.2	2.2	1.2	1.2	1.2

26SMBC24MM: Animal Tissue Culture (30 Hours)

Sr. No.	Name of the Topic	Hours
1	Introduction to Animal Cell Culture Laboratory: Definition, applications and limitations of tissue culture. Requirement of the tissue culture laboratory: different areas requirement, equipments. Aseptic Techniques, Sterilization of materials to be used for cell culture: Liquid reagents, media, serum.	05
2	Media Requirements: Properties and special requirements of tissue culture media, requirement of serum, antibiotics, growth factors, conditioned medium, serum free media, commonly used cell lines and media used.	05
3	Types of Tissue Culture: Organ culture, Primary Explant Culture, Cell Cultures: primary culture (adherent cell and suspension cells) and secondary cell culture, contact inhibition. Transformation, differentiation and dedifferentiation. Cell lines: concept, properties and maintenance. Types of microbial contaminants. Cryopreservation and thawing of cells	10
4	Applications of Cell Culture: In vitro testing of drugs, production of pharmaceutical proteins and vaccines.	05
5	Transgenic Animals: Introduction about transgenic animals, Gene transfer strategies – chemical and physical methods, production of recombinant proteins (eg. Insulin, hormone, antibodies, clotting factors etc) and other applications, Knockout mice, Knock in Mice	05

References:

1. Gene cloning- An introduction, T.A Brown, 2nd and 3rd ed, Chapman &Hall.
2. Recombinant DNA- genes and genomes a short course J. D. Watson, R. M. Myers, A. M. Caudy, J. A. Witkowski, W. H. Freeman &Co. 2007
3. Principles of Gene manipulation, SB Primrose (6th edition).
4. Principles and Techniques of Biochemistry and Molecular Biology, K Wilson and J Walker, 7th edition.



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Abeda Inamdar Senior College

Of Arts, Science and Commerce, Camp, Pune-1

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NAAC accredited 'A' Grade

Course/ Paper Title	Practical: Analytical Biochemistry – II
Course Code	26SMBC25MM
Semester	II
No. of Credits	2 Credits, (60 Hours)

Aims & Objectives of the Course

Objectives

1. To understand isolation and characterization techniques for biomolecules.
2. To learn methods for estimating vitamins, nucleic acids, and sugars.
3. To acquire skills to analyze fats and chemical properties.
4. To detect and analyze phytochemicals in plants.
5. To apply biochemical methods in research and industry.

Course Outcomes

CO No.	Cognitive Level	Course Outcome
CO1	A3	Perform quantitative estimation of biomolecules in biological samples.
CO2	A3	Execute biochemical assays for analysis of enzymes and metabolites.
CO3	A4	Analyze experimental data obtained from biochemical investigations.
CO4	A4	Interpret biochemical parameters in relation to physiological conditions.
CO5	E5	Assess accuracy and reliability of biochemical experimental results.

CO- PO and PSO Mapping Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	3	2	3	3	1	1	2	2	3	3	2	1	1	1
CO2	3	2	3	3	1	1	2	2	3	3	2	1	1	1
CO3	3	3	3	2	2	1	2	2	3	3	3	1	1	1
CO4	3	3	3	2	2	2	3	2	3	3	3	2	2	1
CO5	3	3	3	2	2	2	3	3	3	3	3	2	2	2
AVG	3	2.6	3	2.4	1.6	1.4	2.4	2.2	3	3	2.6	1.4	1.4	1.2

26SMBC25MM: Practical: Analytical Biochemistry – II (60 Hours)

S. No.	Name of the Experiment
	Perform any 12 Experiments from the following -
1	Isolation of Starch and characterization.
3	Detection of phytochemicals from plants.
4	Estimation of DNA/RNA by DPA method.
5	Estimation of sugar by PSA method.
6	Specific reactions for Carbohydrate.
7	Volumetric estimation of sugar.
8	Estimation of sugar by Anthrone method.
9	Separation of compounds using column chromatography.
10	Estimation of inorganic phosphorus by phosphomolybdate/colorimetric method.
11	Estimation of cholesterol.
12	Electrophoresis of serum proteins(demonstration)
13	Estimation of carbohydrates using colorimetric methods.
14	Estimation of Urea from biological samples by colorimetic method.
15	Estimation of Creatinine by biological samples by colorimetic method.
16	Uric acid estimation of biological samples by colorimetic method.
17	Estimation of total proteins from biological samples by colorimetic method.
18	Determination of HMF content from Honey sample.
20	Determination of Salivary amylase activity
21	Determination of enzymatic hydrolysis of starch

References:

1. Practical Biochemistry: Principles and techniques: K. Wilson and J. Walker. (2006).
2. Practical Biochemistry by David Plummer (2015) 3 rd Edition.
3. Introductory Practical Biochemistry by S.K. Sawhney and R.Singh.
4. Practical Biochemistry by J. Jayaraman.
5. Biochemical methods by S. Sadasivam and A. Manickam (2010) New Age International. New Delhi.



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NAAC accredited 'A' Grade

Course/ Paper Title	Practical: Clinical Biochemistry
Course Code	26SMBC26MM
Semester	II
No. of Credits	2 Credits, (60 Hours)

Aims & Objectives of the Course

Objectives

1. To master methods for testing biomolecules.
2. To understand tests for metabolic markers.
3. To analyze blood and urine samples.
4. To measure enzyme activities.
5. To apply methods for clinical diagnosis.

Course Outcomes

CO No.	Cognitive Level	Course Outcome
CO1	A3	Perform clinical biochemical tests for analysis of blood and urine samples.
CO2	A3	Conduct estimation of biochemical parameters such as glucose, urea, cholesterol, and enzymes.
CO3	A4	Analyze clinical data obtained from laboratory investigations.
CO4	A4	Interpret biochemical findings in relation to normal and pathological conditions.
CO5	E5	Judge the diagnostic significance and reliability of clinical test results.

CO- PO and PSO Mapping Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	3	2	3	3	1	1	3	2	3	3	2	1	3	1
CO2	3	2	3	3	1	1	3	2	3	3	2	1	3	1
CO3	3	3	3	2	2	1	3	2	3	3	3	1	3	1
CO4	3	3	3	2	2	2	3	2	3	3	3	2	3	1
CO5	3	3	3	2	2	2	3	3	3	3	3	2	3	2
AVG	3	2.6	3	2.4	1.6	1.4	3	2.2	3	3	2.6	1.4	3	1.2

26SMBC26MM: Practical: Clinical Biochemistry (60 Hours)

S. No.	Name of the Experiment
	Perform any 12 Experiments
1	One or more visit to medical / pathological laboratory should be organized where routine biochemical analysis of urine and blood is performed so that students will get familiar with urea and blood collection method, their proper preservation and storage. Students will also observe some of the tests such as determination blood hemoglobin, or other such test which cannot be performed in college laboratory. Student should prepare systematic report of visit as well as on blood and urea collection method, their proper preservation and storage.
2	Glucose tolerance test
3	Estimation of bilirubin
4	Estimation of creatine phosphokinase
5	Analysis of Normal and abnormal constituents of urine
6	Determination of blood cholesterol by kit method
7	Estimation of glycosylated hemoglobin
8	Estimation of LDH
9	Estimation of alkaline and acid phosphatase from serum
10	Estimation of total protein from serum
11	Determination of SGPT and SGOT
12	Estimation of serum amylase
13	Estimation of blood uric acid by kit method
14	Estimation of blood glucose by kit method
15	Estimation of inorganic phosphorus by Kit method.
16	Estimation of blood urea by kit method
17	Serum Calcium Estimation by Permanganate Titration

References:

1. Practical Organic Chemistry A. I. Vogel (Longmans).
2. Text Book of practical organic Chemistry F. G. Mann & B.C. Sanders.
3. Comprehensive Practical Organic Chemistry by V.K. Ahluwalia and Renu Agarwal.



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NAAC accredited 'A' Grade

Course/ Paper Title	Practical: Computational Biology
Course Code	26SMBC27MM
Semester	II
No. of Credits	2 Credits, (60 Hours)

Aims & Objectives of the Course

Objectives

1. Enable students to draw, edit, and visualize chemical structures and reactions of drugs using ChemDraw and ChemSketch.
2. Introduce the concepts of drug-likeness, physicochemical properties, ADMET, and target prediction in modern drug discovery.
3. Familiarize students with widely used online in silico tools such as SwissADME, pKCSM, ADMETlab, and ADMET SAR.
4. Develop skills in interpreting BOILED-Egg plots and Bioavailability Radar for assessing oral bioavailability and brain penetration.
5. Train students to analyze and compare ADMET profiles of different therapeutic classes of drugs.
6. Equip students with the ability to perform basic biostatistical and pharmacological calculations relevant to drug evaluation.

Course Outcomes

CO No.	Cognitive Level	Course Outcome
CO1	A3	Construct chemical structures and reactions using computational tools such as ChemDraw/ChemSketch.
CO2	A3	Apply in silico tools to evaluate drug likeness, physicochemical properties, and ADMET parameters.
CO3	A4	Analyze drug targets and pharmacokinetic properties using online bioinformatics platforms.
CO4	A4	Interpret graphical outputs such as BOILED-Egg and Bioavailability Radar for drug evaluation.
CO5	A4	Examine statistical data using tests such as t-test, z-test, F-test, and Chi-square.

CO- PO and PSO Mapping Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	3	2	2	3	2	1	1	2	3	3	2	2	1	2
CO2	3	2	3	3	2	1	2	2	3	3	2	2	1	3
CO3	3	3	3	3	2	1	2	2	3	3	3	2	1	3
CO4	3	3	3	3	2	1	2	2	3	3	3	2	1	3
CO5	3	3	3	3	2	1	2	2	3	3	3	2	1	3
CO6	3	3	3	3	2	2	3	3	3	3	3	2	2	3

26SMBC27MM: Practical: Computational Biology (60 Hours)

S. No.	Name of the Experiment
	Perform any 12 Experiments from the following
1	To use ChemDraw/ChemSketch to create structures and reactions for the drugs.
2	Overview of Drug likeness, Physicochemical parameters, ADMET and target prediction.
3	Overview of different online tools used for <i>in silico</i> evaluations like Drug likeness, Physicochemical parameters, ADMET and target prediction. (SwissADME, pKCSM, ADMET lab 3.0, ADMET SAR etc.)
4	<i>In silico</i> prediction of the drug target, Drug likeness and Physicochemical parameters of following classes of drugs – (Any THREE) i) Antibiotic (Chloramphenicol and Gentamicin) ii) Anti-fungal (Miconazole and Tolnaftate) iii) Anti-viral (Acyclovir and Indinavir) iv) Anti-protozoal (Metronidazole and Tinidazole) v) Antimalarial (Chloroquine and Ciprofloxacin) vi) Anti-tubercular (Isoniazid and Ethambutol) vii) Sulfonamides (Sulfamethoxazole and Sulfacetamide)
5	To obtain the BOILED-Egg presentation and the Bioavailability Radar of following classes of drugs using online tools – (Any THREE) i) Anti-fungal (Ketoconazole, Itraconazole and Clotrimazole) ii) Anti-viral (Oseltamivir, Amantadine and Remdesivir) iii) Anti-protozoal (Benznidazole, Nitazoxanide and Metronidazole) iv) Anti-tubercular (Isoniazid, Para amino salicylic acid and Ethambutol) v) Sulfonamides (Sulfanilamide, Sulfadiazine and Sulfacetamide)
6	<i>In silico</i> prediction of ADMET properties of the following classes of drugs – (Any THREE) i) Antipyretics (Paracetamol and Ibuprofen) ii) Analgesics (Acetaminophen and Diclofenac) iii) Anti-inflammatory (Celecoxib and Naproxen) iv) Antihistamines (Cetirizine and Diphenhydramine) v) Antihypertensive (Captopril and Furosemide)

	vi) Anti-diabetic (Glimepiride and Glipizide) vii) Antidepressants (Fluoxetine and Sertraline)
7	Calculation of T, Z, F and Chi-square Test for a given set of data.
8	To calculate different pharmacological metrics like IC ₅₀ , MIC, GI ₅₀ , Selective index (SI) for a given set of data.

References:

1. Bioinformatics concepts, skills and applications- S.C.Rastogi, N,Mendirattar and Y. Rastogi, CBS Publishers, New Delhi.
2. Bioinformatics- Westhead, Parish and Twynan, Bio Scientific Publishers, Oxford.
3. Introduction to bioinformatics: A theoretical and practical approaches - S.A. Krawetz, D. D. Womble, Human Press.
4. Bioinformatics: sequence and genome analysis- D. W. Mount, CSH lab press.
5. Internet for the molecular biologist- S. R. Swindell, R. R. Miller, G. S. A. Meyers, Horizon Scientific Press.
6. Any relevant reference/procedure may be used.



M. C. E. Society's

Abeda Inamdar Senior College

Of Arts, Science and Commerce, Camp, Pune-1

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NAAC accredited 'A' Grade

Course/ Paper Title	Biostatistics
Course Code	26SMBC28MEA
Semester	II
No. of Credits	2 Credits, (30 Hours)

Aims & Objectives of the Course

Objectives
1. To enhance students' understanding of fundamental concepts in Biostatistics.
2. To acquaint students with the principles of significance testing.
3. To inculcate an understanding of hypothesis testing using both parametric and non-parametric methods.

Course Outcomes

CO No.	Cognitive Level	Course Outcome
CO1	R1	Define basic statistical terms and concepts used in biological data analysis.
CO2	U2	Explain measures of central tendency, dispersion, and probability distributions.
CO3	A3	Apply statistical methods for analysis of experimental data.
CO4	A4	Analyze data using hypothesis testing and correlation techniques.
CO5	E5	Evaluate statistical results for interpretation in biological research.

CO- PO and PSO Mapping Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	3	2	1	2	1	1	1	2	3	1	1	2	1	2
CO2	3	2	2	2	1	1	1	2	3	1	2	2	1	2
CO3	3	3	2	3	1	1	2	2	3	2	2	3	1	3
CO4	3	3	3	3	2	1	2	2	3	2	3	3	1	3
CO5	3	3	3	3	2	2	2	3	3	2	3	2	2	3
AVG	3	2.6	2.2	2.6	1.4	1.2	1.6	2.2	3	1.6	2.2	2.4	1.2	2.6

26SMBC28MEA: Biostatistics (30 Hours)

Sr. No.	Name of the Topic	Hours
1	Descriptive Statistics: Fundamental concepts – Sample Statistics and Population, parameter, sampling methods and sampling errors, data (qualitative and quantitative data, discrete and continuous series data), data sources, variables. Measures of central tendency – Mean, Mode, median. Measures of dispersion – Mean deviation, Standard deviation and Variance. Simple linear Regression and correlation (significance testing not necessary)	15
2	Inferential Statistics: The concepts of null hypothesis, alternate hypothesis, Test statistics, P-value significance level, type I and type II errors, one tailed and two tailed tests, degrees of freedom. Parametric statistical test: Z-test, t-test and F-test. Test of Significance: Chi square test (Goodness of fit and Independence). Comparison of 3 or more samples – ANOVA One way and two way. Nonparametric Tests:, Sign test, Wilcoxon's signed rank test and Mann-Whitney U Test.	15

References:

1. Irfan Ali Khan and AtiyaKhanum, Fundamentals of Biostatistics. 3rd Ed. Ukaaz, Publications, Hyderabad
2. Norman T.J.Bailey Statistical methods in biology, 3rd Ed. Cambridge University Press
3. Goon,Gupta and Dasgupta Fundamentals of statistics, World Press, Kolkata. Lindgren B.W. Statistical Theory, Macmillan Publishing Co. Inc.
4. Wayne Daniel (2007) 4. Montgomery D.C. Design and analysis of experiments, John Wiley & Sons
5. Stephen Newman, Biostatistical methods in Epidemiology. Wiley Interscience Publication
6. Aviva Petrie and Carolene Sabin, 2005, Medical Statistics at a glance, 2nd Edition, Blackwell
7. Haefner James W. (1996) Modeling Biological Systems: Principles and Applications, Kluwer Academic Publications
8. David Brown & Peter Rothery. Models in biology: Mathematics, statistics, and computing John Wiley & Sons, USA
9. Practical Fermentation Technology Edited by Brian McNeil and Linda M. Harvey 2008 John Wiley & Sons, Ltd. ISBN:978-0-470-01434-9
10. Bioprocess Engineering Principles by Pauline M. Doran (1995), Elsevier Science & Technology Books, ISBN:0122208552



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Abeda Inamdar Senior College

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NAAC accredited 'A' Grade

Course/ Paper Title	Applied Biology
Course Code	26SMBC28MEB
Semester	II
No. of Credits	2 Credits, (30 Hours)

Aims & Objectives of the Course

Objectives
1. To understand the mechanisms of transcription and gene regulation in eukaryotes
2. To explore rna processing and post-transcriptional regulation
3. To investigate translation mechanisms and protein regulation.
4. To master experimental techniques for gene expression analysis.

Course Outcomes

CO No.	Cognitive Level	Course Outcome
CO1	R1	Outline fundamental concepts and scope of applied biology.
CO2	U2	Explain applications of biological principles in agriculture, medicine, and industry.
CO3	A3	Apply biological knowledge to solve practical problems in applied fields.
CO4	A4	Analyze biological processes involved in environmental and industrial applications.
CO5	E5	Evaluate the impact of applied biology on society and sustainable development.

CO- PO and PSO Mapping Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	3	2	1	1	1	1	2	2	3	1	1	2	1	1
CO2	3	2	2	1	1	1	3	2	3	1	2	2	2	1
CO3	3	3	2	2	1	1	3	2	3	2	2	2	2	1
CO4	3	3	2	2	2	1	3	2	3	2	3	2	2	1
CO5	3	3	3	2	2	2	3	3	3	2	3	2	2	2
AVG	3	2.6	2.0	1.6	1.4	1.2	2.8	2.2	3	1.6	2.2	2.0	1.8	1.2

26SMBC28MEB: Applied Biology (30 Hours)

Sr. No.	Name of the Topic	Hours
1	Transcription in Eukaryotes: RNA Polymerases, Promoters, Enhancers and Silencers, Transcription Factors, Mediator Complex, Activators, Interaction among Activators, Chromatin remodeling; Regulation of Transcription and Epigenetic regulation. RNA Processing: Splicing, Capping and Polyadenylation, Post-Transcriptional Control of Gene Expression, RNA Editing, mRNA Stability, siRNA, miRNA, Translation Repression, mRNA Degradation Translation in Eukaryotes: Ribosomes, Initiation, elongation and termination. Translational regulation, Post-translational modifications and mechanisms of protein degradation .	15
2	Overview of Regulation of Viral Gene Expression (both plant and animal) in connection to host-pathogen interaction: Methods to study gene expression: Mapping and Quantifying Transcripts (Northern Blots, Primer Extension, Run-Off Transcription, Cassette Transcription), Measuring Transcription Rates in vivo (Nuclear Run-On, Reporter Gene Transcription, Measuring Protein Accumulation in Vivo), Assaying DNA–Protein Interactions (Filter Binding, Gel Mobility Shift, DNase Footprinting, Chromatin Immunoprecipitation), Assaying Protein–Protein Interactions.	15

References:

1. Krebs, J. E., Goldstein, E. S. and Kilpatrick, S. T. (2018) Lewin's GENES XII. Jones and Bartlett Learning
2. Watson, J. D. et al. (2017) Molecular Biology of Gene. 7th edition. Pearson.
3. Weaver, R. (2011) Molecular Biology. 5th edition. McGraw-Hill Education.



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Abeda Inamdar Senior College

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NAAC accredited 'A' Grade

Course/ Paper Title	Fermentation Technology
Course Code	26SMBC29MEA
Semester	II
No. of Credits	2 Credits, (30 Hours)

Aims & Objectives of the Course

Objectives

1. To understand sterilization and disinfection techniques.
2. To explore fermentation science and applications.
3. To learn about industrial microbial practices.
4. To study biotechnological production of metabolites and biopharmaceuticals.

Course Outcomes

CO No.	Cognitive Level	Course Outcome
CO1	R1	Outline principles and types of fermentation processes.
CO2	U2	Explain design and operation of fermenters and bioreactors.
CO3	A3	Apply fermentation techniques for production of industrially important products.
CO4	A4	Analyze factors affecting fermentation and product yield.
CO5	E5	Evaluate applications of fermentation technology in industrial and biotechnological sectors.

CO- PO and PSO Mapping Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	3	2	1	1	1	1	2	2	3	1	1	2	1	1
CO2	3	2	2	2	1	1	2	2	3	2	2	2	1	1
CO3	3	3	3	3	1	1	3	2	3	3	2	2	2	1
CO4	3	3	3	2	2	1	3	2	3	3	3	2	2	1
CO5	3	3	3	2	2	2	3	3	3	3	3	2	2	2
AVG	3	2.6	2.4	2.0	1.4	1.2	2.6	2.2	3	2.4	2.2	2.0	1.6	1.2

26SMBC29MEA: Fermentation Technology (30 Hours)

Sr. No.	Name of the Topic	Hours
1	Sterilization and Disinfection – principle, methods and mechanism of action – Physical Agents – Incineration, dry heat, moist heat, filtration, Radiation – (UV and ionising). Chemical agents – disinfectants – phenol, aldehydes, halogens, hypochlorites. Testing of disinfectants phenol coefficient test, Rideal Walker test. Plasma sterilization, Principles, functioning and types of Biosafety cabinets. Sterilization process in fermentation industry. Air and media sterilization. Strategies for bulk sterilization of fermentation media, in situ steam injection and steam sterilization. Strategies of sugar sterilization and avoidance of undesired products. Initial bioburden and precautionary steps. Fermentor sterilization. Batch sterilization, Continuous sterilization. Membrane filtration and Deep bed filtration. Maintenance of filter cartridges. Sterilization for decontamination of solid waste materials. Biosafety contained work areas.	15
2	Fermentation as Co-evolutionary Force: Fermentation Science. Chronology of fermentation process. Fermented traditional foods: Microorganisms and enzymes as key tools of fermentation. Isolation, preservation and improvement of industrially important microorganisms, Media for industrial fermentations – media formulation, Development of inoculum for industrial use. Inoculum preservation and storage. Cell banks: Working cell bank and Master cell bank. Broad array of metabolic pathways employed for the production of primary and secondary metabolites, as well as biopharmaceuticals. Fermented foods: nutrition and human health	15

References:

1. Krebs, J. E., Goldstein, E. S. and Kilpatrick, S. T. (2018) Lewin's GENES XII. Jones and Bartlett Learning
2. Watson, J. D. et al. (2017) Molecular Biology of Gene. 7th edition. Pearson.
3. Weaver, R. (2011) Molecular Biology. 5th edition. McGraw-Hill Education.



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Abeda Inamdar Senior College

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NAAC accredited 'A' Grade

Course/ Paper Title	Bioremediation
Course Code	26SMBC29MEB
Semester	II
No. of Credits	2 Credits, (30 Hours)

Aims & Objectives of the Course

Objectives

1. To understand the concept and types of bioremediation.
2. To recognize the importance of bioremediation in environmental cleanup.
3. To acquire the knowledge of mycoremediation and it's applications in reducing environmental pollutants.

Course Outcomes

CO No.	Cognitive Level	Course Outcome
CO1	R1	Outline basic concepts and types of bioremediation processes.
CO2	U2	Explain microbial mechanisms involved in degradation of pollutants.
CO3	A3	Apply bioremediation techniques for treatment of contaminated environments.
CO4	A4	Analyze factors influencing biodegradation and pollutant removal.
CO5	E5	Evaluate effectiveness of bioremediation strategies for environmental management.

CO- PO and PSO Mapping Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	3	2	1	1	1	1	3	2	3	1	1	2	1	1
CO2	3	2	2	1	1	1	3	2	3	1	2	2	1	1
CO3	3	3	3	2	1	1	3	2	3	2	2	2	1	1
CO4	3	3	3	2	2	1	3	2	3	2	3	2	1	1
CO5	3	3	3	2	2	2	3	3	3	2	3	2	2	2
AVG	3	2.6	2.4	1.6	1.4	1.2	3	2.2	3	1.6	2.2	2.0	1.2	1.2

26SMBC29MEB: Bioremediation (30 Hours)

Sr. No.	Name of the Topic	Hours
1	Introduction: Bioremediation its principle and applications in environmental cleanup. Biological factors, oxygen, and moisture content of soil, availability of nutrients, pH, and temperature.	04
2	Concept of Biostimulation and Bioaugmentation: Microorganisms involved in bioremediation of organic pollutants, overview of mechanism of bacterial bioremediation.	08
3	Types of Bioremediation: In-situ and Ex-situ methods of bioremediation, In-situ bioremediation- Bioventing, biosparging methods, Ex-situ bioremediation- Land farming, composting, biopile process	08
4	Recent Advancements and Challenges in Bioremediation: Advantages and disadvantages of bioremediation.	02
5	Mycoremediation: Introduction, Role of fungi in cleanup of environmental pollutants and applications. Fungi involved in mycoremediation, overview of mechanisms of fungal mycoremediation.	08

References:

1. Pollution and Bioremediation- P. C. Trivedi
2. Introduction to Environmental Biotechnology; by AK Chatterji (2002); Prantice-Hall of India.
3. Jogdand, SN 1995. Environmental Biotechnology.Himalaya Publishing House, Mumbai.
4. Crawford, RL and DLCrawford. 1996. Bioremediation - Principles and Applications. Cambridge University Press, London.



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Abeda Inamdar Senior College

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NAAC accredited 'A' Grade

Course/ Paper Title	Field Work / On Job training (OJT)
Course Code	26SMBC12FP
Semester	II
No. of Credits	4 Credits, (120 Hours)

Aims & Objectives of the Course

Objectives

1. To provide hands-on training in laboratory, research, or industrial environments for practical understanding of biochemistry.
2. To apply theoretical knowledge to real-life biochemical problems and develop technical skills.
3. To enhance problem-solving ability, scientific attitude, and professional ethics.
4. To develop skills in data analysis, scientific reporting, and effective communication.

Course Outcomes

CO No.	Cognitive Level	Course Outcome
CO1	A3	Carry out assigned tasks in laboratory/industry settings using standard procedures.
CO2	A3	Demonstrate practical skills and professional competencies in real work environments.
CO3	A4	Analyze problems encountered during fieldwork and propose suitable solutions.
CO4	A4	Integrate theoretical knowledge with practical applications in biochemistry.
CO5	E5	Evaluate outcomes of project work and present findings in a scientific manner.

CO- PO and PSO Mapping Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	3	2	3	3	2	2	3	2	3	3	2	2	2	2
CO2	3	2	3	3	2	2	3	2	3	3	2	2	2	2
CO3	3	3	3	3	2	2	3	2	3	3	3	2	2	3
CO4	3	3	3	3	2	2	3	2	3	3	3	3	2	3
CO5	3	3	3	3	2	3	3	3	3	3	3	3	3	3
AVG	3	2.6	3	3	2.0	2.2	3	2.2	3	3	2.6	2.4	2.2	2.6

The students, as a part of their course, will be given opportunities to enroll for Field Project(s) or on job training. The student must undergo field work project which related to chemistry. The students must undergo industrial on job training/internship in the 2nd semester in any of the reputed industry, Government-sponsored Research & Development Organization, and reputed academic institution/foreign universities.

In a fieldwork report or On Job training, it is important to include relevant information and observations in following format.

- Introduction:
- Methodology:
- Fieldwork Activities:
- Data Collection:
- Findings, data analysis and Results:
- Discussion:
- Recommendations:
- Conclusion:
- References:
- Supplementary material

In a report on job training, it is important to provide a comprehensive overview of the training program and highlight key learnings and outcomes. Some points to consider when creating a report on job training:

- Introduction:
- Training Program Overview:
- Learning Objectives:
- Training Activities:
- Skills and Knowledge Acquired:
- Challenges and Solutions:
- Feedback and Evaluation:
- Impact and Benefits:

- Recommendations:
- Conclusion:
- Summarize the key findings and outcomes of the training program.

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