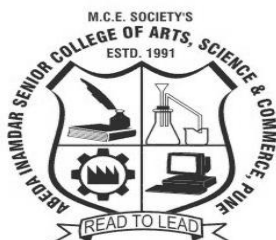


**M.C.E. SOCIETY'S**  
**ABEDA INAMDAR SENIOR COLLEGE OF ARTS, SCIENCE, AND**  
**COMMERCE (AUTONOMOUS), PUNE – 411 001**  
**POST GRADUATE DEPARTMENT OF CHEMISTRY AND RESEARCH CENTER**



***Syllabus for***  
***M. Sc. Part – I (Biochemistry)***  
***As per NEP-2020***  
***From Academic Year 2025-2026***

**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. 2025-26]

### 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
<b>Total</b>	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
<b>Total</b>	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 completing the M. Sc. Programme, the students shall:**

1. Obtain essential knowledge and skills to pursue a career in research, industry and in academic set up.
2. Apply the understanding of experimental approaches to solve problems and will have an ability to implement solution to new problems.
3. Integrate and apply the techniques in Analytical biochemistry, Clinical biochemistry, Microbiology, Molecular biology and Bioinformatics.
4. Evaluate the depth of scientific knowledge in the broad range of fields including Cell biology, Metabolism, Pharmaceutical Biochemistry, Genetics, Nutritional Biochemistry, Immunology and Enzymology.
5. Describe and express the biochemical basis of human diseases, protein structure and conformation, non-invasive diagnostics, biochemical pathway regulation and drug development and synthesize this knowledge and apply the same for multitude of laboratory applications.

**Programme Specific Outcome:**

1. Student will learn the broad knowledge and a solid foundation in biology and chemistry.
2. The student will understand the advance knowledge of Clinical biochemistry, industrial biochemistry, Molecular genetics principles, nature of chemical reactions and health related problems.
3. Student will develop analytical and critical-thinking skills that allow independent exploration of biological phenomena through the scientific method.
4. To introduce students to modern methods of biochemical experimentation within the disciplines of biology and chemistry.
5. The student will understand the interdisciplinary nature of biochemistry and to integrate knowledge of chemistry, physics and other disciplines to a wide variety of biochemical issues for industries, product development and quality control.
6. The student will learn the practical based laboratory skills needed to design, safely conduct and interpret biochemical research.
7. The student will acquire a foundation of biological chemistry of sufficient breadth and depth to enable them to understand and critically interpret the advance chemical literature.
8. The student will develop the ability to effectively communicate scientific information and research results in written and oral formats.
9. The student will learn professionalism, including the ability to work in teams and apply basic ethical principles in life and profession.
10. Enhance scientific knowledge and skills in specific biological domains to meet the current academic and industrial (pharmaceutical and agricultural) demands.

11. Acquire experience in developing scientific hypotheses, conducting experiments, analyzing data and communicating research findings at national and international levels.

### **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.

The 25 marks of Internal Evaluation shall be divided into the following:

- a) One Mid Semester Exams of 20 Marks each converted to 10 marks.
- b) One or Two Class Tests of 15 marks each converted to 5 Marks.
- c) Class Assignments of 5 Marks.
- d) One Presentation/Seminar/MCQ Test of 5 Marks. or
- e) One Group Discussion/Open Book Test of 5 or 10 Marks.
- f) A compulsory Mock Practical Examination and Viva Voce of practical subjects.
- g) Internal marks for Journal / project report/ dissertation report 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
<b>SEMESTER – I</b>			
1	23SMBC11MM	Biomolecules	2
2	23SMBC12MM	Fundamentals of Microbiology	2
3	23SMBC13MM	Cell Biology	2
4	23SMBC14MM	Biophysical Techniques	2
5	23SMBC15MM	Practical: Analytical Biochemistry Practical – I	2
6	23SMBC16MM	Practical: Biophysical Techniques Practical	2
7	23SMBC17MM	Practical: Microbiology Practical	2
<b>Major Elective: Any One</b>			
8a	23SMBC18MEA	Genetics	2
8b	23SMBC18MEB	Plant Biochemistry	2
<b>Major Elective: Any One</b>			
9a	23SMBC19MEA	Enzymology	2
9b	23SMBC19MEB	Nutrition Science	2
10	23SMBC11RM	Research Methodology	4
<b>SEMESTER – II</b>			
1	23SMBC21MM	Molecular Biology	2
2	23SMBC22MM	Bioenergetics and Metabolism	2
3	23SMBC23MM	Clinical Biochemistry	2
4	23SMBC24MM	Animal Tissue Culture	2
5	23SMBC25MM	Practical: Analytical Biochemistry – II	2
6	23SMBC26MM	Practical: Clinical Biochemistry	2
7	23SMBC27MM	Practical: Computational Biochemistry	2
<b>Major Elective: Any One</b>			
8a	23SMBC28MEA	Biostatistics	2
8b	23SMBC28MEB	Applied biology	2
<b>Major Elective: Any One</b>			
9a	23SMBC29MEA	Fermentation technology	2
9b	23SMBC29MEB	Bioremediation	2
10	23SMBC21FP	Field Project /On Job Training (OJT)	4



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### SEMESTER – I

<b>Course/ Paper Title</b>	<b>Biomolecules</b>
<b>Course Code</b>	<b>23SMBC11MM</b>
<b>Semester</b>	<b>I</b>
<b>No. of Credits</b>	<b>2 Credits, (30 Hours)</b>

#### 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.

#### Expected Course Specific Learning Outcomes

Learning Outcome
<b>Student should be able to –</b>
1. Describe the chemical makeup of living organisms and macromolecules.
2. Classify and explain carbohydrates and lipids' structures and functions.
3. Understand the role of vitamins and coenzymes in metabolism.
4. Understand protein structure levels and their biological functions.
5. Learn methods like X-ray diffraction and Ramachandran plots for protein analysis.

#### 23SMBC11MM: Biomolecules (30 Hours)

Sr. No.	Name of the Topic	Hours
1	<b>The Molecular Logic of Life:</b> The chemical unity of diverse living organisms, composition of living matter. Macromolecules and their monomeric subunits. <b>Properties of water:</b> With interactions in aqueous systems. Ionization of water, weak acid weak bases.	02
2	<b>Carbohydrates:</b> Classification, basic chemical structure, general reactions and properties, biological significance, Sugar derivatives, deoxy sugars, amino sugars, and sugar acids.	06
3	<b>Lipids:</b> Classification, structure and function of major lipid subclasses- acylglycerols, Lipoproteins, chylomicrons, LDL, HDL and VLDL, rancidity. Formation of micelles, monolayers, bilayer, liposomes.	04

4	<b>Vitamins and Co-enzymes:</b> Classification, water soluble and fat soluble vitamins. Structure, dietary requirements, deficiency conditions, coenzyme forms and their mechanism.	04
5	<b>Proteins: Amino acids:</b> Classification, Properties, reactions, rare amino acids. <b>Protein classification:</b> Reactions, functions, properties and Solid phase synthesis. <b>Structural levels of protein:</b> a. Primary Structure: Peptide bond, importance of primary structure. b. Secondary structure: X ray diffraction, alpha-helix, $\beta$ - structure, $\beta$ -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. Ramachandran plot.	14

### References:

1. Principles of Biochemistry, Lehninger CRS. Publication, 7<sup>th</sup> 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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<b>Course/ Paper Title</b>	<b>Fundamentals of Microbiology</b>
<b>Course Code</b>	<b>23SMBC12MM</b>
<b>Semester</b>	I
<b>No. of Credits</b>	2 Credits, (30 Hours)

### Aims & Objectives of the Course

Objectives
<ol style="list-style-type: none"> <li>1. To understand microbial diversity.</li> <li>2. To master microbial growth and cultivation techniques.</li> <li>3. To explore microbial interactions and pathogenesis.</li> <li>4. To apply microbiology in industry and environment.</li> </ol>

### Expected Course Specific Learning Outcomes

Learning Outcome
<p><b>Student should be able to –</b></p> <ol style="list-style-type: none"> <li>1. Classify and differentiate microbes based on their taxonomy, morphology, ultrastructure, and unique characteristics of archaea, eubacteria, yeast, and viruses.</li> <li>2. Formulate culture media, apply techniques for isolating and enumerating microorganisms.</li> <li>3. Analyze microbial growth kinetics, and optimize growth conditions for heterotrophs and autotrophs in laboratory and industrial settings.</li> <li>4. Explain the mechanisms of microbial interactions with hosts, including quorum sensing and the role of pathogenicity islands in virulence, and identify key microbes responsible for infections in humans, animals, and plants.</li> <li>5. Apply knowledge of microbial processes to industrial production (e.g., ethanol, antibiotics, enzymes), food microbiology, and environmental management techniques.</li> </ol>

### 23SMBC12MM: Fundamentals of Microbiology (30 Hours)

Sr. No.	Name of the Topic	Hours
1	<b>Overview of Microbial World:</b> Bacterial taxonomy, Morphological and structural organization of microbes. Ultrastructure of Archaea, Eubacteria, Unicellular eukaryotes (Yeast) and Viruses (Bacterial, animal and tumour viruses).	08

2	<b>Cultural Characteristics of Microorganisms:</b> 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	<b>Microbial Interactions and Infection:</b> 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, Bioleaching, 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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<b>Course/ Paper Title</b>	<b>Cell Biology</b>
<b>Course Code</b>	<b>23SMBC13MM</b>
<b>Semester</b>	I
<b>No. of Credits</b>	2 Credits, (30 Hours)

### Aims & Objectives of the Course

<b>Objectives</b>
<ol style="list-style-type: none"> <li>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.</li> <li>2. To study cellular organelles, their roles and involvement in key metabolic and biochemical processes.</li> <li>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.</li> <li>4. To analyze the processes of mitosis and meiosis, the cell cycle and its regulation.</li> <li>5. To explore the mechanisms of stem cell differentiation and tissue specialization to appreciate their importance in growth, development, and repair.</li> </ol>

### Expected Course Specific Learning Outcomes

<b>Learning Outcome</b>
<p><b>Student should be able to –</b></p> <ol style="list-style-type: none"> <li>1. Comprehend the fundamental concepts of cell biology.</li> <li>2. Explore the structure and functions of cellular components.</li> <li>3. Understand membrane dynamics and cytoskeletal organization.</li> <li>4. Learn cell division and tissue differentiation.</li> </ol>

### 23SMBC13MM: Cell Biology (30 Hours)

Sr. No.	Name of the Topic	Hours
1	<b>Milestones in the Development of Cell Biology:</b> 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	05

	cell, sub cellular organization of activities.	
2	<b>Plasma Membrane:</b> 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 <sup>2+</sup> and Fe transport.	10
3	<b>Cytoskeleton and Organization:</b> 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	<b>Cell Division:</b> 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:

1. Lodish, Harvey. Molecular cell biology. Macmillan, 2008.
2. 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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<b>Course/ Paper Title</b>	<b>Biophysical Techniques</b>
<b>Course Code</b>	<b>23SMBC14MM</b>
<b>Semester</b>	I
<b>No. of Credits</b>	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.

### Expected Course Specific Learning Outcomes

Learning Outcome
<b>Student should be able to –</b>
1. Explain electrophoretic mobility and chromatography principles.
2. Perform experiments using SDS-PAGE, HPLC, and ultracentrifugation.
3. Analyse and interpret fluorescence spectra and sedimentation data.
4. Utilize biophysical techniques in interdisciplinary research.

### 23SMBC14MM: Biophysical Techniques (30 Hours)

Sr. No.	Title with Contents	Hours
1	<b>Electrophoretic Techniques:</b> 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,	08

	2-D gel electrophoresis, Western blotting.	
2	<b>Chromatography Techniques:</b> 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	<b>Spectroscopy:</b> 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	<b>Sedimentation:</b> 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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<b>Course/ Paper Title</b>	<b>Practical: Analytical Biochemistry– I</b>
<b>Course Code</b>	<b>23SMBC15MM</b>
<b>Semester</b>	I
<b>No. of Credits</b>	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.

### Expected Course Specific Learning Outcomes

Learning Outcome
<b>Student should be able to –</b>
1. Separate and identify amino acids, proteins, and carbohydrates.
2. Estimate biomolecules using methods like Ninhydrin, Biuret, and DNSA.
3. Isolate biomolecules like cystine and egg proteins.
4. Analyze natural products like chlorophyll and Vitamin B.
5. Apply biochemical techniques in research and industry.

### 23SMBC15MM: Practical: Analytical Biochemistry – I (60 Hours)

S. No.	Name of the Experiment
	<b>Perform any 12 experiments from the following –</b>
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 of 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.
19	Estimation of inorganic phosphorus by Fiske-Subbarow method.
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) 5<sup>th</sup> Edition.
2. Practical Biochemistry by David Plummer (2015) 3<sup>rd</sup> 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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<b>Course/ Paper Title</b>	<b>Practical: Biophysical techniques</b>
<b>Course Code</b>	<b>23SMBC16MM</b>
<b>Semester</b>	<b>I</b>
<b>No. of Credits</b>	<b>2 Credits, (60 L)</b>

### Aims & Objectives of the Course

<b>Objectives</b>
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.

### Expected Course Specific Learning Outcomes

<b>Learning Outcome</b>
<b>Student should be able to –</b>
1. Expertise in gel filtration and ion exchange chromatography.
2. Separate biomolecules using TLC and gel electrophoresis.
3. Analyze nucleic acids and hemoglobin derivatives with absorption spectroscopy.
4. Estimate biomolecule concentrations using spectrofluorimeter.
5. Understand sub-cellular fractionation and RBC membrane testing.

### 23SMBC16MM: Practical: Biophysical techniques (60 Hours)

<b>S. No.</b>	<b>Name of the Experiment</b>
	<b>Perform any 12 experiments from the following –</b>
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 of DNA by paper or agarose gel electrophoresis.
5	Dilution/ separation of given biomolecules by using Dialysis.

6	Concentrate the given biomolecule sample using Reverse dialysis.
7	Separation of amino acids by Ion Exchange chromatography.
8	Verification of Lambert's Beer's Law and determination of molar extinction coefficient
9	Absorption spectrum of Nucleic acid and determination of its $\lambda_{max}$ .
10	Absorption spectra of different hemoglobin derivatives.
11	Quantitative estimation by using Spectrofluorimeter.
12	Measurement of Refractive Index.
13	Sub- Cellular fractionation by sedimentation.
14	RBC membrane fragility.
15	pH metry: Acid base titration curves. Measurement of pKa of amino acids.
16	Determination of relative viscosity, Specific viscosity and intrinsic viscosity.
17	Determination of capacity of an ion exchange column.
18	Separation of amino acids by ion exchange chromatography.
19	Demonstration experiment on HPLC
20	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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<b>Course/ Paper Title</b>	<b>Practical: Microbiology</b>
<b>Course Code</b>	<b>23SMBC17MM</b>
<b>Semester</b>	I
<b>No. of Credits</b>	2 Credits, (60 L)

### **Aims & Objectives of the Course**

<b>Objectives</b>
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.

### **Expected Course Specific Learning Outcomes**

<b>Learning Outcome</b>
<b>Student should be able to –</b>
1. Learn the techniques needed for cultivation of microbes.
2. Understand how these organisms live and grow under different conditions.
3. Proficient in isolation of bacteriophages and application in environmental contaminants.
4. Estimate DNA and RNA.
5. Analyze and estimate microbial growth.

### **23SMBC17MM: Practical: Microbiology (60 Hours)**

<b>S. No.</b>	<b>Name of the Experiment</b>
<b>Experiment No. 1 to 4 are compulsory and perform any 08 experiments from 05 to 20</b>	
1-4	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.

5	Microbiological analysis of food products
6	Microbiological examination of spoiled foods – Bacteria / Fungi
7	Screening of antibiotic producing organisms from soil.
8	Influence of Environment on Microorganisms; Factors affecting growth– pH, temperature, nutrients & salts.
9	Microbiology of water: Detection of coliforms in water - MPN Technique.
10	Isolation of coliphage from sewage.
11	Replica plating technique.
12	Extraction of Nucleic acids
13	Estimation of Protein – Lowry’s method
14	Estimation of DNA and RNA.
15	Separation of proteins by Thin Layer chromatography
16	Detection of amylase, caseinase, catalase activity
17	Total viable count determination by pour plate method
18	Total viable count determination by spread plate method.
19	Microbial assay of vitamins.
20	Microbial assay of antibiotics.

**Reference:**

1. Textbook of Practical Microbiology by Ahuja Subhash Chandra Parija.
2. Prescott M (2005) Microbiology. 6<sup>th</sup> 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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## **Abeda Inamdar Senior College**

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

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NAAC accredited 'A' Grade

<b>Course/ Paper Title</b>	<b>Genetics</b>
<b>Course Code</b>	<b>23SMBC18MEA</b>
<b>Semester</b>	I
<b>No. of Credits</b>	2 Credits, (30 Hours)

### **Aims & Objectives of the Course**

<b>Objectives</b>
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.

### **Expected Course Specific Learning Outcomes**

<b>Learning Outcome</b>
<b>Student should be able to –</b>
1. Understand Genetic Information Storage and Replication: Learn how DNA stores and duplicates genetic material within cells.
2. Explore Gene Expression and Impact: Study how genes influence characteristics and biological functions in organisms.
3. Prepare for Advanced Applications: Gain foundational insights that support future specialization in fields like genomics, bioinformatics, and medical genetics.

### **23SMBC18MEA: Genetics (30 Hours)**

<b>Sr. No.</b>	<b>Name of the Topic</b>	<b>Hours</b>
1	<b>Law of Segregation:</b> 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	<b>Sex-linked Inheritance in Man:</b> X-linked inheritance (colour blindness, haemophilia), Y-linked traits, XY-linked inheritance, sex- influenced traits,	02

	sex-limited traits. Dosage compensation	
3	<b>Early Evidence for Linkage and Genetic Recombination:</b> 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 <i>Drosophila</i> , 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	<b>Fine Structure of Gene:</b> 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 <i>drosophila</i> , complementation test. c) Modern Concept of Gene – classical, neoclassical and modern concepts..	04
	<b>Prokaryotic and Eukaryotic Model Systems in Genetic Analysis of Bacteriophage and <i>E. Coli</i>:</b> a) Structure and Life Cycle of Bacteriophage – T4 bacteriophage, morphology, composition, model genetic system, applications b) <i>E. coli</i> as Model Organism – genetic manipulation, applications c) <i>E. coli</i> 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

<b>Course/ Paper Title</b>	<b>Plant Biochemistry</b>
<b>Course Code</b>	<b>23SMBC18MEB</b>
<b>Semester</b>	I
<b>No. of Credits</b>	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.

### Expected Course Specific Learning Outcomes

Learning Outcome
<b>Student should be able to –</b>
1. Analyze the mechanisms of photosynthesis, including light and dark reactions.
2. Explore the structures, biosynthesis, and functions of various plant hormones.
3. Understand the nitrogen cycle, nitrogen fixation, and nitrate assimilation.
4. Acquire knowledge of metabolic engineering strategies, metabolite profiling, and structure elucidation techniques using NMR, GC-MS, LC-MS, and spectroscopy.
5. Investigate the innate immune responses of plants.

### 23SMBC18MEB: Plant Biochemistry (30 Hours)

Sr. No.	Name of the Topic	Hours
1	<b>Photosynthesis and Carbon Assimilation:</b> Hill reaction, Photosystem I and photosystem II, Photophosphorylation, Light harvesting complexes, Nonphotochemical quenching, Photosynthesis inhibitors, Carboxylation, Structure and kinetics of RUBISCO, CO <sub>2</sub> concentrating mechanisms, Storage and utilization of fixed carbon.	05
2	<b>Plant Hormones:</b> Structure and function of plant hormones- auxin, cytokinin, ethylene, abscisic acid, florigin, gibberellins, brassinosteroids,	05

	jasmonates, salicylic acid, nitric oxide, Steroid and peptide hormones	
3	<b>Nitrogen Metabolism and Secondary Metabolites:</b> 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	<b>Metabolic Engineering:</b> 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	<b>Innate Immune Responses in Plants:</b> 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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Of Arts, Science and Commerce, Camp, Pune-1

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NAAC accredited 'A' Grade

<b>Course/ Paper Title</b>	<b>Enzymology</b>
<b>Course Code</b>	<b>23SMBC19MEA</b>
<b>Semester</b>	I
<b>No. of Credits</b>	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.

### Expected Course Specific Learning Outcomes

Learning Outcome
<b>Student should be able to –</b>
1. Classify and give nomenclature of enzymes, and distinguish between monomeric, oligomeric, and multienzyme complexes.
2. Derive and analyze the Michaelis-Menten equation, understand enzyme-substrate interactions.
3. Investigate enzyme catalysis mechanisms
4. Explore enzyme regulation mechanisms.
5. Understand the structures and biological functions of coenzymes.

### 23SMBC19MEA: Enzymology (30 Hours)

Sr. No.	Name of the Topic	Hours
1	<b>Introduction to Enzymology:</b> 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.	05
2	<b>Kinetics of Enzyme Action:</b> Concept of ES complex, active site, specificity,	10

	<p>derivation of Michaelis-Menten equation for uni- substrate reactions. Different plots for the determination of <math>K_m</math> &amp; <math>V_{max}</math> and their physiological significances. Importance of <math>K_{cat}/K_m</math>. Kinetics of zero &amp; first 20 order reactions. Significance and evaluation of energy of activation. Collision &amp; 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 <math>K_i</math> 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>	
3	<p><b>Mechanism of Enzyme Action:</b> 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><b>Enzyme Regulation:</b> General mechanisms of enzyme regulation, product inhibition. Reversible (glutamine synthase &amp; 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’ &amp; ‘sequential’ models for allosteric enzymes. Half site reactivity, Flipflop mechanism, positive and negative co-operativity with special reference to aspartate transcarbamoylase &amp; phosphofructokinase. Protein-ligand binding measurement, analysis of binding isotherms, Hill and Scatchard plots.</p>	05
5	<p><b>Multienzyme System:</b> Occurrence, isolation &amp; their properties: Mechanism of action and regulation of pyruvate dehydrogenase &amp; fatty acid synthase complexes. Enzyme-enzyme interaction, multiple forms of enzymes with 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 .</p>	05

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

(Autonomous) Affiliated to Savitribai Phule Pune University, Pune

NAAC accredited 'A' Grade

<b>Course/ Paper Title</b>	<b>Nutrition Science</b>
<b>Course Code</b>	<b>23SMBC19MEB</b>
<b>Semester</b>	<b>I</b>
<b>No. of Credits</b>	<b>2 Credits, (30 Hours)</b>

### Aims & Objectives of the Course

<b>Objectives</b>
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.

### Expected Course Specific Learning Outcomes

<b>Learning Outcome</b>
<b>Student should be able to –</b>
1. Understand food value and energy content.
2. Learn protein quality and metabolism.
3. Understand energy measurement and carbohydrate roles.
4. Know the functions of lipids and minerals.
5. Recognize food-related diseases and disorders.

### 23SMBC19MEB: Nutrition Science (30 Hours)

<b>Sr. No.</b>	<b>Name of the Topic</b>	<b>Hours</b>
1	<b>Introduction and Basic Concepts:</b> Composition of Human body. Nutritional value of foods and effect of processing. Energy content and its measurement in foods. Thermogenic effect of foods.	02
2	<b>Role of food proteins:</b> 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
3	<b>Carbohydrates and Energy metabolism:</b> Dietary requirements and source of carbohydrates, Classification, Available and Unavailable. Physico-	08

	chemical properties and the physiological role. Energy requirement and measurement of energy requirement: Direct and Indirect calorimetry. Factors affecting requirements; BMR, SDA and activity. BMR and relation of temperature regulation to basal metabolism.	
4	<b>Lipids:</b> Nutritional classification of dietary lipids, sources and their physiological functions.	02
5	<b>Minerals:</b> Nutritional significance. Dietary Macro elements, Calcium, Phosphorus, Magnesium. Trace Elements, Iron, Iodine, Zinc, Copper etc. Food utilization: Ingestion, digestion, absorption transport, storage and disposal of food nutrients (proteins, carbohydrates, fats, vitamins and minerals).	04
6	<b>Primary Nutritional Diseases:</b> Protein energy malnutrition, starvation, obesity, vitamin deficiency disorders and biochemical basis of causation and diagnosis of nutritional anaemias. <b>Conditional Nutritional Disorders:</b> Disorders of Gastrointestinal tract, Liver, Biliary tract and Pancreas and Heart, Diabetes. <b>Food toxins and Allergy</b>	08

#### References:

1. Nutrition and Dietetics, 4<sup>th</sup> Edition by Shubhangini A Joshi, McGraw Hill Education (India) Private Limited, New Delhi.
2. Biochemistry, 4<sup>th</sup> 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 5<sup>th</sup> 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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(Autonomous) Affiliated to Savitribai Phule Pune University, Pune

NAAC accredited 'A' Grade

<b>Course/ Paper Title</b>	<b>Research Methodology in Chemistry</b>
<b>Course Code</b>	<b>23SMBC11RM</b>
<b>Semester</b>	I
<b>No. of Credits</b>	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.

### Expected Course Specific Learning Outcomes

Learning Outcome
<b>Student should be able to –</b>
1. Develop skills in qualitative and quantitative data analysis and presentation.
2. Understand the limitations of particular research methods.
3. Develop advanced critical thinking and enhanced writing skills.
4. To write a research report and thesis.

### 23SMBC11RM: Research Methodology in Chemistry (60 Hours)

Sr. No.	Name of the Topic	Hours
1	<b>Introduction to Research methodology:</b> 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 a good research.	04
2	<b>Scope of Research and Ethics:</b> 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	05

	importance Research ethics, Institutional ethics committee, Plagiarism, Patenting and intellectual propertyrights.	
3	<b>Processes in research proposal development:</b> Components of research proposal- Components of research proposal: 1.Title page 2. Summary/Abstract 3. Introduction/background 4. Statementof the problem 5. Literature review 6. Hypotheses/questions 7. Conceptualframework 8. Objective/aim of the study 9. Research methods, material, and procedure 10. Work plan 11. Budget 12. References 13.Appendices/annexes.	08
4	<b>Literature search technique:</b> Using SCOPUS, Google Scholar, PUBMED, Web of Science, science direct, Indian Citation Index, ResearchGate, and scifinder. <b>Overview of the journal article:</b> 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 CitationReport, SNIP, SJR, IPP, Cite Score 2. Metrics: h-index, g index, i10 indexetc.	06
5	<b>Presentation of Scientific findings, Scientific Report Writing:</b> Publication Process: Types of technical documents- Full length researchpaper, 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 paper,Work plan, Materials and methodology, Results and discussion, Key issuesand arguments, Acknowledgement, Conflict of interest statement,bibliography, Technical Resumes & Cover Letters. Softwares in Chemistry Data plotting Structure Drawing, GrammarCheckers and Sentence Correction Tools.	08
6	<b>Scientometrics:</b> How to cite and how to do referencingStyles of referencing: APA, MLA, Oxford, Harvard, ChicagoAnnotated 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	<b>Data Analysis and interpretation:</b> 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 linearequations, 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 regressionanalysis. Types of errors and level of significance. Tests of significance – F & t tests, chi-square tests.	06
8	<b>Publications Ethics:</b> Definition, nature of moral judgements and reactions, Ethics with respect toscience and research. Intellectual honesty and research	04

	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.	
9	<b>Presentation and Communication skills:</b> Tables, Figures and Pictures using Excel, PowerPoint slide preparation, Preparation of Posters, Electronic submission of manuscripts, oral and poster, Communication skills.	04
10	<b>Chemistry Laboratory Practices: Safety practices in Chemical research:</b> 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. <b>Working conditions and equipment:</b> 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. <b>Maintaining data and observations-</b> importance of 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.	10

#### 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 Experience: 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).



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NAAC accredited 'A' Grade

### SEMESTER – II

<b>Course/ Paper Title</b>	<b>Molecular Biology</b>
<b>Course Code</b>	<b>23SMBC21MM</b>
<b>Semester</b>	II
<b>No. of Credits</b>	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.

#### Expected Course Specific Learning Outcomes

Learning Outcome
<b>Student should be able to –</b>
1. Acquaint with the knowledge of central dogma of molecular biology and its role in cellular activities.
2. Study the importance of post translational and post transcriptional modifications in the cell.

#### 23SMBC21MM: Molecular Biology (30 Hours)

Sr. No.	Name of the Topic	Hours
1	<b>Introduction to molecular biology:</b> Overview on Central dogma of molecular biology	02
2	<b>Replication of DNA:</b> 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	10

	activation.	
3	<b>Transcription of DNA:</b> 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	<b>Translation:</b> Features of genetic code, Wobble hypothesis, structure and functions of t-RNA (Cloverleaf model), m-RNA and ribosomes and it's 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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<b>Course/ Paper Title</b>	<b>Bioenergetics and Metabolism</b>
<b>Course Code</b>	<b>23SMBC22MM</b>
<b>Semester</b>	II
<b>No. of Credits</b>	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.

### Expected Course Specific Learning Outcomes

Learning Outcome
<b>Student should be able to –</b>
1. Understand metabolic pathways and energy conversion.
2. Comprehend glycolysis, citric acid cycle, and alternative carbohydrate pathways.
3. Learn fatty acid oxidation and lipid biosynthesis.
4. Understand amino acid degradation, biosynthesis, and related disorders.
5. Grasp purine and pyrimidine metabolism and nucleotide coenzyme regulation.

### 23SMBC22MM: Bioenergetics and Metabolism (30 Hours)

Sr. No.	Name of the Topic	Hours
1	<b>Introduction of Metabolism and Overview:</b> Bioenergetics: Basic law of thermodynamic, internal energy, enthalpy, entropy, concept of free energy, standard free energy change of a chemical reaction, redox potentials, high energy compounds, structure and significance of ATP. Glycolysis: Detailed study, energetics, regulation and significance. Citric acid cycle: Detailed study, energetics, regulation and significance. Electron transport and oxidative phosphorylation, AIP synthase and mechanism. Alternate pathways of carbohydrate metabolism: Pentose phosphate pathway, glyoxalate cycle, glucuronic acid pathway, inter conversion of hexoses,	15

	<p>Pasteur effect. Polysaccharide metabolism: Biosynthesis, degradation and regulation of glycogen, metabolism starch and cellulose, inborn error of carbohydrate metabolism. Gluconeogenesis. Lipid metabolism: Beta oxidation of even and odd number carbon atoms fatty acids, energetics and regulation. Formation of ketone bodies, other types of fatty acid oxidation.</p> <p>Biosynthesis of lipids: Requirements of carbon dioxide and citrate for biosynthesis, fatty acid synthase complex, regulation of biosynthesis. Biosynthesis of triglycerides, cholesterol and phospholipids</p>	
2	<p><b>Oxidative Degradation of Amino Acids:</b> Proteolysis, transamination, oxidative deamination, acetyl CoA, alpha ketoglutarate, acetoacetyl CoA, succinate, fumarate and oxaloacetate pathway. Decarboxylation, urea cycle, ammonia excretion. Biosynthesis of amino acids: Amino acid biosynthesis, precursor functions of amino acids, biosynthesis of aromatic amino acids, Histidine, one carbon atom transfer by folic acid (Biosynthesis of glycine, serine, cysteine, methionine, threonine.) Inborn errors of amino acid metabolism. Peptides, polyamines, porphyrins, gamma glutamyl cycle, glutathione biosynthesis, nonribosomal protein biosynthesis. Purine and pyrimidine degradation. Biosynthesis of purine and pyrimidine nucleotides, regulation and biosynthesis of nucleotide coenzymes.</p>	15

#### References:

1. Biochemistry – Lehninger, 7th edition (2017)
2. 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)



M. C. E. Society's

## Abeda Inamdar Senior College

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

(Autonomous) Affiliated to Savitribai Phule Pune University, Pune

NAAC accredited 'A' Grade

Course/ Paper Title	Clinical Biochemistry
Course Code	23SMBC23MM
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.

### Expected Course Specific Learning Outcomes

Learning Outcome
<b>Student should be able to –</b>
1. Gain an in-depth understanding of the biochemical mechanisms underlying various diseases related to digestion, carbohydrate, lipid, amino acid, and nucleic acid metabolism, as well as the impact of genetic mutations and enzyme deficiencies in these processes.
2. Learn to recognize the clinical symptoms, diagnostic tests, and biochemical markers associated with diseases such as diabetes mellitus, pancreatitis, hyperlipidemia, and inborn errors of metabolism, while understanding the role of biochemical assays and tests like glucose tolerance tests and lipid profiles.

### 23SMBC23MM: Clinical Biochemistry (30 Hours)

Sr. No.	Name of the Topic	Hours
1	<b>Body Fluids:</b> Introduction, Collection, Preservation, composition and functions of Blood, Urine, Faeces, CSF and Amniotic Fluid.	04
2	<b>Biological Materials:</b> 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.	06
3	<b>Clinical Aspects of Carbohydrate and Lipid Metabolic Disorders:</b> Clinical	08

	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.	
4	<b>Impairments in organ function:</b> Organ function tests: a) Liver function tests. b) Kidney function tests. c) Thyroid function tests. d) Pancreatic function tests. e) Gastric function tests.	12

### 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



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## Abeda Inamdar Senior College

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

(Autonomous) Affiliated to Savitribai Phule Pune University, Pune

NAAC accredited 'A' Grade

<b>Course/ Paper Title</b>	<b>Animal Tissue Culture</b>
<b>Course Code</b>	<b>23SMBC24MM</b>
<b>Semester</b>	II
<b>No. of Credits</b>	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.

### Expected Course Specific Learning Outcomes

Learning Outcome
<b>Student should be able to –</b>
1. Gain an in-depth understanding of the of animal cell culture, including aseptic handling, sterilization procedures, and the requirements of a tissue culture laboratory, to ensure successful and contamination-free cell growth, along with their specific applications and limitations, to choose the most appropriate culture method for specific research goals.
2. Study the applications of animal cell culture in biomedical research, such as drug testing, production of recombinant proteins, and vaccine development, and learn the ethical considerations and technical challenges involved in working with transgenic animals.

### 23SMBC24MM: Animal Tissue Culture (30 Hours)

Sr. No.	Name of the Topic	Hours
1	<b>Introduction to Animal Cell Culture Laboratory:</b> 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	<b>Media Requirements:</b> 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	<b>Types of Tissue Culture:</b> 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	<b>Applications of Cell Culture:</b> In vitro testing of drugs, production of pharmaceutical proteins and vaccines.	05
5	<b>Transgenic Animals:</b> 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 (6<sup>th</sup> edition).
4. Principles and Techniques of Biochemistry and Molecular Biology, K Wilson and J Walker, 7<sup>th</sup> edition.



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## Abeda Inamdar Senior College

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

(Autonomous) Affiliated to Savitribai Phule Pune University, Pune

NAAC accredited 'A' Grade

<b>Course/ Paper Title</b>	<b>Practical: Analytical Biochemistry – II</b>
<b>Course Code</b>	<b>23SMBC25MM</b>
<b>Semester</b>	II
<b>No. of Credits</b>	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.

### Expected Course Specific Learning Outcomes

Learning Outcome
<b>Student should be able to –</b>
1. To isolate and characterize biomolecules like casein and starch.
2. To estimate Vitamin C, DNA/RNA, and sugars.
3. To determine fat properties (saponification, acid value, iodine number).
4. To detect phytochemicals and carbohydrates.
5. To use biochemical techniques for analysis in practical applications.

### 23SMBC25MM: Practical: Analytical Biochemistry – II (60 Hours)

S. No.	Name of the Experiment
	<b>Perform any 12 Experiments from the following -</b>
1	Isolation of Starch and characterization.
2	Alpha and Beta amylolysis.
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 colorimetric method.
15	Estimation of Creatinine by biological samples by colorimetric method.
16	Uric acid estimation of biological samples by colorimetric method.
17	Estimation of total proteins from biological samples by colorimetric method.
18	Determination of HMF content from Honey sample.
19	Estimation of DNA by Diphenylamine Method
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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<b>Course/ Paper Title</b>	<b>Practical: Clinical Biochemistry</b>
<b>Course Code</b>	<b>23SMBC26MM</b>
<b>Semester</b>	II
<b>No. of Credits</b>	2 Credits, (60 Hours)

### Aims & Objectives of the Course

Objectives
<ol style="list-style-type: none"><li>1. To master methods for testing biomolecules.</li><li>2. To understand tests for metabolic markers.</li><li>3. To analyze blood and urine samples.</li><li>4. To measure enzyme activities.</li><li>5. To apply methods for clinical diagnosis.</li></ol>

### Expected Course Specific Learning Outcomes

Learning Outcome
<p><b>Student should be able to –</b></p> <ol style="list-style-type: none"><li>1. Test lipoproteins, glucose, bilirubin, etc.</li><li>2. Perform blood and urine analysis.</li><li>3. Measure LDH, SGPT, and amylase.</li><li>4. Accurately test cholesterol, proteins, and HbA1c.</li><li>5. Use results for clinical applications.</li></ol>

### 23SMBC26MM: Practical: Clinical Biochemistry (60 Hours)

S. No.	Name of the Experiment
	<b>Experiment No. 1 is compulsory and perform any 11 Experiments from 2 to 18</b>
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	Blood sugar determination by Folin-Wu method
5	Estimation of creatine phosphokinase
6	Analysis of Normal and abnormal constituents of urine
7	Determination of blood cholesterol by kit method
8	Estimation of glycosylated hemoglobin
9	Estimation of LDH and its isozymes
10	Estimation of alkaline and acid phosphatase from serum
11	Estimation of total protein and albumin from serum
12	Determination of SGPT and SGOT
13	Estimation of serum amylase
14	Estimation of blood uric acid by kit method
15	Estimation of blood glucose by kit method
16	Estimation of inorganic phosphorus by Kit method.
17	Estimation of blood urea by kit method
18	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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<b>Course/ Paper Title</b>	<b>Practical: Computational Biology</b>
<b>Course Code</b>	<b>23SMBC27MM</b>
<b>Semester</b>	II
<b>No. of Credits</b>	2 Credits, (60 Hours)

### **Aims & Objectives of the Course**

<b>Objectives</b>
<ol style="list-style-type: none"><li>1. Learn to effectively use standard biological databases such as NCBI, PDB, and SWISS-PROT, and apply bioinformatics tools for tasks like sequence analysis, protein structure prediction, and molecular phylogenetic studies.</li><li>2. Gain practical experience in creating and managing biological databases using PHP-MySQL, designing interactive web pages, and integrating them with bioinformatics data for real-time retrieval and analysis.</li><li>3. Learn how to use programming languages like Python and Bash scripting for tasks such as DNA/RNA sequence analysis, string handling, file manipulation (e.g., FASTA format), and regular expression searches in biological sequences.</li><li>4. Develop proficiency in using sequence analysis tools, multiple sequence alignment programs (like Muscle and Mafft), and protein structure visualization tools to interpret genomic and proteomic data.</li><li>5. Explore specialized fields like immunoinformatics and clinical informatics, and gain a foundational understanding of technologies like microarrays and 2D dot plots for analyzing biological data in clinical and research contexts.</li></ol>

### **Expected Course Specific Learning Outcomes**

<b>Learning Outcome</b>
<p><b>Student should be able to –</b></p> <ol style="list-style-type: none"><li>1. Use biological databases and bioinformatics tools.</li><li>2. Develop skills in web development for bioinformatics.</li><li>3. Understand bioinformatics programming and scripting.</li><li>4. Understand bioinformatics programming and scripting.</li><li>5. Understand immunoinformatics and clinical informatics.</li></ol>

### 23SMBC27MM: Practical: Computational Biology (60 Hours)

S. No.	Name of the Experiment
	<b>Perform any 12 Experiments from the following</b>
1	Basic use of standard biological databases: NCBI, PDB, SWISS PROT Database creation and management using PHP-MySQL, Creating Simple web pages with forms
2	Creating interactive pages with Javascript, setting up PHP-MySQL environment, retrieving data from PHP-MySQL units PHP Pages, case studies.
3	Basic introduction to Linux, Bash Scripting, Server connection with ssh, Executing programs on server, Writing programs using Python features : Sequence analysis – Reading DNA/Protein sequences, sequence length, GC%, handle string search;
4	Programs using string handling function-substring search, count of nucleotides, check RNA/DNA, ORF finding, Transcription, Translation; File handling programs- ReadWriteFasta;
5	Program with regular expression- Define RE for a set of sequences, search for subsequences/patterns, locations; Programs for processing FASTA files.
6	Analyzing Bio sequences: Basic sequence analysis tools for DNA, RNA.
7	Introduction to molecular phylogenetic, Phylip.
8	Protein structure data bases and visualization tools- structural alignment.
9	Protein structure prediction methods- Comparative modeling, threading.
10	Immunoinformatics and clinical informatics. Microarrays- 2D- (basics)
11	Dot Plots- dotlet. Multiple sequence alignment using Muscle and Mafft.
12	Specialized Genome databases: (SGD, TIGR),
13	Drawing structures and reaction using Chem Draw.
14	To draw the structures of class of drugs given in course.
15	Overview of Drug likeness, Physicochemical parameters, SwissADME and SwissADME target prediction.
16	To determine physicochemical parameter of given Antibiotic and Antimalarial drugs. Chloramphenicol and Chloroquine
17	To determine physicochemical parameter of given Anti-tubercular drugs. Isoniazid and Para amino salicylic acid.
18	To determine physicochemical parameter of given Anti-viral drugs. Acyclovir and Indinavir.
19	To determine physicochemical parameter of given Anti-fungal agents. Miconazole and Tolnaftate.
20	To determine physicochemical parameter of given Anti-protozoal agents. Metronidazole and Tinidazole.
21	To determine physicochemical parameter of given Sulfonamides. Sulfamethoxazole and Sulfacetamide.
22	To determine drug likeness of given Anti-tubercular drugs using SwissADME. Isoniazid

	and Ethambutol.
23	To determine drug likeness of given Anti-viral drugs using SwissADME. Amantadine and Indinavir.
24	To predict the target of given Anti-tubercular drugs using SwissADME target prediction. Isoniazid and Para amino salicylic acid.
25	To predict the target of given Anti-protozoal agents using SwissADME target prediction. Metronidazole and Tinidazole.
26	To obtain the BOILED-Egg presentation and the Bioavailability Radar of given Antitubercular drugs. Ethambutol and Para amino salicylic acid
27	To obtain the BOILED-Egg presentation and the Bioavailability Radar of given Antiviral drugs using SwissADME. Acyclovir and Amantadine
28	To determine ADMET properties of given Anti-protozoal agents using SwissADME Metronidazole and Tinidazole
29	To determine ADMET properties of given drugs using SwissADME. Paracetamol and Ibuprofen
30	To determine ADMET properties of given drugs using SwissADME. Chloramphenicol and Chloroquine
31	To determine the drug likeness, physicochemical parameter and ADMET properties of any synthetic drug.

### 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.



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## Abeda Inamdar Senior College

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

(Autonomous) Affiliated to Savitribai Phule Pune University, Pune

NAAC accredited 'A' Grade

<b>Course/ Paper Title</b>	<b>Biostatistics</b>
<b>Course Code</b>	<b>23SMBC28MEA</b>
<b>Semester</b>	II
<b>No. of Credits</b>	2 Credits, (30 Hours)

### Aims & Objectives of the Course

<b>Objectives</b>
<ol style="list-style-type: none"> <li>1. To enhance students' understanding of fundamental concepts in Biostatistics.</li> <li>2. To acquaint students with the principles of significance testing.</li> <li>3. To inculcate an understanding of hypothesis testing using both parametric and non-parametric methods.</li> </ol>

### Expected Course Specific Learning Outcomes

<b>Learning Outcome</b>
<p><b>Student should be able to –</b></p> <ol style="list-style-type: none"> <li>1. Understand descriptive statistics concepts.</li> <li>2. Test hypotheses and draw conclusions from data, enhancing their research skills.</li> <li>3. Apply the concepts and use both parametric and non-parametric tests.</li> </ol>

### **23SMBC28MEA: Biostatistics (30 Hours)**

Sr. No.	Name of the Topic	Hours
1	<b>Descriptive Statistics:</b> 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	<b>Inferential Statistics:</b> 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	15

	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.	
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**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 DasguptaFundamentals 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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Of Arts, Science and Commerce, Camp, Pune-1

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NAAC accredited 'A' Grade

<b>Course/ Paper Title</b>	<b>Applied Biology</b>
<b>Course Code</b>	<b>23SMBC28MEB</b>
<b>Semester</b>	II
<b>No. of Credits</b>	2 Credits, (30 Hours)

### **Aims & Objectives of the Course**

<b>Objectives</b>
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.

### **Expected Course Specific Learning Outcomes**

<b>Learning Outcome</b>
<b>Student should be able to –</b>
1. Develop a comprehensive understanding of the molecular processes involved in transcription, including the roles of RNA polymerases, promoters, enhancers, silencers, transcription factors, and the mediator complex, as well as how chromatin remodeling and epigenetic regulation influence gene expression.
2. Learn about the various post-transcriptional modifications such as splicing, capping, polyadenylation, RNA editing, and the regulation of mRNA stability, along with mechanisms such as siRNA, miRNA, and translation repression that control gene expression after transcription.
3. Understand the process of translation, including initiation, elongation, and termination, and explore the regulatory mechanisms that control translation, along with the post-translational modifications and protein degradation pathways that influence protein function and cellular processes.
4. Gain proficiency in techniques used to study gene expression, such as Northern blots, reporter gene assays, and assays for DNA-protein and protein-protein interactions, enabling the measurement of transcription rates, protein accumulation, and gene regulation in various experimental contexts, including host-pathogen interactions.

### 23SMBC28MEB: Applied Biology (30 Hours)

Sr. No.	Name of the Topic	Hours
1	<b>Transcription in Eukaryotes:</b> 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	<b>Overview of Regulation of Viral Gene Expression (both plant and animal) in connection to host-pathogen interaction:</b> 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. 5<sup>th</sup> edition. McGraw-Hill Education.



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

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NAAC accredited 'A' Grade

<b>Course/ Paper Title</b>	<b>Fermentation Technology</b>
<b>Course Code</b>	<b>23SMBC29MEA</b>
<b>Semester</b>	<b>II</b>
<b>No. of Credits</b>	<b>2 Credits, (30 Hours)</b>

### **Aims & Objectives of the Course**

<b>Objectives</b>
<ol style="list-style-type: none"><li>1. To understand sterilization and disinfection techniques.</li><li>2. To explore fermentation science and applications.</li><li>3. To learn about industrial microbial practices.</li><li>4. To study biotechnological production of metabolites and biopharmaceuticals.</li></ol>

### **Expected Course Specific Learning Outcomes**

<b>Learning Outcome</b>
<p><b>Student should be able to –</b></p> <ol style="list-style-type: none"><li>1. Develop a clear understanding of the principles, methods, and mechanisms of action of various sterilization and disinfection techniques, including physical agents (e.g., heat, radiation, filtration) and chemical agents (e.g., phenol, aldehydes, hypochlorites), and their applications in different industries.</li><li>2. Gain knowledge of the historical development and scientific principles behind fermentation, including its role in producing traditional fermented foods, and the use of microorganisms and enzymes in industrial fermentation processes.</li><li>3. Understand the processes involved in the isolation, preservation, and improvement of industrially significant microorganisms, and the preparation and storage of inoculum and cell banks for large-scale fermentation.</li><li>4. Explore the metabolic pathways used in the production of primary and secondary metabolites, including biopharmaceuticals, and understand the nutritional and health benefits of fermented foods for human consumption.</li></ol>

### 23SMBC29MEA: Fermentation Technology (30 Hours)

Sr. No.	Name of the Topic	Hours
1	<b>Sterilization and Disinfection</b> – 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	<b>Fermentation as Co-evolutionary Force:</b> 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.



**M. C. E. Society's**

**Abeda Inamdar Senior College**

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

(Autonomous) Affiliated to Savitribai Phule Pune University, Pune

NAAC accredited 'A' Grade

<b>Course/ Paper Title</b>	<b>Bioremediation</b>
<b>Course Code</b>	<b>23SMBC29MEB</b>
<b>Semester</b>	II
<b>No. of Credits</b>	2 Credits, (30 Hours)

**Aims & Objectives of the Course**

<b>Objectives</b>
<ol style="list-style-type: none"> <li>1. To understand the concept and types of bioremediation</li> <li>2. To recognize the importance of bioremediation in environmental cleanup.</li> <li>3. To acquire the knowledge of mycoremediation and it's applications in reducing environmental pollutants.</li> </ol>

**Expected Course Specific Learning Outcomes**

<b>Learning Outcome</b>
<p><b>Student should be able to –</b></p> <ol style="list-style-type: none"> <li>1. Have the knowledge of different methods of bioremediation.</li> <li>2. Able to apply the knowledge of bioremediation and mycoremediation in creating an eco-friendly environment.</li> <li>3. To understand the recent trends in bioremediation and it's challenges.</li> </ol>

**23SMBC29MEB: Bioremediation (30 Hours)**

Sr. No.	Name of the Topic	Hours
1	<b>Introduction:</b> Bioremediation it's principle and applications in environmental cleanup. Biological factors, oxygen, and moisture content of soil, availability of nutrients, pH, and temperature.	04
2	<b>Concept of Biostimulation and Bioaugmentation:</b> Microorganisms involved in bioremediation of organic pollutants, overview of mechanism of bacterial bioremediation.	08
3	<b>Types of Bioremediation:</b> In-situ and Ex-situ methods of bioremediation, In-situ bioremediation- Bioventing, biosparging methods, Ex-situ bioremediation- Land farming, composting, biopile process	08
4	<b>Recent Advancements and Challenges in Bioremediation:</b> Advantages and	02

	disadvantages of bioremediation.	
5	<b>Mycoremediation:</b> 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.



**M. C. E. Society's**

## **Abeda Inamdar Senior College**

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

(Autonomous) Affiliated to Savitribai Phule Pune University, Pune

NAAC accredited 'A' Grade

<b>Course/ Paper Title</b>	<b>Field Work / On Job training (OJT)</b>
<b>Course Code</b>	<b>23SMBC12FP</b>
<b>Semester</b>	II
<b>No. of Credits</b>	4 Credits, (120 Hours)

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 2<sup>nd</sup> 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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