DWARAKA DOSS GOVERDHAN DOSS VAISHNAV COLLEGE
(Autonomous)
Reaccredited by NAAC with "A++" grade
College with Potential for Excellence, Linguistic Minority Institution
Affiliated to University of Madras
Arumbakkam, Chennai – 600 106

DIAMOND JUBILEE YEAR 1964-2024

# DEPARTMENT OF BIOCHEMISTRY

## M.Sc., Biochemistry

## I – IV SEMESTERS

## SCHEME AND SYLLABUS

## Effective For the Students Admitted from the Academic Year 2025 Onwards

## INSTITUTION

### VISION

To impart value-based quality academia; to empower students with wisdom and to charge them with rich Indian traditions and culture; to invoke the self, to broaden the same towards nation building, harmony and Universal brotherhood.

### MISSION

To ensure sustained progress and development in imparting quality education, to pioneer new avenues of teaching and research and to emerge as an institution with potential for excellence.

## DEPARTMENT OF BIOCHEMISTRY

### VISION

"To become a globally recognized center of excellence in Biochemistry by fostering innovative teaching, advancing cutting-edge research, and empowering society through impactful contributions, while nurturing professionals who combine technical expertise, entrepreneurial innovation, and real-world problem-solving skills to address global challenges and drive transformative advancements."

### MISSION

| | |
|---|---|
| M1 | To provide better understanding of the subject with sound knowledge in theory and practical and apply the biochemical knowledge in solving health and environment related problems |
| M2 | To cultivate the ability to apply creativity and independent thinking to bridge the gap between industry and academics to meet the industrial demands. |
| M3 | To follow a multidisciplinary research strategy by harnessing all the available resources |

### PROGRAM EDUCATION OBJECTIVES (PEOs)

| **Our programme will produce graduates who** | |
|---|---|
| **PEO1** | Will demonstrate the knowledge, understanding and application, of the various concepts related to Biochemistry. |
| **PEO2** | Will have sound foundation in scientific knowledge required to solve practical challenges during their work as a professional. |
| **PEO3** | Will possess professional, ethical & effective communication skills and critical thinking and have problem solving ability with multidisciplinary approach. |
| **PEO4** | will be able to design, plan and execute small scientific projects. |
| **PEO5** | Will have a sense of belonging to the Institution and strengthen all departmental activities through their support. |

**PEO TO MISSION STATEMENT MAPPING**

| MISSION STATEMENTS | PEO1 | PEO2 | PEO3 | PEO4 | PEO5 |
|---|---|---|---|---|---|
| M1 | 3 | 3 | 3 | 3 | 3 |
| M2 | 3 | 3 | 3 | 3 | 3 |
| M3 | 3 | 3 | 3 | 3 | 3 |

**CORRELATION: 3- STRONG, 2- MEDIUM, 1- LOW**

**PROGRAM OUTCOMES (PO) IN RELATION TO GRADUATE ATTRIBUTES**

| | |
|---|---|
| **PO1** | Attain a high level of proficiency and understanding in all aspects of the subject |
| **PO2** | Identify and resolve problems efficiently, applying critical thinking to everyday situations |
| **PO3** | Develop strategies to mitigate public health and safety risks and promote community welfare |
| **PO4** | Execute lab experiments in accordance with safety guidelines and best practices. |
| **PO5** | Establish a solid grounding in life sciences to pave the way for a thriving career and entrepreneurial ventures |
| **PO6** | Prepare for Research and development success by cultivating expertise and staying attuned to emerging industry requirement. |

**MAPPING OF POs TO PEOs**

| PEO/PO | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 |
|---|---|---|---|---|---|---|
| **PEO 1** | 3 | 3 | 3 | 3 | 3 | 3 |
| **PEO 2** | 3 | 3 | 3 | 3 | 3 | 3 |
| **PEO 3** | 3 | 3 | 3 | 3 | 3 | 3 |
| **PEO 4** | 3 | 3 | 3 | 3 | 3 | 3 |
| **PEO 5** | 3 | 3 | 3 | 3 | 3 | 3 |

**3-Strong Correlation 2- Medium Correlation 1- Low Correlation**

**PROGRAM SPECIFIC OUTCOMES**

| **After successful completion of a 2-year MSc programme, the students will be able to** | |
|---|---|
| **PSO1** | Understand the fundamental concepts, principles, and processes underlying the academic field of Biochemistry, its different subfields (clinical, nutritional, molecular biology), and its linkages with related disciplinary areas/subjects |
| **PSO2** | Demonstrate the structure of macromolecules, enzyme kinetic behaviour, gene expression, metabolic control, molecular signalling, immunity, etc |
| **PSO3** | Impart practical skills and scientific knowledge in domains of Molecular biology, enzymology, clinical Biochemistry, Microbiology, immunology, and Bioinformatics |
| **PSO4** | Demonstrate procedural knowledge that creates different types of professionals in Biochemistry and related fields such as research, pharmaceuticals, the food industry, clinical laboratories, teaching, product quality, the cosmetics industry, etc. |
| **PSO5** | Identify environmental problems, analyze, and derive valid conclusions with fundamental knowledge in biology and computers. Apply reasoning to assess societal and health issues |

## DEPARTMENT OF BIOCHEMISTRY

### ELIGIBILITY FOR ADMISSION

The candidate must have completed B.Sc., Biochemistry or any other relevant life science disciplines like Chemistry, Botany, Zoology, Microbiology, and Biotechnology from an accredited university with a minimum of 50% marks in aggregate.

### DURATION OF THE COURSE

The duration of the course for two academic years, consisting of four semesters, and each semester comprises 90 days.

### CURRICULUM

The M.Sc. in Biochemistry curriculum typically covers fundamental and advanced topics in biochemistry, focusing on the structure, function, and regulation of biomolecules, metabolic pathways, and cellular processes. The curriculum often includes courses in analytical methods, microbiology, statistics, and intellectual property. It also delves into molecular biology, enzyme kinetics, and the role of biochemistry in various diseases.

### DISSERTATION

Semester IV consists of a project and dissertation for 100 marks. Students are allocated individually to a dissertation with the faculty of the department. The format for dissertations is similar to the thesis style, incorporating introduction, materials & methods, results, discussion, and bibliography. The dissertation is submitted in a typewritten and bound form after a plagiarism check, and a copy of each dissertation is submitted to the Department for permanent record. Each student should present/ publish a paper on his/her project.

### ELIGIBILITY FOR THE AWARD OF DEGREE

A Candidate shall be eligible for the award of Master of science in Biochemistry if he/she has undergone the prescribed course of study in the college affiliated to University for a period of not less than two academic years and passed the examinations of all the four semesters prescribed earning a minimum of 91 Credits as per the given distribution and also fulfilled other conditions as have been prescribed thereof.

**SCHEME ON EXAMINATIONS**

As per the University Regulation, the following split-up of marks is to be followed.

**(i) SPLIT UP FOR INTERNAL AND EXTERNAL MARKS FOR THEORY AND PRACTICAL**

| Sl. No. | Paper | Internal | External | Total |
|---|---|---|---|---|
| 1. | Theory | 50 | 50 | 100 |
| 2. | Practical | 50 | 50 | 100 |

**(ii) SPLIT UP FOR INTERNAL ASSESSMENT MARKS FOR THEORY**

**CIE- Continuous Internal Evaluation (50 Marks)**

| | |
|---|---|
| **CIA** | **30** |
| **Generic Skill** | **15** |
| **Attendance** | **5** |
| **Total** | **50** |

**iii) MARKING SCHEME FOR ATTENDANCE**

| Attendance | Marks (5) |
|---|---|
| 80 % and above | 5 |
| 75-80% | 4 |
| 65-74% | 3 |
| 51-64% | 2 |
| 31-50% | 1 |
| Less than 30 % | 0 |

**iv) SPLIT UP FOR INTERNAL ASSESSMENT MARKS FOR PRACTICALS**

| Break-up | Marks (50) |
|---|---|
| Model Examination | 25 |
| Classroom Practicals | 20 |
| Attendance | 05 |
| **Total** | **50** |

## SCHEME OF I SEMESTER M.Sc., BIOCHEMISTRY PROGRAM

| SEMESTER I | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Component** | **Course Category** | **Course Code** | **Name of the Course** | **Overall Credits** | **Hrs Distribution** | | | | **Total Contact Hours** | **Marks** | | |
| | | | | | L | T | P | S | | CIA | ESE | Total |
| **Part I** | **Core Course I** | 2524101 | Biomolecules | 4 | 4 | 1 | 0 | 0 | 5 | 50 | 50 | 100 |
| | **Core Course II** | 2524102 | Intermediary Metabolism | 4 | 4 | 1 | 0 | 0 | 5 | 50 | 50 | 100 |
| | **Core Course III** | 2524103 | Human Physiology and Nutrition | 4 | 5 | 0 | 0 | 0 | 5 | 50 | 50 | 100 |
| | **Core Course IV** | 2524104 | Enzymes | 4 | 4 | 1 | 0 | 0 | 5 | 50 | 50 | 100 |
| | **Core Practical I** | 2524105 | Biomolecules and Intermediary Metabolism | 3 | 0 | 0 | 5 | 0 | 5 | 50 | 50 | 100 |
| | **Core Practical II** | 2524106 | Enzymes and Nutritional Biochemistry | 3 | 1 | 0 | 4 | 0 | 5 | 50 | 50 | 100 |
| **Part II** | **Soft Skill I** | | | 2 | 2 | 0 | 0 | 0 | | 50 | 50 | 100 |
| **Total** | | | | **24** | | | | | **30** | | | |

## SCHEME OF II SEMESTER M.Sc., BIOCHEMISTRY PROGRAM

| SEMESTER II | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Component** | **Course Category** | **Course Code** | **Name of the Course** | **Overall Credits** | **Hrs Distribution** | | | | **Total Contact Hours** | **Marks** | | |
| | | | | | L | T | P | S | | CIA | ESE | Total |
| **Part I** | **Core Course V** | 2524207 | Analytical Biochemistry | 4 | 4 | 1 | 0 | 0 | 5 | 50 | 50 | 100 |
| | **Core Course VI** | 2524208 | Molecular Biology | 4 | 4 | 1 | 0 | 0 | 5 | 50 | 50 | 100 |
| | **Core Course VII** | 2524209 | Microbiology | 4 | 5 | 0 | 0 | 0 | 5 | 50 | 50 | 100 |
| | **Core Course VIII** | 2524210 | Immunology | 4 | 4 | 1 | 0 | 0 | 5 | 50 | 50 | 100 |
| | **Core Practical III** | 2524211 | Analytical Biochemistry and Molecular Biology | 3 | 1 | 0 | 4 | 0 | 5 | 50 | 50 | 100 |
| | **Core Practical IV** | 2524212 | Microbiology and Immunology | 3 | 1 | 0 | 4 | 0 | 5 | 50 | 50 | 100 |
| **Part II** | **Soft Skill II** | | | 2 | 2 | 0 | 0 | 0 | | 50 | 50 | 100 |
| **Total** | | | | **24** | | | | | **30** | | | |

## SCHEME OF III SEMESTER M.Sc., BIOCHEMISTRY PROGRAM

| SEMESTER III | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Component** | **Course Category** | **Course Code** | **Name of the Course** | **Over All Credits** | **Hrs Distribution** | | | | **Total contact Hours** | **Marks** | | |
| | | | | | L | T | P | S | | CIA | ESE | Total |
| **Part I** | **Core Course IX** | 2524313 | Advanced Clinical Biochemistry | 4 | 5 | 0 | 0 | 0 | 5 | 50 | 50 | 100 |
| | **Core Course X** | 2524314 | Biotechnology | 4 | 4 | 1 | 0 | 0 | 5 | 50 | 50 | 100 |
| | **Discipline Specific Elective I** Employability Course I (A) | 2524315(A) | Membrane Biochemistry | 3 | 4 | 0 | 0 | 0 | 4 | 50 | 50 | 100 |
| | **OR** | | | | | | | | | | | |
| | **Discipline Specific Elective I** Employability Course I (B) | 2524315(B) | Plant Biochemistry | | 4 | 0 | 0 | 0 | | 50 | 50 | 100 |
| | **OR** | | | | | | | | | | | |
| | **Discipline Specific Elective I** Employability Course I (C) | 2524315(C) | Stem Cell Biology | | 4 | 0 | 0 | 0 | | 50 | 50 | 100 |
| | **Discipline Specific Elective II** Entrepreneurship Course II (A) | 2524316(A) | Nanotechnology | 3 | 4 | 0 | 0 | 0 | 4 | 50 | 50 | 100 |
| | **OR** | | | | | | | | | | | |
| | **Discipline Specific Elective II** Entrepreneurship Course II (B) | 2524316(B) | Fundamentals of Forensic Science | | 4 | 0 | 0 | 0 | | 50 | 50 | 100 |
| | **OR** | | | | | | | | | | | |
| | **Discipline Specific Elective II** Entrepreneurship Course II (C) | 2524316(C) | Molecular Endocrinology | | 4 | 0 | 0 | 0 | | 50 | 50 | 100 |
| | **Multi-Discipline Elective/Open Elective I** | 2524317 | Healthcare Management | 3 | 4 | 0 | 0 | 0 | 4 | 50 | 50 | 100 |
| | **Core Practical V** | 2524318 | Advanced Clinical Biochemistry | 3 | 1 | 0 | 4 | 0 | 5 | 50 | 50 | 100 |
| | **Internship** | 2524319 | | 2 | - | - | - | - | - | 50 | 50 | 100 |
| **Part II** | **Soft Skill III** | | | 2 | 2 | 0 | 0 | 0 | - | 50 | 50 | 100 |
| | **Skill Enhancement Course- Discipline Specific I** | 2524320 | Bioinformatics | 3 | 2 | | 1 | | 3 | 50 | 50 | 100 |
| **Total** | | | | **27** | | | | | **30** | | | |

## SCHEME OF IV SEMESTER M.Sc., BIOCHEMISTRY PROGRAM

| SEMESTER IV | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Component** | **Course Category** | **Course Code** | **Name of the Course** | **Overall Credits** | **Hrs Distribution** | | | | **Total contact Hours** | **Marks** | | |
| | | | | | L | T | P | S | | CIA | ESE | Total |
| **Part I** | **Discipline Specific Elective III** Entrepreneurship Course III(A) | 2524421 (A) | Bioethics, IPR & HR | 3 | 4 | 0 | 0 | 0 | 4 | 50 | 50 | 100 |
| | **OR** | | | | | | | | | | | |
| | **Discipline Specific Elective III** Entrepreneurship Course III (B) | 2524421 (B) | Developmental Biology | | 4 | 0 | 0 | 0 | | 50 | 50 | 100 |
| | **OR** | | | | | | | | | | | |
| | **Discipline Specific Elective III** Entrepreneurship Course III (C) | 2524421 (C) | Biochemical Pharmacology and Toxicology | | 4 | 0 | 0 | 0 | | 50 | 50 | 100 |
| | **Discipline Specific Elective IV -** Employability Course IV(A) | 2524422 (A) | Gene Editing and Gene Therapy | 3 | 4 | 0 | 0 | 0 | 4 | 50 | 50 | 100 |
| | **OR** | | | | | | | | | | | |
| | **Discipline Specific Elective IV -** Employability Course IV(B) | 2524422 (B) | Molecular Basis of Diseases and Therapeutic Strategies | | 4 | 0 | 0 | 0 | | 50 | 50 | 100 |
| | **OR** | | | | | | | | | | | |
| | **Discipline Specific Elective IV** Employability Course IV(C) | 2524422 (C) | Nutrigenomics | | 4 | 0 | 0 | 0 | | 50 | 50 | 100 |
| | **Core Project** | 2524423 | | 4 | | | | | 19 | 50 | 50 | 100 |
| **Part II** | **Skill Enhancement Course – Discipline Specific II** | 2524424 | Biostatistics and Research Methodology | 3 | 3 | 0 | 0 | 0 | 3 | | | |
| | **Soft skill IV** | | | 2 | 2 | 0 | 0 | 0 | - | 50 | 50 | 100 |
| | **Industrial Visit** | 2524425 | | 1 | - | - | - | - | - | 50 | 50 | 50 |
| **Total** | | | | **16** | | | | | **30** | | | |

**DSE**-Discipline Specific Elective; **OE**- Open Elective /**MDE**-Multi-Disciplinary Elective ;
**SEC-DS**- Skill Enhancement Course- Discipline Specific;

## OVERALL SEMESTER-WISE CREDIT DISTRIBUTION

| Sl No | Category | Course Category | No of Courses | Credits | Total Credits |
|---|---|---|---|---|---|
| 1. | Part I | Core Theory | 10 | 4 | 40 |
| 2. | | Core Practical | 5 | 3 | 15 |
| 3. | | Core Project | 1 | 4 | 4 |
| 4. | | Core Internship | 1 | 2 | 2 |
| 5. | | Discipline-Specific Elective | 4 | 3 | 12 |
| 6. | | Multi-Disciplinary Elective | 1 | 3 | 3 |
| 7. | Part II | Skill Enhancement Course - Discipline Specific | 2 | 3 | 6 |
| 8. | | Soft Skill | 4 | 2 | 8 |
| 9. | | Industrial Visit | 1 | 1 | 1 |
| 10. | Total Mandatory Credits | | | 91 | |
| 11. | Extra Credits<br>**Note: Students can take extra credit course from their own department or from other department as per the Admitting Body / University norms.**<br>**Self-Study course (2C)** - (Department specific , curriculum and Evaluation scheme and assessment to be framed by the department<br>**Value added course** - minimum 30hrs **(2C)**<br>**Certificate Course/Short-Time Course** - minimum of 15 days (minimum 45 hrs) **(3C) -** preferred online<br>**Swayam/NPTEL/MOOC courses (2C)** - maximum of 12 credits<br>**Skilled based vocational courses (2C)** e.g. basic computing skill, tailoring, jewel making, beauty parlour course, interiors etc., through skill development cell of college.<br>**Other languages (2C)**<br>**International HRD program** – 30hrs **(2C)** | | | | |

**Total Credits 91 ; Part I- 76 : Part II 15 (8+6+1)**

**I M.Sc BIOCHEMISTRY**

**FIRST SEMESTER**

**Core Course I**

**Course Title: BIOMOLECULES**

| | | | |
|---|---|---|---|
| **Course code** | **2524101** | **Credits** | **04** |
| **L:T:P:S** | **4:1:0:0** | **CIA Marks** | **50** |
| **Exam Hours** | **03** | **ESE Marks** | **100** |

**LEARNING OBJECTIVE**

To understand the properties of carbohydrates, proteins, lipids, cholesterol, DNA, RNA, glycoproteins and glycolipids and their importance in biological systems.

**COURSE OUTCOMES: At the end of the Course, the Student will be able to:**

| | |
|---|---|
| **CO1** | Explain the structure, types, and functions of carbohydrates, including sugar derivatives and bacterial cell wall polysaccharides. |
| **CO2** | Identify amino acid structures and classify proteins based on properties and structure. |
| **CO3** | Analyze protein structures and explain the stabilization forces and peptide synthesis. |
| **CO4** | Differentiate DNA and RNA, and describe the structure and roles of nucleotides and nucleic acids. |
| **CO5** | Classify different lipids and explain their structure, properties, and biological functions. |

**Mapping of Course Outcomes to Program Outcomes and Program-Specific Outcomes:**

| CO/PO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| CO2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| CO3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| CO4 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| CO5 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |

**CORRELATION: 3-STRONG 2- MEDIUM 3- LOW**

| MO. NO. | CONTENTS OF MODULE | HRs | COs |
|---|---|---|---|
| I | **Carbohydrates:** Definition, nomenclature, classification, structure, chemistry and function of Carbohydrates:- occurrence, classification and chemical properties of Monosaccharides:- structure and biological importance of sugars, their derivatives, NTPs, lactones, glycosides – Disaccharides, Lactose, Maltose, Sucrose – Oligosaccharides – structure and biological importance-Homoglycans; starch, glycogen, cellulose, dextrin, inulin, Heteroglycans -mucopolysaccharides – cell surface carbohydrates; bacterial cell wall polysaccharides. | 15 | CO1 |
| II | **Amino Acids:** Classification, structure and properties of amino acids - Classification and biological functions of proteins - Primary structure of proteins and sequence determination. Peptide bond and its salient features - secondary structure – α helix, β-pleated sheet and turns- Ramachandran Plot. Super secondary structures, motifs- helix-loop helix, hairpin, β-motif, β-α-β motif. Conformational study of collagen. | 15 | CO2 |
| III | **Proteins:** Tertiary structure of proteins (myoglobin) –quaternary structure of proteins of hemoglobin. Forces that stabilize the protein structure: Chemical synthesis of peptides, Folding of proteins. | 10 | CO3 |
| IV | **Nucleic Acids**: Structure of Purine, Pyrimidine, nucleosides and nucleotides - Major classes of RNA, their structure and biological function. Watson and Crick Model, A, B, and Z forms of DNA. DNA supercoiling - Properties of DNA – hypochromicity, hyperchromicity, denaturation and renaturation, Cot curve, C value paradox. Maxam-Gilbert method, Sanger's dideoxy method, and enzymatic methods of sequence analysis. Chemical synthesis of oligonucleotides. | 13 | CO4 |
| V | **Lipids:** Definitions, general structure of fatty acids- biological functions of lipids- properties of lipids- classification of lipids- simple fats, oils, waxes. compound lipids, phospholipids, sulpholipids, glycolipids. Derived lipids- structure and function of important steroids- cholesterol, bile acids. Terpenes- mono, di, poly and sesqueterpenes, carotenes and xanthophylls. | 12 | CO5 |

**RECOMMENDED BOOKS**


1. J. L. Jain, N. J. (2016). *Fundamentals of Biochemistry 7th edition.* S. Chand @ Co. Ltd- ISBN: 9788121924535
2. Sathyanarayana. (2017). *Biochemistry.* Elsevier - ISBN: 9788131236017
3. David.L.Nelson, M. M. (2017). *Lehninger's Principles of Biochemistry* .7th ed, Freeman. W.H. and Company - ISBN 10: 1464126119 / ISBN 13: 9781464126116


**REFERENCE BOOKS**


1. Rodwell, V. (2018). *Harper's Illustrated Biochemistry.* McGrew. Hill .
2. Jeremy M. Berg, L. e. (2019). *Biochemistry* . WH Freeman - ISBN-10 : 812243049X, ISBN-13 : 978-8122430493.
3. Donald Voet, C. W. (2012). *Principles of Biochemistry* (4th ed.). Wiley - ISBN 10: 1118092449 / ISBN 13: 9781118092446.


**WEB LINKS**

1. https://onlinecourses.nptel.ac.in/noc22_cy06/preview
2. https://onlinecourses.nptel.ac.in/noc24_bt12/preview
3. https://archive.nptel.ac.in/courses/104/105/102105034/

**I M.Sc BIOCHEMISTRY**

**FIRST SEMESTER**

**Core Course II**

**Course Title: INTERMEDIARY METABOLISM**

| | | | |
|---|---|---|---|
| **Course Code** | **2524102** | **Credits** | **04** |
| **L:T:P:S** | **4:1:0:0** | **CIA Marks** | **50** |
| **Exam Hours** | **03** | **ESE Marks** | **100** |

**LEARNING OBJECTIVE**

To explore the biochemical pathways of intermediary metabolism, including carbohydrate, lipid, and amino acid metabolism, and to analyse how these pathways are integrated and regulated

**COURSE OUTCOMES: At the end of the Course, the Student will be able to:**

| | |
|---|---|
| **CO1** | Define metabolism and describe the glucose metabolism pathways—glycolysis, TCA cycle, and electron transport chain (ETC) involved in ATP production. |
| **CO2** | Explain fatty acid oxidation and synthesis, and identify key steps in cholesterol metabolism and synthesis of prostaglandins, leukotrienes, and thromboxanes. |
| **CO3** | Explain how cells generate biochemical energy using thermodynamic principles and demonstrate energy coupling in endergonic and exergonic reactions. |
| **CO4** | Describe the urea cycle and outline the synthesis of biologically important amines. |
| **CO5** | Apply the chemical reactions involved in purine and pyrimidine metabolism |

**Mapping of Course Outcomes to Program Outcomes And Program-Specific Outcomes:**

| CO/PO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 3 | 3 | 2 | 3 | 2 | 3 | 3 | 2 | 3 | 3 |
| CO2 | 3 | 3 | 3 | 2 | 3 | 2 | 3 | 3 | 2 | 3 | 3 |
| CO3 | 3 | 3 | 3 | 2 | 3 | 2 | 3 | 3 | 2 | 3 | 3 |
| CO4 | 3 | 3 | 3 | 2 | 3 | 2 | 3 | 3 | 2 | 3 | 3 |
| CO5 | 3 | 3 | 3 | 2 | 3 | 2 | 3 | 3 | 2 | 3 | 3 |

**CORRELATION: 3-STRONG 2- MEDIUM 3- LOW**

| MO. NO. | CONTENTS OF MODULE | HRs | COs |
|---|---|---|---|
| I | **Carbohydrate Metabolism**: Definition of Metabolism, Anabolism, and Catabolism. Carbohydrate metabolism: Aerobic and anaerobic glycolysis and energetics of glycolysis. Pyruvate Dehydrogenase Complex. TCA cycle and energetics. Gluconeogenesis, Metabolism of glycogen, Pentose Phosphate Pathway | **15** | **CO1** |
| II | **Lipid Metabolism**- Biosynthesis of FA, sphingolipids, phosphoglycerides - Beta oxidation, Alpha oxidation, Omega oxidation. Biosynthesis and degradation of cholesterol, Role of HMG CoA Reductase - arachidonic acid pathway – eicosanoids. | **15** | **CO2** |
| III | **Biological Oxidation**: ETC – Redox potential – redox couple – action potential – free energy - Role of high-energy phosphates, Components, sequence and Inhibitors of electron transport chain. Oxidative phosphorylation- the chemiosmotic hypothesis. F0 F1 ATP synthase. ATP biosynthesis. Uncouplers, ATP/ADP exchange, malate aspartate/glycerol phosphate shuttle | **10** | **CO3** |
| IV | **Amino Acid Metabolism**: Transamination and its mechanism, oxidative and non-oxidative deamination, decarboxylation-urea cycle and its regulation. Conversion of amino acids to specialized products. Serotonin, gamma aminobutyric acid, dopamine, epinephrine, nor-epinephrine, creatinine, creatine. | **13** | **CO4** |
| V | **Nucleic Acid Metabolism** – Synthesis of Purine and Pyrimidine – De novo and Salvage pathway. Regulation - Degradation of purines and pyrimidines. | **12** | **CO5** |

**RECOMMENDED BOOKS**


1. Sathyanarayana. (2017). *Biochemistry.* Elsevier - ISBN: 9788131236017
2. Rodwell, V. (2018). *Harper's Illustrated Biochemistry.* McGrew. Hill.
3. David.L.Nelson, M. M. (2017). *Lehninger's Principles of Biochemistry.* 7th ed, Freeman. W.H. and Company - ISBN 10: 1464126119 / ISBN 13: 9781464126116


**REFERENCE BOOKS**


1. Jeremy M. Berg, L. e. (2019). *Biochemistry.* WH Freeman - ISBN-10 : 812243049X, ISBN-13 : 978-8122430493
2. J. L. Jain, N. J. (7th ed, 2016). *Fundamentals of Biochemistry, 7th edition.* S. Chand @ Co.Ltd - ISBN: 9788121924535
3. Voet.J.G, D. V. (2010). *Biochemistry* (4th ed.). John Wiley & Sons Inc - ISBN: 978-0-470-57095-1


**WEB LINKS**

1. https://onlinecourses.nptel.ac.in/noc25_bt03/preview
2. https://onlinecourses.nptel.ac.in/noc23_cy61/preview
3. https://onlinecourses.nptel.ac.in/noc24_bt12/preview

**I M.Sc BIOCHEMISTRY**

**FIRST SEMESTER**

**Core Course III**

**Course Title: HUMAN PHYSIOLOGY AND NUTRITION**

| Course Code | 2524103 | Credits | 04 |
|---|---|---|---|
| L:T:P:S | 5:0:0:0 | CIA Marks | 50 |
| Exam Hours | 03 | ESE Marks | 100 |

**LEARNING OBJECTIVE**

To gain insights into the fundamental principles of human physiology and the role of nutrition in maintaining health.

**COURSE OUTCOMES: At the end of the Course, the Student will be able to:**

| | |
|---|---|
| CO1 | Explain the functions and mechanisms of blood components , hematopoiesis, blood coagulation, blood groups, and lymph formation, while understanding the structure, properties, and functioning of the circulatory system, |
| CO2 | Describe the components and mechanisms of the respiratory system, while explaining the processes of digestion and absorption of carbohydrates, proteins, and fats in the digestive system. |
| CO3 | Analyze the structure and function of the excretory system, while exploring the nervous system's structure, resting/action potentials, neurotransmitters and the role of GABA in nerve impulse transmission. |
| CO4 | Identify the nutritional aspects of carbohydrates, proteins, and lipids, including dietary sources, RDA, physiological roles while analyzing the health status in their deficiency state. |
| CO5 | Compare the classification, dietary sources, RDA, deficiency symptoms, and physiological functions of vitamins (A, D, C, B1, B2, folic acid) and minerals (calcium, phosphorus, magnesium, iron, iodine, zinc). |

**Mapping of Course Outcomes to Program Outcomes and Program Specific Outcome:**

| CO/PO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 2 | 3 | 3 |
| CO2 | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 2 | 3 | 3 |
| CO3 | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 2 | 3 | 3 |
| CO4 | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 2 | 3 | 3 |
| CO5 | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 2 | 3 | 3 |

**CORRELATION: 3-STRONG 2- MEDIUM 3- LOW**

| MO. NO | CONTENTS OF MODULE | HRs | COs |
|---|---|---|---|
| I | **Blood:** Composition and function, Red blood cells, Hemoglobin, white blood cells, and platelets. Hematopoiesis- Blood coagulation, blood groups, and blood transfusion. Formation and functions of lymph.<br>**Circulatory System**: heart position, structure, properties of cardiac muscle. overview of systemic and pulmonary circulation, conducting system of the heart, heart rate, cardiac cycle, cardiac output. | 15 | CO1 |
| II | **Respiratory System:** Components of the respiratory system, Mechanism of respiration. Bohr effect – gas exchange and partial oxygen pressure, chloride shift. **Digestive System:** Secretion of digestive juices, digestion, and absorption of carbohydrates, proteins, and fats. | 15 | CO2 |
| III | **Excretory System:** Components of the excretory system, structure of the kidney. Mechanism of formation of urine, composition of urine.<br>**Nervous system:** Structure of neuron, resting potential and action potential, neurotransmitters- definitions, types – cholinergic and adrenergic with examples. Role of GABA -Mechanism of nerve impulse transmission. | 10 | CO3 |
| IV | **Nutrition:** Definition, Basic food groups. **Nutritional Aspects of Carbohydrates**- Dietary sources, RDA, Physiological role; significance of fiber in the diet. **Nutritional Aspects of Proteins** - Dietary sources, RDA, Physiological role; significance of essential amino acids, Protein energy malnutrition in children; **Nutritional Aspects of Lipids** - Dietary sources, RDA, Physiological role; significance of essential fatty acids, MUFAs, and PUFAs. | 13 | CO4 |
| V | **Vitamins** - Major classification, Dietary sources, RDA, deficiency symptoms and physiological functions of Vitamin A, D, Vitamin C, B1, B2 and folic acid. **Minerals** Dietary sources, RDA, deficiency symptoms and Physiological functions of dietary Calcium, phosphorus, magnesium, iron, iodine, zinc fortification – enrichment with examples. | 12 | CO5 |

**RECOMMENDED BOOKS**


1. Derrickson, G. J. (2017). *Principles of Anatomy and Physiology.* John Wiley and Sons - ISBN: 978-1-119-40006-6
2. Sembulingam, K. S. (2019). *Essentials Of Medical Physiology.* Jaypee Brothers Medical Publishers - ISBN 10: 9352706927
3. Sharma, D. S. (2017). *Nutritional Biochemistry.*CBS Publishers and distributors - ISBN 10: 8123925271 / ISBN 13: 9788123925271


**REFERENCE BOOKS**


1. D. Venkatesh, H. H. (2018). *Textbook of Medical Physiology.* Wolters Kluwer India Pvt. Ltd - ISBN-10 : 9387963535 / ISBN-13 : 978-9387963535
2. H. S. Ravi Kumar Patil, H. K. (2009). A Textbook of Human Physiology. I K International Publishing House Pvt. Ltd - ISBN : 9789380026503.
3. Srilakshmi, B. (2019). *Dietetics* (Multi Colour Edition ed.). New Age International Publishers - ISBN 10: 9386649209 / ISBN 13: 9789386649201


**WEB LINKS**

1. https://onlinecourses.nptel.ac.in/noc25_bt22/preview
2. https://onlinecourses.swayam2.ac.in/cec20_bt19/preview
3. https://onlinecourses.swayam2.ac.in/cec19_ag02/preview

**I M.Sc BIOCHEMISTRY**

**FIRST SEMESTER**

**Core Course IV**

**Course Course : ENZYMES**

| | | | |
|---|---|---|---|
| **Course Code** | **2524104** | **Credits** | **04** |
| **L:T:P:S** | **4:1:0:0** | **CIA Marks** | **50** |
| **Exam Hours** | **03** | **ESE Marks** | **100** |

**LEARNING OBJECTIVE**

To understand the structure, function, and kinetics of enzymes, factors affecting their activity and to analyze enzyme mechanisms and apply this knowledge to biochemical and clinical contexts.

**COURSE OUTCOMES: At the end of the Course, the Student will be able to:**

| | |
|---|---|
| **CO1** | Explain the chemical nature, nomenclature, and general characteristics of enzymes, including enzyme units. |
| **CO2** | Derive the Michaelis-Menten equation and its graphical representations to analyze enzyme kinetics, while understanding bi-substrate reaction mechanisms and factors affecting enzyme activity. |
| **CO3** | Evaluate the mechanisms of enzyme action, and regulation of enzyme activity |
| **CO4** | Analyze the effects of competitive, non-competitive, and uncompetitive inhibitors on enzyme kinetics and explain the role of coenzymes in enzyme catalysis, |
| **CO5** | Describe the principles of enzyme immobilization and their industrial applications and assess the roles of abzymes, ribozymes, and enzymes in medical diagnostics and food industry. |

**Mapping Of Course Outcomes to Program Outcomes And Program-Specific Outcomes:**

| CO/PO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| CO2 | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| CO3 | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| CO4 | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| CO5 | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |

**CORRELATION: 3-STRONG 2- MEDIUM 3- LOW**

| MO. NO | CONTENTS OF MODULE | HRs | COs |
|---|---|---|---|
| I | **Introduction** - chemical nature and general characterization - nomenclature, IUB system of enzyme classification - definitions with examples of holoenzyme, apoenzyme, isoenzymes, monomeric enzymes, oligomeric enzymes, multi-enzyme complexes, Coenzymes, cofactors, metalloenzymes, activators, inhibitors, active site, allosteric site, catalytic site, regulatory site on the enzyme molecule. Enzyme specificity, specific activity, enzyme units – IU, Katal and enzyme turnover number and specific activity. | 15 | CO1 |
| II | **Enzyme Kinetics** - Introduction to chemical kinetics, rate and order of reactions. Derivation of the Michaelis-Menten Equation. Line - Weaver and Burk plot, Eadie- Hofstee plot, Hanes plot - bi-substrate reactions - brief introduction to sequential and ping-pong mechanisms with examples. Factors affecting enzyme activity: enzyme concentration, substrate concentration, pH and temperature. | 15 | CO2 |
| III | **Mode of Action of Enzyme** - Definition and significance of energy of activation - Lock and key theory and induced fit theory - Regulation of enzyme activity - definition, types and examples. Enzyme catalysis -acid–base catalysis, Metal ion and proximity orientation effects. Mechanism of action of chymotrypsin, carboxypeptidase, ribonuclease, and lysoenzyme. | 10 | CO3 |
| IV | **Enzyme Inhibition** – Definition, examples, determination of $K_m$ and $V_{max}$ in the presence and absence of Competitive, non-competitive and uncompetitive inhibitors (with kinetic derivations). Coenzymes in enzyme catalysis: Reactions involving NAD/NADP, FMN/FAD, Coenzyme A, biotin, lipoamide, TPP, pyridoxal phosphate, tetrahydrofolate and cobamide. | 15 | CO4 |
| V | **Immobilization** of enzymes and their industrial applications – abzymes – ribozymes – Medical application of enzymes - use of glucose oxidase in enzyme electrodes. Application of enzymes in food industry. | 10 | CO5 |

**RECOMMENDED BOOKS**


1. David.L.Nelson, M. M. (7th ed 2017). *Lehninger Principles of Biochemistry* . Freeman. W.H. and Company - ISBN 10: 1464126119 / ISBN 13: 9781464126116
2. Trevor Palmer, P. B. (2007). *Enzymes.* Wood head Publishing(7th ed.). Wood head Publishing - ISBN : 9780857099921, 0857099922
3. Meenakshi Meena, D. C. (2009). *Fundamentals of Enzymology.* Aavinshankar Publisher - ISBN-10 : 8179102807 / ISBN-13 : 978-8179102800


**REFERENCE BOOKS**


1. Donald Voet, C. W. (2012). *Principles of Biochemistry(4th ed).* Wiley - ISBN 10: 1118092449 / ISBN 13: 9781118092446
2. Sathyanarayana. (2017). *Biochemistry.* Elsevier - ISBN: 9788131236017
3. Rodwell, V. (2018). *Harper's Illustrated Biochemistry.* McGrew. Hill .


**WEB LINKS**

1. https://onlinecourses.nptel.ac.in/noc23_bt05/preview
2. https://onlinecourses.nptel.ac.in/noc24_bt12/preview
3. https://archive.nptel.ac.in/courses/102/105/102105058/

**I M.Sc BIOCHEMISTRY**

**FIRST SEMESTER**

**Core Practical-I**

**Course Title: BIOMOLECULES AND INTERMEDIARY METABOLISM**

| | | | |
|---|---|---|---|
| **Course Code** | **2524105** | **Credits** | **03** |
| **L:T:P:S** | **0:0:5:0** | **CIA Marks** | **50** |
| **Exam Hours** | **06** | **ESE Marks** | **50** |

**LEARNING OBJECTIVE**

To develop proficiency in the estimation, extraction, and purification of biomolecules such as pyruvate, lactate, tryptophan, carbohydrates, proteins, lipids, starch, glycogen, and nucleic acids,

**COURSE OUTCOMES: At the end of the Course, the Student will be able to:**

| | |
|---|---|
| **CO1** | Examine colorimetric estimation of pyruvate, lactate, and tryptophan in biological samples. |
| **CO2** | Assess the concentration of carbohydrate and protein in an unknown solution |
| **CO3** | Demonstrate the extraction method for lipid and starch |
| **CO4** | Determine glycogen content in liver tissue and nucleic acid purity by A260/A280 ratio using standard laboratory techniques |
| **CO5** | Interpret the significance of determining the iodine number and saponification number of an edible oil |

**Mapping of Course Outcomes to Program Outcomes and Program-Specific Outcomes:**

| CO/PO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 2 |
| CO2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 2 |
| CO3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 2 |
| CO4 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 2 |
| CO5 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 2 |

**CORRELATION : 3 -STRONG 2- MEDIUM 3- LOW**

| Sl. No. | CONTENTS | HRs | COs |
|---|---|---|---|
| 1 | Estimation of Pyruvate | 5 | CO1 |
| 2 | Estimation of Lactate | 5 | CO1 |
| 3 | Estimation of Tryptophan | 5 | CO1 |
| 4 | Estimation of Carbohydrates by the Anthrone Method | 5 | CO2 |
| 5 | Estimation of Protein by Lowry's Method | 5 | CO2 |
| 6 | Extraction of Lipids from Oil Seeds | 5 | CO3 |
| 7 | Extraction and Purification of Starch from Potatoes | 5 | CO3 |
| 8 | Determination of Glycogen Content in Liver Tissue | 5 | CO4 |
| 9 | Determination of Nucleic Acid Purity by A260/A280 Ratio | 5 | CO4 |
| | **Demonstration Experiments** | | |
| 10 | Determination of the Iodine Number of an edible oil | 3 | CO5 |
| 11 | Determination of Saponification Number of an edible oil | 2 | CO5 |

**RECOMMENDED BOOKS**


1. S. K. Sawhney and Randhir Singh (2014). *Introductory Practical Biochemistry* Narosa Publishing House Reprint.
2. S. Sadasivam A. Manickam (2018). *Biochemical Methods* New Age International Pvt Ltd, Third edition
3. Singh, S. (2014). *Introductory Practical Biochemistry* (reprint ed.). Narosa Publishing House - ISBN 10: 9386217627 / ISBN 13: 9789386217622


**REFERENCE BOOKS**


1. Manickam, S. S. (2016). *Biochemical Methods*. New age International Pvt Ltd publishers - ISBN 10: 8122421407 / ISBN 13: 9788122421408
2. Jayaraman, J. (2011). *Laboratory Manual in Biochemistry.* New Age International Pvt Ltd Publishers - ISBN-10 : 812243049X, ISBN-13 : 978-8122430493
3. Ashwood, B. (2001). *Tietze's Fundamentals of Clinical Chemistry.* WB Saunders Company, Oxford Science Publications USA - ISBN 10: 0721686346 / ISBN 13: 9780721686349


**WEB LINKS**

1. https://youtu.be/pGIPcvwHJcU
2. https://youtu.be/VjnaRdINVWY
3. https://youtu.be/URFZgWd5m4k

**I M.Sc BIOCHEMISTRY**

**FIRST SEMESTER**

**Core Practical-II**

**Course title: ENZYMES AND NUTRITIONAL BIOCHEMISTRY**

| | | | |
|---|---|---|---|
| **Course Code** | **2524106** | **Credits** | **03** |
| **L:T:P:S** | **1:0:4:0** | **CIA Marks** | **50** |
| **Exam Hours** | **06** | **ESE Marks** | **50** |

**LEARNING OBJECTIVE**

To develop a comprehensive understanding of biochemical principles and analytical techniques by studying enzyme kinetics, biomolecule quantification, and nutrient analysis.

**COURSE OUTCOMES: At the end of the course, the student will be able to :**

| | |
|---|---|
| CO 1 | Determine and interpret the effects of pH, temperature, and substrate concentration on enzyme activity. |
| CO 2 | Evaluate the specific activity of enzymes like lactate dehydrogenase (LDH) and total ATPase |
| CO 3 | Assess the biochemical composition of food samples by estimating protein, iron, calcium, and ascorbic acid content using standard analytical methods |
| CO4 | Demonstrate spectrofluorimetry for the estimation of riboflavin |
| CO5 | Demonstrate proficiency in techniques such as native gel electrophoresis for separating LDH isoenzymes. |

**Mapping of Course Outcomes to Program Outcomes and Program-Specific Outcomes:**

| CO/PO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 2 |
| CO2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 2 |
| CO3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 2 |
| CO4 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 2 |
| CO5 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 2 |

**CORRRELATION : 3 -STRONG 2- MEDIUM 3- LOW**

| Sl.NO. | CONTENTS | HRs | COs |
|---|---|---|---|
| 1 | Determination of the Optimum pH of Salivary Amylase | 5 | CO1 |
| 2 | Determination of the Optimum Temperature of Acid Phosphatase | 5 | CO1 |
| 3 | Effect of Substrate concentration on the activity of Alkaline Phosphatase | 5 | CO1 |
| 4 | Determination of the enzyme activity of Total ATPase. | 5 | CO2 |
| 5 | Determination of the specific activity of Lactate Dehydrogenase. | 5 | CO2 |
| 6 | Estimation of Protein from a Food Sample | 5 | CO3 |
| 7 | Estimation of Iron from a food sample | 5 | CO3 |
| 8 | Estimation of Calcium from a food sample | 5 | CO4 |
| 9 | Estimation of Ascorbic acid from a food sample | 5 | CO4 |
| **Demonstration Experiments** | | | |
| 10 | Estimation of Riboflavin by Spectrofluorimetry | 5 | CO5 |
| 11 | Separation of LDH isoenzymes by native gel electrophoresis | 5 | CO5 |

**RECOMMENDED BOOKS**

1. Work, T. W. (2009). *Laboratory Techniques in Biochemistry & Molecular Biology by Amsterdam.* North Holland Pub. Co -
2. Walker, K. W. (2010). *Principles and techniques of Practical Biochemistry* (7th ed.). Cambridge University Press - ISBN-10 : 1108716989 / ISBN-13 : 978-1108716987
3. Singh, S. (2014). *Introductory Practical Biochemistry* (reprint ed.). Narosa Publishing House - ISBN 10: 9386217627 / ISBN 13: 9789386217622

**REFERENCE BOOKS**

1. Manickam, S. S. (2016). *Biochemical Methods*. New Age International Pvt Ltd publishers - ISBN 10: 8122421407 / ISBN 13: 9788122421408
2. Jayaraman, J. (2011). *Laboratory Manual in Biochemistry.* New Age International Pvt Ltd Publishers - ISBN-10: 812243049X, ISBN-13: 978 8122430493
3. Shalini Sehgal. *A Laboratory manual of food analysis* -Paper Back Dreamtech press,2020

**WEB LINKS**

1. https://youtu.be/nt0h9WTnVAM
2. https://youtu.be/eVmFrf4T93A
3. https://youtu.be/FfM5Fuyy600

**I M.Sc BIOCHEMISTRY**
**SECOND SEMESTER**

**Core Course -V**

**Course Title: ANALYTICAL BIOCHEMISTRY**

| | | | |
|---|---|---|---|
| **Course Code** | **2524207** | **Credits** | **04** |
| **L:T:P:S** | **4:1:0:0** | **CIA Marks** | **50** |
| **Exam Hours** | **03** | **ESE Marks** | **100** |

**LEARNING OBJECTIVE**

To gain a comprehensive understanding of the principles, techniques, and applications of biochemical investigation methods—including spectroscopy, chromatography, electrophoresis, centrifugation, electrochemical techniques, and radioisotope-based analyses—while developing the ability to design experiments, interpret data, and apply these tools to study biomolecules, metabolism, and cellular processes

**COURSE OUTCOMES: At the end of the Course, the Student will be able to**

| | |
|---|---|
| **CO1** | Analyze the methodology involved in slice techniques, homogenization and cell sorting while understanding electrochemical techniques. |
| **CO2** | Explain spectroscopic techniques (UV, fluorescence, mass spectrometry) to analyze and interpret biomolecules |
| **CO3** | Apply different chromatography methods (paper, TLC, affinity, HPLC) to separate and purify biomolecules like amino acids, sugars, and plant extracts. |
| **CO4** | Demonstrate electrophoretic techniques for the separation of proteins (SDS-PAGE) and DNA (agarose gel electrophoresis). |
| **CO5** | Apply centrifugation techniques for the separation of biological samples and subcellular organelles using differential centrifugation. |

**Mapping of Course Outcomes to Program Outcomes and Program-Specific Outcomes:**

| CO/PO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 2 |
| CO2 | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 2 |
| CO3 | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 2 |
| CO4 | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 2 |
| CO5 | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 2 |

**CORRELATION : 3 -STRONG 2- MEDIUM 3- LOW**

| MO. NO | CONTENTS OF MODULE | HRS | COS |
|---|---|---|---|
| I | **General approaches to Biochemical investigation.** Organ and tissue slice technique, and homogenization techniques, cell sorting and cell counting. Electrochemical techniques – principles of redox reactions, pH electrode. Clark's oxygen electrode and their applications. Method of investigating metabolism-principle- isotopic tracers. | 15 | CO1 |
| II | **Spectroscopy:** p r i n c i p l e , spectra - definition, types- absorption & emission-wavelength, wave number, frequency.<br>Principle, procedure and application of NMR and mass spectroscopy. Principle, procedure and application of UV-VIS and ESR spectrophotometry, spectrofluorimetry and X ray diffraction. | 15 | CO2 |
| III | **Chromatography:** definitions, types- adsorption &partition. Principles, procedure and application- paper chromatography-TLC. Column chromatography- ion–exchange chromatography, gel filtration and affinity chromatography. Hydroxy apatite chromatography and hydrophobic interaction chromatography (HIC)-GLC and HPLC. | 10 | CO3 |
| IV | **Electrophoresis:** General Properties of electrophoresis, support media, factors affecting electrophoresis, high voltage and low voltage electrophoresis, SDS–PAGE, iso electric focusing, Isotachophoresis, 2D PAGE and capillary electrophoresis. Cellulose acetate and continuous flow electrophoresis, pulse field gel electrophoresis, Agarose gel electrophoresis | 10 | CO4 |
| V | **Centrifugation:** Basic principles and laws of sedimentation. Preparative and analytical ultracentrifuges. Sedimentation equilibrium methods. Differential and density gradient centrifugation.<br>Radioisotopes-definition and examples, half life. Detection- GM counter, and scintillation counter, and autoradiography. units of radioactivity. Hazards and safety aspects in handling radioisotopes | 15 | CO5 |

**RECOMMENDED BOOKS**


1. Anand, C. (2014). *Instrumental methods of Analysis.* Himalaya Publishing house - ISBN : 978-93-5142-088-0
2. Wilson/Walker. (2018). *Wilson and Walker's Principles and Techniques of Biochemistry and Molecular Biology.*
   Cambridge University Press - ISBN: 9781316677056
3. Dr. AvinashUpadhyay, D. K. (2016). *Biophysical Chemistry.* Himalaya Publishing house - ISBN-10 : 8184888074 / ISBN-13 : 978-8184888072


**REFERENCE BOOKS**


1. Dua, S. (2010). *Biochemical Methods of Analysis: Theory and Applications.*Narosa - ISBN-10 : 1842655906 / ISBN-13 : 978-1842655900
2. Bernard J.White, J. F. (2015). *Biochemical Techniques - Theory And Practice.* CBS Publishers & Distributors.
3. Basha, M. (2020). *Analytical Techniques in Biochemistry.* Humana Press - ISBN : 978-1-07.


**WEB LINKS**

1. https://onlinecourses.nptel.ac.in/noc22_bt64/preview
2. https://archive.nptel.ac.in/courses/102/107/102107028/
3. https://nptel.ac.in/courses/102103044

**I M.Sc BIOCHEMISTRY**

**SECOND SEMESTER**

**Core Course-VI**

**Course Title: MOLECULAR BIOLOGY**

| Course Code | 2524208 | Credits | 04 |
|---|---|---|---|
| L:T:P:S | 4:1:0:0 | CIA Marks | 50 |
| Exam Hours | 03 | ESE Marks | 100 |

**LEARNING OBJECTIVE**

Understand the molecular mechanisms of DNA replication, transcription, translation, gene regulation, and DNA repair, while analyzing their roles in maintaining genetic integrity and cellular function.

**COURSE OUTCOMES: At the end of the Course, the Student will be able to:**

| | |
|---|---|
| CO1 | Explain the enzymology and regulation of DNA replication in prokaryotes and eukaryotes, including mitochondrial replication. |
| CO2 | Classify mutations and identify various DNA repair mechanisms to assess their impact on genetic stability. |
| CO3 | Describe the mechanisms of prokaryotic and eukaryotic transcription, and inhibitors of transcription. |
| CO4 | Evaluate the characteristics of genetic code and mechanisms of protein synthesis in prokaryotes and eukaryotes, including post-translational modifications, and protein folding. |
| CO5 | Define the operon concept (lac operon, trp operon) to analyze positive and negative regulation of gene expression in prokaryotes. |

**Mapping of Course Outcomes to Program Outcomes and Program Specific Outcome:**

| CO/PO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 2 | 3 | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| CO2 | 3 | 2 | 3 | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| CO3 | 3 | 2 | 3 | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| CO4 | 3 | 2 | 3 | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| CO5 | 3 | 2 | 3 | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |

**CORRELATION : 3-STRONG 2- MEDIUM 3- LOW**

| MO. NO | CONTENTS OF MODULE | HRs | COs |
|---|---|---|---|
| I | **Replication**– DNA as genetic material (Meselson & Stahl experiments), enzymology of replication in prokaryotes, replication in E. coli, Øx174 model, mitochondrial replication. Replication in eukaryotes. Regulation of replication in prokaryotes and eukaryotes. | 15 | CO1 |
| II | **DNA Repair And Mutation**- Direct repair, Mismatch repair, base excision, nucleotide excision repair, recombinant repair -SOS repair, Mutation-mutants, mutagen, Types-Spontaneous, induced, frameshift, site-directed mutagenesis. | 15 | CO2 |
| III | **Transcription-**Role of RNA polymerase, promoter site, consensus sequence, transcriptional factors –mechanism of prokaryotic and eukaryotic transcription, post-translational modifications and processing of mRNA-5'capping, 3'polyadenylation, splicing mechanism, tRNA, rRNA. Inhibitors of transcription. | 15 | CO3 |
| IV | **Translation-** characteristics of genetic code, wobble hypothesis, monocistronic mRNA, and polycistronic mRNA. Mechanism of protein synthesis in prokaryotes and eukaryotes, Shine-Dalgarno sequence, inhibitors of protein synthesis. Post-translational modifications, protein folding, chaperones and heat shock proteins | 10 | CO4 |
| V | **Regulation of Gene Expression**- gene expression regulation in prokaryotes- operon concept- positive and negative regulation of la operon – role of cAMP and glucose - trp operon – attenuation. | 10 | CO5 |

**RECOMMENDED BOOKS**


1. Watson, J. D. (2017). *Molecular Biology of the Gene.* Pearson - ISBN-10 : 9332585474 / ISBN-13 : 978-9332585478
2. V.Malathi. (2012). *Essentials of Molecular Biology* (1st ed.). Pearson Education - ISBN-10 : 8131773213 / ISBN-13 : 978-8131773215
3. David, L., Nelson, M. M. (7th ed, 2017). *Lehninger Principles of Biochemistry.* Freeman. W.H. and Company - ISBN 10: 1464126119 / ISBN 13: 9781464126116


**REFERENCE BOOKS**


1. Donald Voet, G. (2016). *Fundamentals of Biochemistry: Life at the molecular level* (5th ed.). john Wiley & sons- ISBN: 978 1- 118-91840-1
2. Albert, B. (2014). *Molecular Biology of the Cell.* W.W. Norton and Company - ISBN 10: 0815344643 / ISBN 13: 9780815344643
3. Rastogi, V. B. (2016). *Principles of Molecular Biology* (2nd ed.). Medtech - ISBN-10 : 9789384007478 / ISBN-13 978-9384007478.


**WEB LINKS**

1. https://onlinecourses.nptel.ac.in/noc24_bt07/preview
2. https://nptel.ac.in/courses/102106025
3. https://archive.nptel.ac.in/courses/104/108/104108056/

**I M.Sc BIOCHEMISTRY**

**SECOND SEMESTER**

**Core Course-VII**

**Course Title: MICROBIOLOGY**

| | | | |
|---|---|---|---|
| **Course Code** | **2524209** | **Credits** | **04** |
| **L:T:P:S** | **5:0:0:0** | **CIA Marks** | **50** |
| **Exam Hours** | **03** | **ESE Marks** | **100** |

**LEARNING OBJECTIVE**

To develop a comprehensive understanding of microbiology, encompassing its history, principles, and applications, while gaining knowledge of microbial structure, growth, genetics, and classification, as well as their roles in medical, industrial, environmental, and food-related contexts, to address challenges in health, industry, and environmental sustainability.

**COURSE OUTCOMES: At the end of the Course, the Student will be able to:**

| | |
|---|---|
| **CO1** | Describe the history of microbiology and explain the working principles of different types of microscopes. |
| **CO2** | Explain the structure of bacterial cells and illustrate how genetic information is transferred in bacteria. |
| **CO3** | Summarize the knowledge gained on the normal microbial flora and types of infections. |
| **CO4** | Explain the role of microbes in the production of industrial products like enzymes, alcohol, and antibiotics. |
| **CO5** | Apply the principles of food microbiology to real-world food safety and processing issues. Formulate fermented food products using microbial techniques. |

**Mapping of Course Outcomes to Program Outcomes and Program-Specific Outcomes:**

| CO/PO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| CO2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| CO3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| CO4 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| CO5 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |

**CORRELATION : 3-STRONG 2- MEDIUM 3- LOW**

| MO. NO | CONTENTS OF MODULE | HRs | COs |
|---|---|---|---|
| I | **Introduction to Microbiology**<br>History and scope of Microbiology. Germ theory of disease, Koch's postulates. Microscopy – principles and applications of bright field, dark field, fluorescence, phase contrast and electron microscopes. Principles and uses of simple, differential, negative and spore staining techniques Carl Woese's three-domain system of classification. Major groups of bacteria- Archaea, Eubacteria | 15 | CO1 |
| II | **Structural features of Prokaryotes**<br>Ultrastructure of bacteria. Cultivation of bacteria, nutritional requirements and nutritional types of bacteria. Physical factors affecting growth, Bacterial growth curve – continuous growth (chemostat and turbidostat), synchronous culture and enumeration of bacteria.DNA organization, extra chromosomal genetic elements – transfer of genetic information, conjugation, Hfr strains, transformation and transduction. General characteristics of fungi, algae and protozoa. | 15 | CO2 |
| III | **Medical Microbiology:** Distribution, occurrence of normal microbial flora on skin, respiratory tract, genitourinary tract and GI tract. Infection – types, methods of transmission, factors affecting infection - epidemiological terminologies - epidemic, pandemic, endemic - infectious disease transmissions. Pathogenic microorganisms - *Salmonella, E. coli, Klebsiella, Streptococcus, Mycobacterium* and HIV | 10 | CO3 |
| IV | **Industrial Microbiology**: Outline of fermentation process, fermentor- Design and types (Continuous stirred tank fermentor, Airlift fermentor), Producer organism - Development of industrial strains, Fermentation/Production medium, Downstream Processing. Products of industrial microbiology – penicillin, ethanol, vinegar, citric acid, and protease. Bioremediation. Fermented foods - cheese, yoghurt, pickles, bread. Water Microbiology – microbes in waste treatment- Domestic and industrial wastewater. Bacteriological analysis of water. | 15 | CO4 |
| V | **Food Microbiology-** food spoilage, food preservation – methods with example- Food infections –Clostridium, staphylococcus and Salmonella, fungal intoxication – Aspergillus and food toxicity. Microbiological examination of food- direct microscopic count and dye reduction method (MBRT).Food safety, Risks and hazards- Microbiological consideration in food safety, effects of processing and storage on microbiological safety. Food laws and regulations- HACCP, FSSAI, BIS (Fundamentals only) | 10 | CO5 |

**RECOMMENDED BOOKS**


1. Pelzar, C. (2007). *Textbook of Microbiology*(5th ed). Tata McGraw Hill.
2. Parija. (2012). *Textbook of Microbiology and Immunology,* 2/e . ELSEVIER - ISBN 10: 813124461X / ISBN 13: 9788131244616.
3. Prescott. (2017). *Microbiology*(8th ed.). McGraw-Hill, Boston - ISBN-10 : 1259281590 / ISBN- 13 : 978- 1259281594.


**REFERENCE BOOKS**


1. Panicker, A. R. (2017). *Textbook of Microbiology* (10th ed.). Orient Longmans - ISBN 10: 1847558569 ISBN13: 9781847558565.
2. W.C, F. (2014). *Food Microbiology.* Mc Graw Hill Boston - ISBN-10 : 1259281590 / ISBN13 : 978- 1259281594.


**WEB LINKS**

1. https://onlinecourses.nptel.ac.in/noc24_bt07/preview
2. https://archive.nptel.ac.in/courses/102/103/102103015/
3. https://archive.nptel.ac.in/courses/102/105/102105058/

**I M.Sc BIOCHEMISTRY**

**SECOND SEMESTER**

**Core Course-VIII**

**Course Title: IMMUNOLOGY**

| | | | |
|---|---|---|---|
| **Course Code** | **2524210** | **Credits** | **04** |
| **L:T:P:S** | **4:1:0:0** | **CIA Marks** | **50** |
| **Exam Hours** | **03** | **ESE Marks** | **100** |

**LEARNING OBJECTIVE**

To develop a comprehensive understanding of the immune system, including its components, mechanisms, and functions, while exploring the principles of immunity, antigen-antibody interactions, immune disorders, and diagnostic techniques, to apply this knowledge in understanding health, disease, and therapeutic interventions

**COURSE OUTCOMES: At the end of the Course, the Student will be able to:**

| | |
|---|---|
| CO1 | Classify the types of immunity, cells, and organs of the immune system as well as state the types of vaccines. |
| CO2 | Demonstrate understanding of antigens, antibodies, and the complement system. |
| CO3 | Explain the origin, development, and function of B and T lymphocytes. Illustrate the pathways of antigen processing and presentation. |
| CO4 | Identify and explain the molecular mechanisms of hypersensitivity, autoimmunity, and immune suppression. |
| CO5 | Discuss the principles and methodology involved in immunological techniques |

**Mapping of Course Outcomes to Program Outcomes and Program-Specific Outcomes:**

| CO/PO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 3 | 3 | 2 | 3 | 2 | 3 | 3 | 3 | 3 | 3 |
| CO2 | 3 | 3 | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 3 |
| CO3 | 3 | 3 | 3 | 2 | 3 | 2 | 3 | 3 | 3 | 3 | 3 |
| CO4 | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| CO5 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |

**CORRELATION : 3-STRONG 2- MEDIUM 3- LOW**

| MO. NO | CONTENTS OF MODULE | HRs | COs |
|---|---|---|---|
| I | **Immunity:** Classification, Innate immunity- Factors governing innate immunity- Mechanical, and cellular factors. Acquired immunity-Types<br>Cells of the immune system. Lymphoid organs, Central and peripheral. Bone marrow, thymus, Bursa of Fabricius, spleen, lymph node, MALT, cells of the lymphoreticular system. Vaccination – types: live, killed, attenuated, toxoids, recombinant vaccines. | 15 | CO1 |
| II | **Antigens and Antibodies:** Antigens and immunogens, Haptens, and adjuvants. - definition. Factors affecting antigenicity. Epitopes and Paratopes. Antibodies - Structure and function of IgG. IgA, IgM, IgD, and IgE. Isotypes, Allotypes and Idiotypes. Complements – classical and alternate pathways – disorders of complement activation. | 10 | CO2 |
| III | **B and T cell development-** B-cell markers.. Maturation, activation, and differentiation of B cells. Theories of antibody formation - clonal selection theory. Molecular basis of antibody diversity, T cell marker, TCR structure and diversity. Maturation, activation, and differentiation of T cells. Antigen processing &presentation - Cytosolic and endocytic pathway, Complement components and its activation ( classical & alternate pathway) | 15 | CO3 |
| IV | **Hypersensitivity** – immediate & delayed, Autoimmunity – Organ and Systemic specific diseases. Myasthenia gravis, Graves disease, Systemic lupus erythematosus, Glomerulonephritis and Rheumatoid arthritis. Transplantation immunology – MHC complex, class I and II structures and functions – graft vs. host reactions, HLA typing – lymphocytotoxicity, cross matching, immune suppressive agents. | 15 | CO4 |
| V | **Antigen – Antibody Reactions** – precipitation & agglutination reactions – applications – WIDAL test and Coombs test – immunodiffusion – SID, DID – immunoelectrophoresis. ELISA and its types, Immunofluorescence - Direct, indirect and FACS. Monoclonal antibodies production and applications – RIA. | 10 | CO5 |

**RECOMMENDED BOOKS**


1. Jud Owen, J. P. ( 2013). *Kuby Immunology.* International Edition W. H. Freeman - ISBN-10 : 1464137846, ISBN-13: 978-1464137846
2. Paniker. (2017). *Immunology* (10th ed.). University Press - ISBN 10: 1847558569 / ISBN 13: 9781847558565
3. Sudha Gangal. (2013). *Textbook of Basic and Clinical Immunology.* Orient Blackswan Private Limited - New Delhi - ISBN 10: 8173718296 / ISBN 13: 9788173718298


**REFERENCE BOOKS**


1. Roitt, I. (2017). *Immunology(13th ed).* Wiley Black Well - ISBN-10 : 1118415779 / ISBN-13 : 978-1118415771
2. Kuby, J. (2018). *Immunology(5th ed).* W.H. Freeman - ISBN-10 : 1319114709 / ISBN-13 : 978-1319114701
3. Rao, C. V. (2017 ). *Immunology* (3rd ed.). Alpha Science Int. Ltd - ISBN-10 : 1842652559 /ISBN-13 : 978-1842652558


**WEB LINKS**

1. https://onlinecourses.nptel.ac.in/noc22_bt40/preview
2. https://archive.nptel.ac.in/courses/104/108/104108055/
3. https://archive.nptel.ac.in/courses/102/103/102103038/

**I M.Sc BIOCHEMISTRY**

**SECOND SEMESTER**

**Core Practical-III**

**Course title: ANALYTICAL BIOCHEMISTRY AND MOLECULAR BIOLOGY**

| Course Code | 2524211 | Credits | 03 |
|---|---|---|---|
| L:T:P:S | 1:0:4:0 | CIA Marks | 50 |
| Exam Hours | 06 | ESE Marks | 50 |

**LEARNING OBJECTIVE**

To gain hands-on experience in the separation, identification, and characterization of biomolecules such as amino acids, sugars, lipids, proteins, nucleic acids, and plant pigments using chromatographic, electrophoretic, and molecular biology techniques, while developing skills in experimental design, data interpretation, and the application of these methods to study biological systems.

**COURSE OUTCOMES: At the end of the course, the student will be able to :**

| | |
|---|---|
| CO 1 | Demonstrate the separation and identification of sugars, amino acids, lipids, and plant pigments on planar and column chromatographic techniques |
| CO 2 | Evaluate the separation of proteins by gel filtration and molecular weight determination by SDS PAGE |
| CO 3 | Determine the melting temperature of DNA and estimate DNA and RNA in plant/ animal/microbial sample |
| CO4 | Examine the extraction of plasmid DNA and its visualization by agarose gel electrophoresis |
| CO5 | Identify the application of RT-PCR and ion exchange chromatography |

**Mapping of Course Outcomes to Program Outcomes and Program-Specific Outcomes:**

| CO/PO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 2 |
| CO2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 2 |
| CO3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 2 |
| CO4 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 2 |
| CO5 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 2 |

**CORRELATION: 3-STRONG 2- MEDIUM 1- LOW**

| Sl.NO. | CONTENTS | HRs | COs |
|---|---|---|---|
| 1 | Separation and identification of amino acids by paper chromatography | 5 | CO1 |
| 2 | Separation of identification of sugars by paper chromatography | 5 | CO1 |
| 3 | Separation and identification of lipids by thin-layer chromatography | 5 | CO1 |
| 4 | Separation and identification of plant pigments by column chromatography | 5 | CO1 |
| 5 | Separation of proteins by gel filtration. | 5 | CO2 |
| 6 | Determination of molecular weight of the proteins by SDS-PAGE | 5 | CO2 |
| 7 | Determination of melting temperature (Tm) and % GC content of DNA sample | 3 | CO3 |
| 8 | Isolation and estimation of DNA from animal tissue | 5 | CO3 |
| 9 | Isolation and estimation of RNA from yeast | 5 | CO3 |
| 10 | Extraction of plasmid DNA and visualization by agarose gel electrophoresis | 5 | CO4 |
| **Demonstration Experiments** | | | |
| 11 | Identification of gene expression by RT-PCR | 5 | CO5 |
| 12 | Purification of lysozyme by ion exchange chromatography | 5 | CO5 |

**RECOMMENDED BOOKS**


1. Archana Ayyagari, A. N. (2007). *Lab Manual in Biochemistry, Immunology and Biotechnology.* Tata McGraw Hill Education - ISBN: 9780070617674 0070617678 9780070077454 0070077452
2. Walker, K. W. (2000). *Practical Biochemistry principles and techniques* (5th ed.). Cambridge University Press
3. Singh, S. a. (2014). *Introductory Practical Biochemistry* (reprint ed.). Narosa publishing house - ISBN 10: 9386217627 / ISBN 13: 9789386217622


**REFERENCE BOOKS**


1. Manickam, S. S. (2018). *Biochemical Methods* (3rd ed.). New age International Pvt Ltd publishers - ISBN 10: 8122421407 / ISBN 13: 9788122421408
2. Jayaraman, J. (2011). *Laboratory Manual in Biochemistry.* New Age International Pvt Ltd Publishers - ISBN- 10: 812243049X, ISBN-13: 978-8122430493
3. Walker, K. W. (2010). *Principles and Techniques of Practical Biochemistry* (7th ed.). Cambridge University Press - ISBN-10 : 1108716989 / ISBN-13 : 978-110871698


**WEB LINKS**

1. Biochemistry Lab - Thin layer chromatography for separation and identification of lipids
2. SDS-PAGE explained - Protein Separation Technique
3. Agarose Gel Electrophoresis
4. Ion exchange chromatography

**I MSc BIOCHEMISTRY**

**SECOND SEMESTER**

**Core Practical IV**

**Course Title: MICROBIOLOGY AND IMMUNOLOGY**

| Course Code | 2524212 | Credits | 03 |
|---|---|---|---|
| L: T:P:S | 1:0:4:0 | CIA Marks | 50 |
| Exam Hours | 06 | ESE Marks | 50 |

**LEARNING OBJECTIVE**

To develop practical skills in microbiological and immunological techniques, including bacterial identification, enumeration, biochemical characterization, antibiotic sensitivity testing, biofilm analysis, blood grouping, serological testing and antigen quantification while gaining a comprehensive understanding of their applications in diagnostics, research, and biotechnology.

**COURSE OUTCOMES: At the end of the course, the student will be able to:**

| | |
|---|---|
| CO1 | Demonstrate Gram staining of bacteria |
| CO2 | Assess the ability of bacteria to bring about sugar fermentation and produce enzymes (catalase) and to enumerate bacteria in air |
| CO3 | Analyse the sensitivity of bacteria towards antibiotics and estimate biofilm formation using the crystal violet assay |
| CO4 | Identify blood groups, tests for complement fixation and VDRL test |
| CO5 | Examine tests for quantitative determination of antigens and demonstration of transformation of *E. Coli* and the ELISA technique |

**Mapping of Course Outcomes to Program Outcomes and Program-Specific Outcomes:**

| CO/PO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 2 |
| CO2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 2 |
| CO3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 2 |
| CO4 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 2 |
| CO5 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 2 |

**CORRELATION: 3-STRONG 2- MEDIUM 3- LOW**

| Sl. No. | CONTENTS | HRs | COs |
|---|---|---|---|
| 1 | Gram staining of bacteria | 4 | CO1 |
| 2 | Enumeration of bacteria from air by standard plate method/Study of bacterial flora of skin by swab method | 4 | CO2 |
| 3 | Biochemical characterization of bacteria: a) Sugar fermentation test b) Enzyme detection – Catalase | 4 | CO2 |
| 4 | Antibiotic sensitivity test, MIC | 4 | CO3 |
| 5 | Crystal violet assay for estimation of biofilm formation | 4 | CO3 |
| 6 | ABO blood grouping and Rh factor typing by slide agglutination Test | 5 | CO4 |
| 7 | Complement fixation test | 3 | CO4 |
| 8 | VDRL test/Slide Flocculation test | 5 | CO4 |
| 9 | Quantitative determination of antigen -Single Radial Immuno diffusion | 5 | CO5 |
| 10 | Quantitative determination of antigen -Double Immuno diffusion | 5 | CO5 |
| | **Demonstration Experiments** | | |
| 11 | Transformation of *E.coli* | 4 | CO5 |
| 12 | Demonstration of ELISA | 3 | CO5 |

**RECOMMENDED BOOKS**


1. TobiliSam.(2020) *Immunology: Overview and Laboratory Manual* -Yellow, Springer,1st edition,
2. Deepak Diwedi and Vinod.(2013) *Laboratory Manual on Immunology and Molecular Biology*- Lambert, Academic Publishing,
3. Panicker, A. R. (2017). *Textbook of Microbiology* (10th ed.). Orient Longmans - ISBN 10: 1847558569 / ISBN 13: 9781847558565


**REFERENCE BOOKS**


**1.** Prescott. (2017). *Microbiology* (8th ed.). Mc Graw Hill, Boston - ISBN-10 : 1259281590 / ISBN-13 : 978-1259281594

**2.** Sudha Gangal. (2013). *Textbook of Basic and Clinical Immunology.* Orient Blackswan Private Limited - New Delhi - ISBN 10: 8173718296 / ISBN 13: 9788173718298

**3.** Kuby, J. (2018). *Immunology($5^{th}$ ed).* W.H. Freeman - ISBN-10 : 1319114709 / ISBN-13 : 978-1319114701


**WEB LINKS**

1. https://youtu.be/NO3C5TBo1KY
2. https://youtu.be/JFXVPOym3fs
3. https://youtu.be/sgdzlrUFEwQ

**II MSc BIOCHEMISTRY**

**THIRD SEMESTER**

**Core Course-IX**

**Course Title: ADVANCED CLINICAL BIOCHEMISTRY**

| | | | |
|---|---|---|---|
| **Course Code** | **2524313** | **Credits** | **04** |
| **L: T:P:S** | **5:0:0:0** | **CIA Marks** | **50** |
| **Exam Hours** | **03** | **ESE Marks** | **100** |

**LEARNING OBJECTIVE**

To develop a comprehensive understanding of metabolic, enzymatic, and clinical disorders related to carbohydrate, lipid, protein, and nucleic acid metabolism, as well as diseases of the liver, gastrointestinal system, kidneys, and blood, while gaining insights into diagnostic methods, laboratory tests, and their applications in clinical management and treatment.

**COURSE OUTCOMES: At the end of the Course, the Student will be able to:**

| | |
|---|---|
| CO1 | Evaluate glucose homeostasis, diabetes mellitus, glycogen storage diseases, and inborn errors of metabolism to understand their clinical implications and diagnostic approaches. |
| CO2 | Interpret the clinical significance of plasma enzymes in diagnosing diseases related to myocardial infarction, liver, muscle, and bone disorders. |
| CO3 | Assess lipid metabolism disorders and liver diseases |
| CO4 | Describe gastrointestinal disorders and kidney-related diseases and tests to determine their pathophysiology and clinical management. |
| CO5 | Explain etiology, clinical manifestations, and diagnostic criteria of blood dyscrasias. |

**Mapping of Course Outcomes to Program Outcomes and Program-Specific Outcomes:**

| CO/PO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| CO2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| CO3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| CO4 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| CO5 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |

**CORRELATION : 3-STRONG 2- MEDIUM 3- LOW**

| MO. NO | CONTENTS OF MODULE | HRs | COs |
|---|---|---|---|
| I | **Disorders of Carbohydrate Metabolism** - Glucose homeostasis, diabetes mellitus and its management, GTT, assay of HbA1c, glycogen storage disease. Inborn errors of metabolism- galactosemia, fructosuria, and lactose intolerance. | **15** | **CO1** |
| II | **Clinical Enzymology** - enzymes in plasma and their origin, Clinical significance of enzymes -isoenzymes (LDH, CK) - phosphatase, 5' nucleotidase, amylase, lipase, transaminase and gamma glutamyl transferase. Measurement of serum enzymes in diagnosis, enzyme pattern in myocardial infarction, liver, muscle and bone diseases. | **15** | **CO2** |
| III | **Diseases Related to Lipid Metabolism** – Hypercholesterolemia, atherosclerosis, role of LDL, hyperlipoproteinemias, and its types. Diseases relating to the liver - cirrhosis, hepatitis. Jaundice with its types. Inherited diseases of bilirubin metabolism – Criggler-Najjar syndrome, Dubin-Johnson syndrome, Gilbert syndrome - liver function tests | **15** | **CO3** |
| IV | **Gastrointestinal Disorders** -Acidity, ulcers, gastric, duodenal, colon cancer, pancreatitis, gastric and pancreatic function tests. **Diseases related to the kidney -** nephritis, nephrosis, uremia, renal failure, renal calculi, renal hypertension, renal tubular acidosis, and diabetes insipidus. Kidney function tests. | **10** | **CO4** |
| V | **Disorders of Blood** - Blood dyscrasias, Agranulocytosis, Thrombocytopenia, Aplastic, Hemolytic anemia, Hemoglobinopathies, Thrombosis, leucocytosis, leucopenia | **10** | **CO5** |

**RECOMMENDED BOOKS**


1. Chatterjee Ranashinde. (2012). *Medical Biochemistry(8$^{th}$ ed).* Jaypee - ISBN : 9789350254844
2. Kaplan. (2010). *Clinical Biochemistry* (6th ed.). Mosby - ISBN-10 : 1464137846, ISBN-13 : 978-1464137846
3. Tietz. (2018). *Clinical Biochemistry* (8th ed.). Saunders


**REFERENCE BOOKS**


1. Gupta, P. P. (2013). *Textbook of Biochemistry with Biomedical Significance* (2nd ed.). CBS Publishers and distributors - ISBN 10: 8123922450 / ISBN 13: 9788123922454
2. T.M.Devlin. (2006). *Textbook of Biochemistry with Clinical Correlations.* CBS Publishers and Distributers - ISBN 10: 0471513482 / ISBN 13: 9780471513483
3. Ayling, M. &. (2014). *Clinical Biochemistry* (3rd ed.). Metabolic and Clinical Aspects - ISBN 10: 0702051403 / ISBN 13: 9780702051401


**WEB LINKS**

1. https://nptel.ac.in/courses/104105139
2. https://onlinecourses.swayam2.ac.in/cec20_ag01/preview
3. https://onlinecourses.nptel.ac.in/noc22_bt07/preview

**II MSc BIOCHEMISTRY**
**THIRD SEMESTER**

**Core Course-X**

**Course Title: BIOTECHNOLOGY**

| | | | |
|---|---|---|---|
| **Course Code** | **2524314** | **Credits** | **04** |
| **L: T:P:S** | **5:0:0:0** | **CIA Marks** | **50** |
| **Exam Hours** | **03** | **ESE Marks** | **100** |

**LEARNING OBJECTIVE**

To understand the principles and applications of biotechnology, including genetic engineering, fermentation, animal and plant biotechnology, and basic molecular biology techniques, while exploring their roles in medicine, agriculture, and industry

**COURSE OUTCOMES**: **At the end of the Course, the Student will be able to:**

| | |
|---|---|
| **CO1** | Apply the basic requirements and tools employed in the genetic engineering process |
| **CO2** | Describe the process of fermentation , Fermentor and Applications of Fermentation in Food industry |
| **CO3** | Appraise gene transfer methods in animals |
| **CO4** | Interpret the principles and technical advances behind the in vitro culture of plant cells |
| **CO5** | Demonstrate the basic and recent techniques applied in the field of Biotechnology |

**Mapping of Course Outcomes to Program Outcomes and Program-Specific Outcomes:**

| CO/PO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 3 | 3 |
| CO2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 3 | 3 |
| CO3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 3 | 3 |
| CO4 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 3 | 3 |
| CO5 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 3 | 3 |

**CORRELATION: 3-STRONG 2- MEDIUM 3- LOW**

| MO. NO | CONTENTS OF MODULE | HRs | COs |
|---|---|---|---|
| I | **Biotechnology**-Definition and application. Genetic Engineering**:** Basic principles, restriction enzymes, linkers, adapters, cloning vectors and their properties, plasmids (pBR322), cosmids, YAC, Mechanism of natural gene transfer by Agrobacterium, integration of foreign DNA molecules. | **15** | **CO1** |
| II | **Fermentation**- definition and types. Fermentor- design. Downstream processing -definition and steps. Applications of Fermentation in Food Industry: Yogurt, bread, Pharmaceutical: Antibiotics (penicillin), and vaccines. Industrial: Biofuel production. | **15** | **CO2** |
| III | **Animal Biotechnology:** Laboratory requirements of animal cell culture, media required- serum media and serum-free media. Gene transfer methods in animals – microinjection, electroporation, *in-vitro* fertilization. | **`10** | **CO3** |
| IV | **Plant Biotechnology:** callus, media required for plant tissue culture. Stages in micropropagation, somatic embryogenesis. Production of pest-resistant transgenic plants, transgenic plant technology –for pest resistance, herbicide tolerance, delay of fruit ripening and use of plants to produce commercially important proteins –growth-promoting bacteria in plants –antisense RNA technology. gene transfer. | **13** | **CO4** |
| V | **Basic Techniques:** PCR, Agarose gel electrophoresis, Southern blotting, DNA fingerprinting, RFLP (principle, procedure and applications), DNA microarray | **12** | **CO5** |

**RECOMMENDED BOOKS**


1. U.Sathyanarayana. (n.d.). *Biotechnology* - ISBN-10 : 8187134909 / ISBN-13 : 978-8187134909
2. T.A, B. (2016). *Gene cloning and DNA analysis*. Wiley Blackwell - ISBN 10: 1119072573 / ISBN 13: 9781119072577
3. Primrose, T. a. *Principles of gene manipulation* - ISBN-10 : 1405135441 / ISBN-13 : 978-1405135443


**REFERENCE BOOKS**


1. Dubey, R. (2014). *A Textbook of Biotechnology* . S. Chand - ISBN 10: 8121926084 / ISBN 13: 9788121926089
2. Loroch, R. R. (2016). *Biotechnology for Beginners*. Academic Press - ISBN: 9780128012246
3. H.K.Das. (2010). *Textbook of Biotechnology*. Willey- ISBN: 9788126564040


**WEB LINKS**

1.https://youtu.be/Ll_7z4YS2Ak

2. https://youtu.be/vnmrSTJHiww

3. https://youtu.be/L7qnY_GqytM

**II M.Sc., BIOCHEMISTRY**
**THIRD SEMESTER**

**Discipline-Specific Elective I- Employability Course I (A)**

**Course Title: MEMBRANE BIOCHEMISTRY**

| | | | |
|---|---|---|---|
| **Course Code** | **2524315(A)** | **Credits** | **03** |
| **L:T:P:S** | **4:0:0:0** | **CIA Marks** | **50** |
| **Exam Hours** | **03** | **ESE Marks** | **100** |

**LEARNING OBJECTIVE**

To understand the structure, function, and properties of biological membranes, including plasma membranes, organelle membranes, and bacterial cell walls, while exploring their roles in transport mechanisms, receptor functions, cell-cell communication, and associated diseases

**Employability opportunities**:

- Relevant for pharma, biotech, diagnostics, and research institutions.
- Work related to drug development, membrane protein research, or diagnostic technologies

**COURSE OUTCOMES: At the end of the Course, the Student will be able to:**

| | |
|---|---|
| **CO1** | Analyze the structure, composition, and functions of biological membranes, |
| **CO2** | Identify the structure and function of red blood cell and plant cell membranes, |
| **CO3** | Explain the structure, composition, and functions of membranes surrounding cell organelles |
| **CO4** | Describe the mechanisms of transport across biological membranes, and their metabolic significance in processes like gastric HCl secretion |
| **CO5** | Evaluate the structure, function, and clinical significance of membrane receptors. |

**Mapping of Course Outcomes to Program Outcomes and Program-Specific Outcomes:**

| CO/PO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| CO2 | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| CO3 | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| CO4 | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| CO5 | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |

**CORRELATION: 3-STRONG 2-MEDIUM 1-LOW**

| MO. NO | CONTENTS OF MODULE | HRs | COs |
|---|---|---|---|
| I | **Biological Membranes** – Structure and functions of plasma membrane, Chemical composition and properties of bio membranes - Model lipid membranes - preparation and properties. Detergents, micelles, Liposomes- Role of Liposomes in Drug Delivery, Detergents in Membrane Protein Purification.Cell junctions- Role in regenerative medicine | 10 | CO1 |
| II | **Red cell membrane** – Isolation, major proteins in RBC membrane (Spectrin, Ankyrin, Band 4.1, Anion exchange proteins, Glycophorin) - Diseases caused due to mutations affect membrane proteins - Hereditary spherocytosis, Paroxysmal nocturnal hemoglobinuria- gene therapy and monoclonal antibody treatment. | 10 | CO2 |
| III | **Membranes surrounding mitochondria-** Mitochondrial dysfunction in metabolic and neurodegenerative diseases Endoplasmic reticulum. Membrane surrounding nucleus and lysosomes- Role in drug formulation and delivery research. Bacterial cell wall- structure, composition and biosynthesis. Inhibitors of cell wall synthesis. | 10 | CO3 |
| IV | **Transport across bio membrane** - Simple diffusion and Fick's law, facilitated diffusion - Kinetics of facilitated transport - Symport, antiport and Uniport. Active transport. - protein Pumps - $Na^+$- K+ ATPase and metabolic significance - Gastric HCL secretion. | 10 | CO4 |
| V | **Receptors**-Definition and Types. Neurotransmitter and its types, glucose Transport proteins.Photoreceptors and vision - Receptor desensitization, Receptor mediated endocytosis, LDL receptors - biological and clinical significance. Familial hypercholesterolemia. Hormonal receptors- G Proteins and adenylate cyclaseCyclic AMP (cAMP) and G-Protein Signaling in Drug Development. | 10 | CO5 |

**RECOMMENDED BOOKS**


1. Jeremy M. Berg, L. e. (2019). *Biochemistry(9th ed)* . WH Freeman - ISBN-10 :812243049X, ISBN-13 : 978- 8122430493
2. Donald Voet, C. W. (2010). *Principles of Biochemistry* (4th ed.). Wiley - ISBN 10: 1118092449 / ISBN 13: 9781118092446
3. David.L.Nelson, M. M. (9th ed 2012). *Lehninger Principles of Biochemistry* . Freeman. W.H. and Company – ISBN 10: 1464126119 / ISBN 13: 9781464126116


**REFERENCE BOOKS**


1. Karp, G. (2013). *Cell and Molecular Biology.* John Wiley and Sons Inc - ISBN-10 : 111830179X, ISBN-13 : 978- 1118301791
2. Geoffery M. Cooper, R. E. (2013). *The Cell -A Molecular Approach.* Sinauer Associations - ISBN 10: 0878939644 / ISBN 13: 9780878939640
3. ShlomoMelmed, K. S. (2015). *William Textbook of Endocrinology* (13th ed.). Elsevier- ISBN 10: 0323297382 / ISBN 13: 9780323297387


**WEB LINKS**

1. https://archive.nptel.ac.in/courses/102/106/102106025/
2. https://archive.nptel.ac.in/courses/102/103/102103012/
3. https://onlinecourses.nptel.ac.in/noc22_bt33/preview

**II M.Sc., BIOCHEMISTRY**
**THIRD SEMESTER**

**Discipline-Specific Elective I-Employability Course I (B)**

**Course Title: PLANT BIOCHEMISTRY**

| Course Code | 2524315(B) | Credits | 03 |
|---|---|---|---|
| L:T:P:S | 4:0:0:0 | CIA Marks | 50 |
| Exam Hours | 03 | ESE Marks | 100 |

**LEARNING OBJECTIVE:**
To understand the mechanisms of photosynthesis, plant hormone functions, nitrogen metabolism, stress responses, and antioxidative defense systems, while exploring their roles in plant growth, metabolism, and adaptation to environmental challenges.
**Employability opportunities:** Roles in agricultural biotech companies, research labs, seed and fertilizer companies, food industries, etc.

**COURSE OUTCOMES: At the end of the Course, the Student will be able to:**

| | |
|---|---|
| CO1 | Explain the role of pigments, light and dark reactions, proton gradients, ATP synthesis in chloroplasts, and regulatory mechanisms in photosynthesis. |
| CO2 | Identify the types, structure, mode of action, transport, distribution, and physiological effects of plant hormones |
| CO3 | Analyze the processes of nitrate assimilation, nitrogen fixation, nodule formation and the role of enzymes (nitrate reductase, nitrite reductase) and regulatory factors (nif genes) in plant nitrogen metabolism. |
| CO4 | Demonstrate the effects of plant-origin toxins and environmental stresses on plant growth, metabolism, and stress tolerance mechanisms. |
| CO5 | Discuss the generation of reactive oxygen species, the role of enzymic and non-enzymic components in antioxidative defense mechanisms, and their importance in mitigating oxidative stress in plants. |

**Mapping of Course Outcomes to Program Outcomes and Program-Specific Outcomes:**

| CO/PO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 2 | 2 | 2 | 2 | 2 | 2 | 3 | 3 | 1 | 3 | 1 |
| CO2 | 2 | 2 | 2 | 2 | 2 | 2 | 3 | 3 | 1 | 3 | 1 |
| CO3 | 2 | 2 | 2 | 2 | 2 | 2 | 3 | 3 | 1 | 3 | 1 |
| CO4 | 2 | 2 | 2 | 2 | 2 | 2 | 3 | 3 | 1 | 3 | 1 |
| CO5 | 2 | 2 | 2 | 2 | 2 | 2 | 3 | 3 | 1 | 3 | 1 |

**CORRELATION: 3-STRONG 2-MEDIUM 1-LOW**

| MO. NO. | CONTENTS OF MODULE | HRs | COs |
|---|---|---|---|
| I | **Photosynthesis** – Pigments in photosynthesis, Light and Dark reactions, Proton gradient and ATP synthesis of chloroplast. DCMU, regulation of photosynthesis, CAM metabolism, RUBISCO, photorespiration. Photosynthesis Efficiency & Crop Yield Improvement, Applications of CAM and C4 Plants in Drought Resistance | **10** | **CO1** |
| II | **Plant Hormones-** types and functions. Structure, mode of action, transport, distribution and physiological effect of Auxin, Gibberillin, Cytokinins, ABA and Ethylene. Agriculture-Uses in agriculture extension jobs, agribusiness, pesticide and fertilizer companies | **10** | **CO2** |
| III | **Biofertilizers-** Role of Biofertilizers in Sustainable Agriculture, Nitrate assimilation, structural features of nitrate reductase and nitrite reductase, incorporation of ammonia into organic compounds, regulation of nitrate assimilation. Mechanism of symbiotic Nitrogen fixation | **10** | **CO3** |
| IV | **Toxins of plant origin**–mycotoxins, phytohemagglutinins, lathyrogens, protein toxins. Stress metabolism in plants – Environmental stresses, salinity, water stress, heat, chilling, Stress due to heavy metals, radiation and their impact on plant growth and metabolism. Crop Improvement for Stress Tolerance, Detection and Quantification of Plant Toxins | **10** | **CO4** |
| V | **Antioxidative Defence System in Plants** – reactive oxygen species and their generation, enzymic and non-enzymic components of antioxidative defence mechanism – peroxidase, glutathione, chlorophyll, pigments, carotenoids, oxidative stress. , Antioxidant Role in Abiotic Stress Tolerance, Commercial Use of Plant-Based Antioxidants | **10** | **CO5** |

**RECOMMENDED BOOKS**


1. Verma. (2015). *Plant Physiology.* Athena Academic - ISBN: 9781910390016, 1910390011
2. Lincoln Taiz, A. M. (2018). *Fundamentals of Plant Physiology.* Oxford University Press - ISBN 10: 1605357901 ISBN 13: 9781605357904
3. MohitVerma, S. K. (2018). *Plant Physiology, Biochemistry and biotech.* S Chand - ISBN 10: 812190627X ISBN 13: 9788121906272


**REFERENCE BOOKS**


1. Jain, D. V. (2016). *Fundamentals of Plant physiology.* S Chand - ISBN: 9789352533343
2. N. Shankar, H. S. (2005). *Plant Physiology and Biochemistry.* Rastogi Publications - ISBN 10: 8171337856 / ISBN 13: 9788171337859
3. Piechulla, H.-W. H. (2010). *Plant Biochemistry.* Academic Press - ISBN 10: 0120883910 / ISBN 13: 978012088391


**WEB LINKS**

1. https://onlinecourses.swayam2.ac.in/cec19_bt09/preview
2. https://onlinecourses.swayam2.ac.in/cec20_bt01/preview
3. https://archive.nptel.ac.in/courses/102/106/102106080/

**II M.Sc., BIOCHEMISTRY**
**THIRD SEMESTER**

**Discipline-Specific Elective I-Employability Course I (C)**

**Course Title: STEM CELL BIOLOGY**

| Course Code | 2524315(C) | Credits | 03 |
|---|---|---|---|
| L:T:P:S | 4:0:0:0 | CIA Marks | 50 |
| Exam Hours | 03 | ESE Marks | 100 |

**LEARNING OBJECTIVES**

To understand the fundamental concepts, types, and applications of stem cells, including their characteristics, culture techniques, roles in development and disease, and the associated ethical, legal, and social implications, while exploring their potential in regenerative medicine, drug discovery, and future research directions

**Employability opportunities:**

- High in demand in medical research, regenerative medicine, biotech and pharma companies, and academic institutes.
- Jobs in clinical research organizations (CROs), hospitals, IVF clinics, etc.

**COURSE OUTCOMES: At the end of the course, the students will be able to**

| | |
|---|---|
| CO1 | Analyze the characteristics, types, potency and historical milestones of stem cells to establish a foundational understanding of their significance in biological research |
| CO2 | Evaluate the principles of stem cell culture, conditions for maintenance and expansion, differentiation techniques, and characterization methods to understand their practical applications in research |
| CO3 | Assess, applications of stem cells in regenerative medicine, disease treatment, drug discovery, toxicity testing, and the development of organoids and lab-grown tissues to address real-world challenges." |
| CO4 | Relate the roles of stem cells in embryonic development, cancer stem cells, genetic/epigenetic regulation, and aging to understand their impact on health and disease mechanisms. |
| CO5 | Evaluate ethical concerns, regulatory frameworks, public perception, and social implications of stem cell research to critically assess its societal impact and future directions |

**Mapping of Course Outcomes to Program Outcomes and Program-Specific Outcomes:**

| CO/PO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 3 | 3 | 2 | 3 | 2 | 3 | 3 | 3 | 3 | 3 |
| CO2 | 3 | 3 | 3 | 2 | 3 | 2 | 3 | 2 | 3 | 3 | 3 |
| CO3 | 3 | 3 | 3 | 2 | 3 | 2 | 3 | 3 | 3 | 3 | 3 |
| CO4 | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| CO5 | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |

**CORRELATION : 3 STRONG 2 MEDIUM 1 LOW**

| MO. NO. | CONTENTS OF MODULE | HRs | COs |
|---|---|---|---|
| I | **Introduction to Stem Cells:** Definition and characteristics of stem cells. Types of stem cells: embryonic, adult, and induced pluripotent stem cells (iPSCs). Stem cell potency: totipotent, pluripotent, multipotent, and unipotent. Historical milestones in stem cell research. Stem Cells in Regenerative Medicine | 10 | CO1 |
| II | **Stem Cell Culture and Differentiation:** Basic principles of stem cell culture. Conditions for stem cell maintenance and expansion. Differentiation of stem cells into various lineages. Techniques for characterization (e.g., flow cytometry, immunostaining). Stem Cell Production for Therapeutic Use. Stem Cell-Based 3D Organoids for Disease Modeling and Drug Discovery | 10 | CO2 |
| III | **Applications of Stem Cells:** Regenerative medicine and tissue engineering. Use in treatment of diseases (e.g., Parkinson's, diabetes, spinal injuries). Stem cells in drug discovery and toxicity testing. Organoids and lab-grown tissues | 10 | CO3 |
| IV | **Stem Cells in Development and Disease:** Role of stem cells in embryonic development. Cancer stem cells and tumorigenesis. Genetic and epigenetic regulation of stem cell function. Stem cells and aging, Stem Cell Biomanufacturing for Therapeutics | 10 | CO4 |
| V | **Ethical, Legal, and Social Issues:** Ethical concerns in embryonic stem cell use. Regulatory frameworks (national and international). Public perception and social implications. Future directions in stem cell research | 10 | CO5 |

**RECOMMENDED BOOKS**


1. Robert lanza, J. G. (2009). *Essentials of stem cell biology.* Academic Press - ISBN: 9780080884974
2. Peter J, Q. (1998). *Stem cell biology and gene therapy* (1st ed.). Willyless.
3. A. D. Ho. R. Hoffiman. (2006). *Stem cell transplantation biology processes therapy.* wiley-VCH. ISBN 10: 3527310185 / ISBN 13: 9783527310180


**REFERENCE BOOKS**


1. Potten, C. (2006). *Stem cells.* Elsevier.
2. Neil Singh, L. V.-J. (2011). *A Practical guide to human stem cell biology.* Wiley - ISBN 10: 0470595450
3. Knoepfler, P. (2013). *Stem Cells: An Insider's Guide.* World Scientific Publishing Company.


**WEB LINKS**

1 https://youtu.be/jSWwDCNNtrE
2 https://youtu.be/mnTQTjBZoAE
3 https://youtu.be/xdVVEysDAts

**II M.Sc., BIOCHEMISTRY**
**THIRD SEMESTER**

**Discipline-Specific Elective II-Entrepreneurship Course II (A)**

**Course Title: NANOTECHNOLOGY**

| Course Code | 2524316(A) | Credits | 03 |
|---|---|---|---|
| L:T:P:S | 4:0:0:0 | CIA Marks | 50 |
| Exam Hours | 03 | ESE Marks | 100 |

**LEARNING OBJECTIVES**

To understand the principles, synthesis, characterization, and applications of nanomaterials in nanotechnology, with a focus on their role in nanobiotechnology, drug delivery systems, and biological problem-solving.

**Entrepreneurship opportunities**: To equip students with interdisciplinary knowledge of nanotechnology while developing the innovation mind set, entrepreneurial skills, and real-world understanding needed to identify opportunities, build products, and launch startups in the nanotech sector.

**COURSE OUTCOMES: At the end of the course, the students will be able to**

| | |
|---|---|
| **CO1** | Analyze the scope, importance, and physicochemical properties of nanomaterials. |
| **CO2** | Identify top-down and bottom-up synthesis and green synthesis methods to produce nanomaterials using polymers and metals. |
| **CO3** | Interpret characterization techniques to analyze the properties and structure of nanomaterials |
| **CO4** | Analyze biomolecule-nanomaterial conjugates, DNA nanowires, and nanofluidic systems and explore nano-biomimetic applications in research and technology. |
| **CO5** | Evaluate nanocarriers for drug delivery systems while critically analyzing their health and environmental impact |

**Mapping of Course Outcomes to Program Outcomes and Program-Specific Outcomes:**

| CO/PO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| CO2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| CO3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| CO4 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| CO5 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |

**CORRELATION : 3 STRONG 2 MEDIUM 1 LOW**

| MO. NO. | CONTENTS OF MODULE | HRs | COs |
|---|---|---|---|
| I | **Introduction to Nanotechnology;** Nanotechnology and nanoparticles –Definition, Scope and its importance-Overview of Nanobiotechnology and Nanoscale processes; Physicochemical properties of materials in Nanoscales. Types of Nanomaterials (Quantum dots, Nanoparticles, Nanocrystals, Dendrimers, Buckyballs, Nanotubes). Applications of nanotechnology. Innovation and Product Development in Nanotechnology | 10 | CO1 |
| II | **Nanomaterials Synthesis**: Top-down and bottom-up synthesis -Gas, liquid, and solid phase synthesis of nanomaterials; Polymers in nano material synthesis- natural and synthetic polymers. Metals used in nanomaterial synthesis, Lithography techniques (Photolithography, Dip-pen and Electron beam lithography); Thin film deposition; Electrospinning. Bio-synthesis of nanomaterials -Green synthesis. Intellectual Property Rights (IPR) and Patents in Nanotechnology | 10 | CO2 |
| III | **Characterization techniques :**Characterization of Nano material; Absorption, Fluorescence, and Resonance; Microscopy measurements: SEM, TEM, AFM and STM. Confocal and TIRF imaging. XRD, FTIR | 10 | CO3 |
| IV | **Biomolecules and biomimetics :**Reactive groups on biomolecules (DNA & Proteins); Surface modification and conjugation to nanomaterials. Fabrication and application of DNA nanowires; Nano fluidics to solve biological problems. Nano-biomimetics. **Diagnostic platforms** using protein/nucleic acid functionalization with nanoparticles, Startups offering **functionalized nanocarriers** for gene/drug delivery | 10 | CO4 |
| V | **Nanocarriers**: Properties of nanocarriers; drug delivery systems used in nanomedicine; Role of nano particles in drug delivery. Enhanced Permeability and Retention effect; Blood-brain barrier; Active and passive targeting of diseased cells; Health and environmental impacts of nanotechnology. Translational Nanomedicine and Startup Opportunities | 10 | CO5 |

**RECOMMENDED BOOKS**


1. Madhuri Sharon, Maheshwar Sharon, Sunil Pandey and Goldie Oza *Bio-nanotechnology Concepts and applications*. Ane Books Pvt Ltd, 1 edition 2012.
2. Oded Shoseyov and Ilan Levy. *Nanobiotechnology: Bioinspired Devices and Materials of the Future*. Humana Press; 1 edition 2007.
3. A. R. Clarke and C. N.Eberhardt. *Microscopy Techniques for Material Science.* (Editors) CRC Press. 1st Edition, 2002.


**REFERENCE BOOKS**


1 Christof M. Niemeyer, Chad A. Mirkin *Nanobiotechnology: Concepts, Applications and Perspectives,* -VCH; 1 edition, 2004.

2 Sandra J Rosenthal and David W. Wright, *Nanobiotechnology Protocols (Methods in Molecular Biology)* by Humana Press; 1 edition, 2005.


**WEB LINKS**

1. https://nptel.ac.in/courses/118102003
2. https://onlinecourses.nptel.ac.in/noc24_bt72/preview
3. https://onlinecourses.nptel.ac.in/noc24_mm11/preview

**II M.Sc., BIOCHEMISTRY**
**THIRD SEMESTER**

**Discipline-Specific Elective II-Entrepreneurship Course II (B)**

**Course title: FUNDAMENTALS OF FORENSIC SCIENCE**

| Course Code | 2524316(B) | Credits | 03 |
|---|---|---|---|
| L:T:P:S | 4:0:0:0 | CIA Marks | 50 |
| Exam Hours | 03 | ESE Marks | 100 |

**LEARNING OBJECTIVE**

To understand the principles and applications of forensic biochemistry, including DNA profiling, toxicology, radiation hazards, and digital forensics, while exploring their roles in solving legal, medical, and cybercrime cases.

**Entrepreneurship opportunities:** Provide students with both the scientific knowledge of forensic biochemistry and the entrepreneurial skills necessary to innovate, launch, and manage successful business ventures in the forensic science industry.

**COURSE OUTCOMES: At the end of the Course, the Student will be able to**

| | |
|---|---|
| **CO1** | Apply the principles and methodologies of DNA profiling, to solve forensic cases such as disputed paternity, child swapping, immigration disputes, and fossil studies |
| **CO2** | Discuss the applications of DNA profiling in forensic investigations, while understanding the role of CODIS and adhering to legal and ethical standards in DNA profiling practices. |
| **CO3** | Interpret the absorption, distribution, metabolism, and excretion of drugs and poisons, along with their toxicological effects, to determine their role in fatal and non-fatal forensic cases. |
| **CO4** | Explain the methods for detecting, measuring, and safely handling radiation hazards, including understanding acute and chronic effects on the body and proper disposal of radioactive specimens and tissues. |
| **CO5** | Examine the stages of the digital forensics process to investigate cybercrime cases while analyzing the evolution and types of digital forensics. |

**Mapping of Course Outcomes to Program Outcomes and Program-Specific Outcomes:**

| CO/PO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 3 | 3 | 1 | 3 | 2 | 3 | 3 | 3 | 1 | 3 |
| CO2 | 3 | 3 | 3 | 1 | 3 | 2 | 3 | 3 | 3 | 1 | 3 |
| CO3 | 3 | 3 | 3 | 1 | 3 | 2 | 3 | 3 | 3 | 1 | 3 |
| CO4 | 3 | 3 | 3 | 1 | 3 | 2 | 2 | 2 | 3 | 1 | 2 |
| CO5 | 3 | 3 | 3 | 1 | 3 | 2 | 2 | 2 | 3 | 1 | 2 |

**CORRELATION : 3 STRONG 2 MEDIUM 1 LOW**

| MO. NO. | CONTENTS OF MODULE | HRs | COs |
|---|---|---|---|
| **I** | Forensic Biochemistry - Definition and scope of forensic science.- DNA profiling Introduction, Principle, methodology and role of RFLP and PCR in DNA profiling. Analysis of SNP, Y-STR, Mitochondrial DNA, Forensic DNA Startups: Product Development: Biosensors, DNA extraction kits, mobile labs for field forensics. | **10** | **CO1** |
| **II** | Applications of DNA profiling in disputed paternity cases, Child swapping-Hospital-Based DNA ID System Startup, Civil immigration, and fossil studies with case studies as examples. Combined DNA Index System (CODIS) Legal and ethical standards for DNA profiling. Establishing a Private Paternity DNA Testing Center | **10** | **CO2** |
| **III** | Forensic Toxicology and pharmacology. Scope of Forensic toxicology, Types of poisons, Poison Detection Kits for Law Enforcement and Hospitals, Fate of drug in body samples in fatal and non-fatal cases. Definition of drugs, toxins, and pharmaceuticals. Absorption distribution, Forensic Toxicology Lab Startup" | **10** | **CO3** |
| **IV** | Radiation Hazards, sources of exposure and contact, acute and chronic effects on the organs of the body, Methods of detection and measurement, Handling and disposal of specimens and tissues containing radioisotopes. Portable Radiation Detection Devices, Radiation Safety Consulting Firm | **10** | **CO4** |
| **V** | Digital Forensics- case scenario-, the evolution of cybercrime, Definition of computer forensics, types of digital forensics, and stages of computer forensics process –identification, collection, examination and reporting cybercrime. | **10** | **CO5** |

**RECOMMENDED BOOKS**


1. Vipul Ambade . *Forensic toxicology* second edition CBS Publishers & Distributers , India.
2. B.M.Mithal . *A textbook of Forensic Pharmacy* , 2011, ISBN- 978-8185731131, publishers Vallabh Prakasan
3. Understanding the role of DNA Microsatellite in Cancer Diagnosis and Forensic analysis by Dr.Hakim Saboowala, 2019


**REFERENCE BOOKS**


1. Wilson and Walker. *Principles and techniques of Biochemistry & Molecular Biology* ,ISBN- 978- 1316614761. 2018,
2. Nilakshi Jain & Dhananjay R. Kalbande. *Digital Forensics* Wiley Publishers, ISBN- 978-8126565740 2016,
3. Pankaj Srivastava, Hirak Ranjan Dash, Jose A Lorente. *Forensic DNA typing: Principles, Applications and Advancements*- Springer Nature Singapore, 2020,ISBN- 9789811566554


**WEB LINKS**

1. https://onlinecourses.nptel.ac.in/noc20_bt12/preview
2. https://onlinecourses.nptel.ac.in/noc22_bt07/preview
3. https://onlinecourses.nptel.ac.in/noc25_bt44/preview

**II M.Sc., BIOCHEMISTRY**
**THIRD SEMESTER**

**Discipline-Specific Elective II-Entrepreneurship Course II (C)**

**Course Title: MOLECULAR ENDOCRINOLOGY**

| Course Code | 2524316(C) | Credits | 03 |
|---|---|---|---|
| L:T:P:S | 4:0:0:0 | CIA Marks | 50 |
| Exam Hours | 03 | ESE Marks | 100 |

**LEARNING OUTCOME**

To understand the chemical nature, classification, mechanisms of action, biosynthesis, regulation, and functions of hormones from various endocrine glands, including their roles in physiological processes and homeostasis

**Entrepreneurship opportunities:** To empower students with the knowledge and skills to identify, develop, and evaluate business opportunities based on advances in molecular endocrinology. Students explore gaps in diagnosis, treatment, or management of endocrine disorders (e.g., diabetes, thyroid dysfunction, PCOS). Develop product/service ideas such as:Non-invasive hormone monitoring devices, Personalized hormone therapy using AI and genetic data, Functional foods or nutraceuticals targeting hormonal health

**COURSE OUTCOMES: At the end of the Course, the Student will be able to:**

| | |
|---|---|
| **CO1** | Explain the mechanisms of action of hormones, including Group I and Group II hormones, secondary messengers, and the role of adrenergic and cholinergic receptors in hormonal signaling. |
| **CO2** | Describe the chemistry, secretion, functions, and regulation of anterior pituitary hormones and posterior pituitary hormones, along with the influence of hypothalamic releasing factors. |
| **CO3** | Relate the biosynthesis, secretion, functions, and regulation of thyroid and pancreatic hormones to their roles in metabolism, growth, and homeostasis. |
| **CO4** | Evaluate the biosynthesis, secretion, and functions of adrenal cortex hormones and adrenal medullary hormones in stress response and physiological regulation. |
| **CO5** | Relate the structure, function, and regulation of gonadal hormones (Testosterone, Estrogen, Progesterone) to the ovarian cycle and their roles in reproductive physiology. |

**Mapping of Course Outcomes to Program Outcomes and Program-Specific Outcomes:**

| CO/PO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 2 | 3 | 3 | 3 | 3 | 3 | 3 | **3** | 3 | 3 |
| CO2 | 3 | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| CO3 | 3 | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| CO4 | 3 | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| CO5 | 3 | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |

**CORRELATION: 3-STRONG 2- MEDIUM 1- LOW**

| MO. NO. | CONTENTS OF MODULE | HRs | COs |
|---|---|---|---|
| I | **Hormones**: Definition, Chemical nature and classification. Mechanism of action of Group I and Group II hormones, secondary messengers- G protein, adenyl cyclase, cAMP, Inositol triphosphate and protein kinases. Hormonal receptors- Definition- Adrenergic and cholinergic receptors. Hormonal Therapy Startup for Personalized Health, Hormone Receptor-Based Diagnostics and Therapeutics | **10** | **CO1** |
| II | **Pituitary hormones**- Chemistry, Secretion, Functions and Regulation of Anterior Pituitary hormones - GH, Pituitary tropic hormones (LH, FSH and ACTH) and Posterior Pituitary hormones - Vasopressin and Oxytocin. Hypothalamus and hypothalamic releasing factor | **10** | **CO2** |
| III | **Thyroid hormones** - Biosynthesis, Secretion, Functions and Regulation of T3 and T4.<br>**Pancreatic hormones** – Biosynthesis, Functions and Regulations of Pancreatic hormones (Insulin and Glucagon**)** | **10** | **CO3** |
| IV | **Adrenal cortex hormones** (glucocorticoids and mineralocorticoids) **-** Biosynthesis, Secretion ,Functions<br>**Adrenal medullary hormones** (Epinephrine and Nor-Epinephrine**)-** Biosynthesis, Secretion and Functions. | **10** | **CO4** |
| V | **Gonadal hormones** - Testosterone, Estrogen and Progesterone- structure and function. Ovarian cycle and its regulation. Gonadal Hormone Supplementation and Wellness Products, Hormonal Supplements and Nutraceuticals | **10** | **CO5** |

**RECOMMENDED BOOKS**


1. L, B. (2010). *Hormonal Biochemistry.* Discovery Publishing Pvt. Ltd
2. Cooper, G. a. (2013). *The Cell: A Molecular Approach*. Sinauer Associates, Inc. - ISBN 10: 0878931066 / ISBN 13: 9780878931064
3. Shlomo Melmed, K. S. (2015). William *Textbook of Endocrinology* (13th ed.). Elsevier - ISBN 10: 0323297382 ISBN 13: 9780323297387


**REFERENCE BOOKS**


1. Sathyanarayana. (2017). *Biochemistry*(4th ed). Elsevier - ISBN: 9788131236017

2. Robert K.Murray, D. A. (2018). *Harper's Illustrated Biochemistry* (28th ed.). The McGraw- Hill Companies - ISBN-10 : 0071625917 / ISBN-13 : 978-0071625913

3. Karp, G. (2013). *Cell and Molecular Biology*. John Wiley and Sons Inc - ISBN-10 : 111830179X, ISBN-13 : 978- 1118301791


**WEB LINKS:**

1. .https://www.uc.edu/content/dam/uc/ce/docs/OLLI/Page%20Content/The%20Endocrine%20System.pdf
2. https://dosequis.colorado.edu/Courses/MCDB3145/Docs/Karp-617-660.pdf
3. https://courses.lumenlearning.com/suny-ap2/chapter/the-pituitary-gland-and-hypothalamus/

**II M.Sc., BIOCHEMISTRY**
**THIRD SEMESTER**

**Multi-Discipline Elective/Open Elective –I**

**Course Title: HEALTHCARE MANAGEMENT**

| | | | |
|---|---|---|---|
| **Course Code** | **2524317** | **Credits** | **03** |
| **L:T:P:S** | **4:0:0:0** | **CIA Marks** | **50** |
| **Exam Hours** | **03** | **ESE Marks** | **100** |

**LEARNING OBJECTIVE**

To understand the principles of public health, health care systems, disease prevention, hospital management, and medical record science to address health challenges and improve health care delivery in diverse settings

.

**COURSE OUTCOMES: At the end of the course, the student will be able to:**

| | |
|---|---|
| **CO1** | Analyze the evolution of public health, key public health acts, health problems in developed and developing countries, and the impact of environmental factors on health |
| **CO2** | Explain the structure and functions of health care systems in India |
| **CO3** | Identify epidemiological concepts, prevention strategies, and control measures for specific diseases |
| **CO4** | Evaluate modern hospital management techniques, operational models, quality control mechanisms, and strategies to ensure efficient and quality-assured professional services in Indian hospitals. |
| **CO5** | Describe medical records while addressing exceptional management needs in healthcare units |

**Mapping of Course Outcomes to Program Outcomes and Program-Specific Outcomes:**

| CO/PO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 2 | 3 | 3 | 3 | 3 | 3 | 3 | **3** | 3 | 3 |
| CO2 | 3 | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| CO3 | 3 | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| CO4 | 3 | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| CO5 | 3 | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |

**CORRELATION : 3-STRONG 2- MEDIUM 3- LOW**

| MO. NO. | CONTENTS OF MODULE | HRs | COs |
|---|---|---|---|
| I | **Introduction to Public Health:** Evolution of Public Health. Important public health acts, health problems of developed and developing countries, health problems in India, environment and health. | 10 | CO1 |
| II | **Health Care Systems in India:** Health planning in India, including various committees and national health policy and health goals set from time to time. Publication sector with reference to centre, state, district and block level structures and local bodies and panchayati raj organization and functions of community health centres and primary health centres (PHCS). Health manpower, primary health care and concept, alternative systems of medicine, like ayurveda, homeopathy, etc., holistic approach non- non-governmental publications (NGOs) and private voluntary publications (PVOS). Unorganized sector. | 10 | CO2 |
| III | **Basic Epidemiology and Prevention of Diseases:** Definition and concepts of epidemiology, concepts of health and disease, prevention and control of specific diseases – cholera, plague, smallpox, malaria, tuberculosis, leprosy, filariasis | 10 | CO3 |
| IV | **Hospital Operation Management:** Management of Indian hospitals-challenges and strategies. Modern techniques of hospital management. Operation concept- use of models. Health services research & formalized managerial methods. Management of quality assured services of professional service units of hospitals. Quality control mechanisms | 10 | CO4 |
| V | **Medical Record Science:** Definition and types of medical record, importance of medical record, flow chart of function, statutory requirements of maintenance, coding, indexing and filing, computerization of record, report and returns by the record department, statistical information and ICD. Exceptional management needs in healthcare units- management of blood bank, donated organs, morgues, and dispensaries. | 10 | CO5 |

**RECOMMENDED BOOKS**


1. Amelung, V. E. (2013). *Healthcare Management.* Springer -
2. Kieran, W. (n.d.). *Healthcare management.* Second edition, Tata McGraw-Hill publishers- ISBN 10: 0070706646 / ISBN 13: 9780070706644
3. Sharon b. Buchbinder and Nancy h. Shaks, J. (2012). *Introduction to healthcare management.* Barlett Learning - ISBN 10: 1284156567 / ISBN 13: 9781284156560


**REFERENCE BOOKS**


1. Galloway, N. g. (2017). *Leadership and management in healthcare* (3rd ed.). Sage publishers UK - ISBN 10: 1473965020 / ISBN 13: 9781473965027
2. Vikas, S. l. (n.d.). *Public health management* (2nd ed.). CBS publishers - ISBN: 978-9387742932
3. Sharon B. Buchbinder, N. H. (2011). *Introduction to Health Care Management* (2nd ed.). Jones and Bartlett Publishers, In - ISBN 10: 0763790869 / ISBN 13: 9780763790868


**WEB LINKS**

1. https://onlinecourses.swayam2.ac.in/imb24_mg125/preview
2. https://nptel.ac.in/courses/110104095
3. https://www.researchgate.net/publication/370054564

**II MSc BIOCHEMISTRY**

**THIRD SEMESTER**

**Core Practical-V**

**Course Title: ADVANCED CLINICAL BIOCHEMISTRY**

| | | | |
|---|---|---|---|
| **Course Code** | **2524318** | **Credits** | **03** |
| **L:T:P:S** | **1:0:4:0** | **CIA Marks** | **50** |
| **Exam Hours** | **06** | **ESE Marks** | **50** |

**LEARNING OBJECTIVE**

Perform and interpret biochemical estimations and diagnostic tests to analyze blood glucose, lipids, proteins, kidney function markers, urine constituents, and blood cell types, while demonstrating key assays for enzyme activity and cell viability

**COURSE OUTCOMES: At the end of the course, the student will be able to**

| | |
|---|---|
| CO1 | Estimate glucose and glycosylated Hb and interpret Glucose tolerance test and renal threshold value for glucose |
| CO2 | Interpret cardiac risk by assessing lipid parameters |
| CO3 | Analyze the significance of A/G ratio and Protein estimation |
| CO4 | Analyse renal markers and interpret clearance tests. Identify the abnormal constituents in urine by the Dip Stick Method |
| CO5 | Identify different types of WBCs and demonstrate MTT assay and catalase estimation |

**Mapping of Course Outcomes to Program Outcomes and Program-Specific Outcomes:**

| CO/PO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 2 |
| CO2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 2 |
| CO3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 2 |
| CO4 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 2 |
| CO5 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 2 |

**CORRELATION: 3-STRONG 2- MEDIUM 3- LOW**

| S.NO | CONTENTS | HRs | COs |
|---|---|---|---|
| 1 | Estimation of blood Glucose by glucose oxidase method | 4 | CO1 |
| 2 | Determination of Glycosylated Hemoglobin | 5 | CO1 |
| 3 | Estimation of serum Cholesterol by Zak's method, | 5 | CO2 |
| 4 | Estimation of LDL and determination of Cardiac risk | 5 | CO2 |
| 5 | Estimation of serum Albumin | 3 | CO3 |
| 6 | Determination of A/G ratio | 4 | CO3 |
| 7 | Estimation of Creatinine | 4 | CO4 |
| 8 | Estimation of Urea | 4 | CO4 |
| 9 | Identification of abnormal constituents in urine | 5 | CO4 |
| 10 | Identification of types of WBCs in blood smear | 3 | CO5 |
| **Demonstration Experiments** | | | |
| 11 | MTT assay for cell viability | 4 | CO5 |
| 12 | Estimation of Catalase | 4 | CO5 |

**RECOMMENDED BOOKS**


1. Pal, G. P. (2006). *Text Book of Practical physiology* (2nd ed.). Orient Blacks - ISBN 10: 8125030506 / ISBN 13: 9788125030508
2. Raghu. (2006). *Practical Biochemistry for Medical Students.* Jaypee - ISBN-10 : 818061106X / ISBN-13 : 978- 8180611063
3. Gowenlock, A. H. (1988). *Varley's Practical Clinical Biochemistry* (6th ed.). CBS Publishers and distributors, India - ISBN: 0849301564 9780849301568 0433338067 9780433338062 8123904274


**REFERENCE BOOKS**


1. Plummer, D. T. (n.d.). *An Introduction to Practical Biochemistry(3rd ed).* Tata Mc Graw Hill - ISBN: 9780070841659
2. Jayaraman, J. (2011). *Laboratory Manual in Biochemistry.* New Age International Pvt Ltd Publishers - ISBN-10: 812243049X, ISBN-13 : 978-8122430493
3. Singh, S. K. (2005). *Introductory Practical Biochemistry* (2nd ed.). Alpha Science International, Ltd - ISBN 10: 8173193029 / ISBN 13: 9788173193026


**WEB RESOURCES**

1.https://youtu.be/mWAEIvu1mV8
2. https://youtu.be/3MBiDfAkQhc
3. https://youtu.be/DyGIvs9zrVA

**II MSc BIOCHEMISTRY**

**THIRD SEMESTER**

**Skill Enhancement Course - Discipline Specific I**

**Course Title: BIOINFORMATICS**

| Course Code | 2524320 | Credits | 03 |
|---|---|---|---|
| L:T:P:S | 3:0:0:0 | CIA Marks | 50 |
| Exam Hours | 1.5 | ESE Marks | 50 |

**LEARNING OBJECTIVE**

To understand the fundamentals of bioinformatics, including omics technologies, biological databases, sequence analysis, drug design, molecular docking, and visualization tools, while applying these concepts to analyze drug-target interactions through case studies.

**COURSE OUTCOMES: At the end of the course, the student will be able to:**

| | |
|---|---|
| **CO1** | Explain the basic concepts of bioinformatics and its applications in life sciences. |
| **CO2** | Identify and utilize biological databases, sequence formats, and tools like BLAST for sequence comparison. |
| **CO3** | Explain the stages of drug discovery, lead identification, and the role of in silico tools in drug design. |
| **CO4** | Describe the fundamental principles of molecular docking and interpret docking results using appropriate tools. |
| **CO5** | Interpret visualization software (PyMOL, Chimera) to analyze protein-ligand interactions and understand real-life biological case studies. |

**Mapping of Course Outcomes to Program Outcomes and Program-Specific Outcomes:**

| CO/PO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | **3** | 3 | 3 |
| CO2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| CO3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| CO4 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| CO5 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |

**CORRELATION: 3-STRONG 2- MEDIUM 3- LOW**

| MO. NO. | CONTENTS OF MODULE | HRs | COs |
|---|---|---|---|
| I | **Basics of Bioinformatics:** Bioinformatics- Definition and its applications. Introduction to omics -Genomics, proteomics, metabolomics, transcriptomics- Definition and applications. | 10 | CO1 |
| II | **Biological Databases:** Overview of biological databases such as NCBI, UniProt, PDB and KEGG. Sequence formats like FASTA and GenBank. Basic sequence alignment – local and Global , use of BLAST for sequence comparison. | 10 | CO2 |
| III | **Introduction to Drug Design:** Stages of drug discovery and the role of bioinformatics in identifying drug candidates. Lead discovery- Definition and significance of lead compounds, Sources of lead compounds include natural products (plants, microbes, marine sources), synthetic chemical libraries, and virtual screening with in silico approaches. Hit identification and validation | 10 | CO3 |
| IV | **Fundamentals of Molecular Docking:** Basic concepts of molecular docking and its importance in drug-target interaction studies. Preparation of ligands and receptors. Introduction to docking tools such as AutoDock and AutoDock Vina. Interpretation of docking results including binding scores and molecular interactions. | 10 | CO4 |
| V | **Visualization Tools and Case Studies:** Introduction to visualization tools like PyMOL and Chimera. Basics of protein and ligand structure visualization.<br>**Case Study 1:** Docking of curcumin (a natural compound) with the main protease of SARS-CoV-2<br>**Case Study 2:** Docking of Garlic compound (allicin) against any one bacterial protein**.**<br>**Case Study 3:** Docking of Vitamin C (ascorbic acid) with oxidative stress-related enzyme. | 10 | CO5 |

**RECOMMENDED BOOKS**


1. Mount, D. W. (2004) *Bioinformatics: Sequence and Genome Analysis*, Cold Spring Harbor Laboratory Press, New York.
2. Rastogi, S. C., Mendiratta, N. and Rastogi, P. (2008) *Bioinformatics: Concepts, Skills and Applications*, CBS Publishers & Distributors, New Delhi.
3. Jiang, R., Zhang, X. and Zhang, M. Q. (2009) *Basics of Bioinformatics*, Springer, Berlin.


**REFERENCE BOOKS**


1. Lesk, A. M. (2019) *Introduction to Bioinformatics*, Oxford University Press, Oxford.
2. Ghosh, Z. and Mallick, B. (2008) *Bioinformatics: Principles and Applications*, Oxford University Press, New Delhi.
3. Stromgaard, K., Krogsgaard-Larsen, P., and Madsen, U. (2017). *Textbook of Drug Design and Discovery*, 5th Edition, CRC Press, Taylor & Francis Group.


**WEB LINKS**

1. https://archive.nptel.ac.in/courses/102/106/102106070
2. https://onlinecourses.swayam2.ac.in/cec21_bt04/preview
3. https://onlinecourses.nptel.ac.in/noc25_bt06/preview

**II MSc BIOCHEMISTRY**

**FOURTH SEMESTER**

**Discipline Specific Elective III - Entrepreneurship Course III (A)**

**Course Title: BIOETHICS, IPR, and HR**

| Course Code | 2524421(A) | Credits | 03 |
|---|---|---|---|
| L:T:P:S | 4:0::0 | CIA Marks | 50 |
| Exam Hours | 03 | ESE Marks | 100 |

**LEARNING OBJECTIVE**

To analyze ethical principles and dilemmas in bioethics, evaluate intellectual property rights (IPR) frameworks and their applications in biotechnology, and apply ethical guidelines and IPR laws to address contemporary issues in healthcare, research, and innovation.

**Entrepreneurship opportunities:** An entrepreneurial opportunity for the above Bioethics, IPR, and Biotech Innovation course is to launch an Ethics-Driven Biotech Innovation Platform. This venture would offer integrated services including ethical research compliance (ICMR, IRB), IPR protection (biotech patents, traditional knowledge), and startup incubation focused on responsible healthcare and biotech solutions. It bridges science, ethics, and entrepreneurship to foster socially conscious innovation.

**Course Outcomes**: **At the end of the Course, the Student will be able to:**

| | |
|---|---|
| **CO1** | Explain the principles of bioethics (autonomy, beneficence, non-maleficence, justice) and their application in clinical trials, organ transplantation, and euthanasia. |
| **CO2** | Analyze ethical guidelines for research involving humans and animals, including informed consent, confidentiality, and the role of ethical review boards (IEC, IRB). |
| **CO3** | Evaluate the criteria for patentability and the implications of intellectual property rights (IPR) in biotechnology, including gene editing, GMOs, and drug discovery. |
| **CO4** | Discuss contemporary issues such as bio-piracy, traditional knowledge misuse, and ethical dilemmas in cloning, stem cell research, and synthetic biology. |
| **CO5** | Interpret solutions to balance ethical concerns, human rights, and IPR challenges in healthcare, public health, and global innovations like CRISPR and pandemic responses. |

**Mapping of Course Outcomes to Program Outcomes and Program-Specific Outcomes:**

| CO/PO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| CO2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| CO3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| CO4 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| CO5 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |

**CORRELATION: 3-STRONG 2- MEDIUM 3- LOW**

| MO. NO. | CONTENTS OF MODULE | HRs | COs |
|---|---|---|---|
| I | **Introduction to Bioethics:** Definition, scope, and importance of bioethics. Historical evolution and ethical theories (utilitarianism, deontology, virtue ethics) Principles of bioethics: autonomy, beneficence, non-maleficence, and justice. Case studies: Clinical trials, organ transplantation, euthanasia. Ethical concerns in biotechnology, gene editing, and reproductive technologies. Startup Ethics in Biomedicine: From Idea to Market. Ethical Entrepreneurship in Biotech and Healthcare Innovation | 10 | CO1 |
| II | **Bioethics in Research and Healthcare:** Ethical guidelines for research on humans and animals (ICMR, Helsinki Declaration). Informed consent and patient rights. Confidentiality and data privacy in healthcare. Ethical review boards/committees (IEC, IRB). Public health ethics (vaccination, pandemics, resource allocation) | 10 | CO2 |
| III | **Introduction to Intellectual Property Rights (IPR):** Concept and significance of IPR Types of IPR: Patents, copyrights, trademarks, geographical indications, trade secrets IPR laws in India: The Patents Act, 1970; Copyright Act, 1957; Trademarks Act, 1999 TRIPS agreement and its implications for India Role of WIPO and WTO | 10 | CO3 |
| IV | **IPR in Biotechnology and Life Sciences :**Patentability criteria for biological inventions .Biotechnology patents: genes, cell lines, GMOs, biopharmaceuticals. Traditional knowledge and bio-piracy: Neem, Turmeric, Basmati rice case studies. IPR issues in drug discovery and development. Role of IPR in academic and industrial research collaborations. Valuation of IP in Startup Funding. Global IP Strategies for Biotech Startups | 10 | CO4 |
| V | **Contemporary Issues and Case Studies** Ethical dilemmas in cloning, stem cell research, synthetic biology. CRISPR and gene editing: ethics and patent battles. Case studies: Myriad Genetics (BRCA genes), Monsanto and GM crops, COVID-19 vaccine patents. Open science, Creative Commons, and access to knowledge. Future challenges in IPR and bioethics in India and other countries. Ethical Investment in Controversial Biotech, Startup Exit Strategies and Ethical Legacy | 10 | CO5 |

**RECOMMENDED BOOKS**

1. *Ben Mepham "Bioethics: An Introduction for the Biosciences"*
2. Prabuddha Ganguli. *Intellectual Property Rights: Unleashing the Knowledge Economy*
3. Relevant IPR acts and government policy documents (IPR Policy 2016, Indian Patent Office manual)

**REFERENCE BOOKS**


1. Dubey, R. (2014). *A Textbook of Biotechnology* . S. Chand - ISBN 10: 8121926084 / ISBN 13: 9788121926089
2. T.G.Agitha, N. &. (2009). *Principles of intellectual Property.* Eastern Book Company Lucknow - ISBN 10: 8170121132 / ISBN 13: 9788170121138
3. Acharya, N. (2014). *Text book of Intellectual property rights.* Asia Law House


**WEB LINKS**

1. https://onlinecourses.swayam2.ac.in/nou22_ge29/preview
2. https://archive.nptel.ac.in/courses/129/106/129106002
3. https://onlinecourses.nptel.ac.in/noc21_lw04/preview

**II MSc BIOCHEMISTRY**

**FOURTH SEMESTER**

**Discipline Specific Elective III - Entrepreneurship Course III (B)**

**Course Title: DEVELOPMENTAL BIOLOGY**

| | | | |
|---|---|---|---|
| **Course Code** | **2524421(B)** | **Credits** | **03** |
| **L:T:P:S** | **4:0:0:0** | **CIA Marks** | **50** |
| **Exam Hours** | **03** | **ESE Marks** | **100** |

**LEARNING OBJECTIVE**

To understand the fundamental concepts of development, gametogenesis, fertilization, embryo development, and aging, including key processes like cell differentiation, morphogenetic gradients, sperm-egg interaction, gastrulation, and programmed cell death

**Entrepreneurship Opportunities:**

Innovate in fertility tech with IVF tools, embryo imaging, and gamete diagnostics.

Build therapies targeting aging, stem cells, and apoptosis for cancer or neurodegeneration.

Create educational or research tools based on developmental biology concepts.

**COURSE OUTCOMES**: **At the end of the Course, the Student will be able to:**

| | |
|---|---|
| **CO1** | Illustrate the Basic concepts of developmental biology |
| **CO2** | Outline the process of Gametogenesis and Fertilization |
| **CO3** | Explain the Activation of sperm and egg. |
| **CO4** | Outline the process of Embryo development |
| **CO5** | Discuss the Biology of aging & senescence |

**Mapping of Course Outcomes to Program Outcomes and Program-Specific Outcomes:**

| CO/PO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 2 | 3 | 1 | 2 | 3 | 3 | 2 | 2 | 3 | 3 |
| CO2 | 3 | 2 | 3 | 1 | 2 | 3 | 3 | 2 | 2 | 3 | 3 |
| CO3 | 3 | 2 | 3 | 1 | 2 | 3 | 3 | 2 | 2 | 3 | 3 |
| CO4 | 3 | 2 | 3 | 1 | 2 | 3 | 3 | 2 | 2 | 3 | 3 |
| CO5 | 3 | 2 | 3 | 1 | 2 | 3 | 3 | 2 | 2 | 3 | 3 |

**CORRELATION : 3-STRONG 2- MEDIUM 1- LOW**

| MO. NO. | CONTENTS OF MODULE | HRs | COs |
|---|---|---|---|
| I | **Basic concepts of development :** Potency, commitment, specification, induction, competence, determination and differentiation; morphogenetic gradients; cell fate and cell lineages; stem cells; genomic equivalence and the cytoplasmic determinants. From Lab to Market: Commercializing Developmental Biology, Building startups from academic discoveries in developmental biology Collaborations between developmental biologists and biotech entrepreneurs | **10** | **CO1** |
| II | **Gametogenesis and Fertilization**: Production and structure of gametes, cell surface molecules in sperm egg recognition in animals, , fast and slow block to polyspermy, zygote formation | **10** | **CO2** |
| III | **Activation of sperm and egg**– interaction of sperm and egg – Sequence of events in sperm entry – Egg surface changes. acrosome reaction .Post– fertilization changes. | **10** | **CO3** |
| IV | **Embryo development**- cleavage-types of cleavage, blastula formation, embryonic fields, gastrulation and formation of germ layers in animals; embryogenesis. Fertility tech entrepreneurship: IVF, embryo freezing, time-lapse embryo imaging, Patents & IP in Embryo Tech | **10** | **CO4** |
| V | **Aging and Senescence:** Biology of aging & Senescence, Programmed cell death. Cancer therapies (e.g., pro-apoptotic drugs), Neurodegenerative conditions (e.g., reducing excessive apoptosis) | **10** | **CO5** |

**RECOMMENDED BOOK**

**1.** Dr Richard Twyman (2000) BIOS *Instant Notes in Developmental Biology*

2. Michael J.F. Barresi and Scott F. Gilbert ( 2020) Developmental Biology

3. Textbook of Zoology : *Developmental and Evolutionary Biology* : *For Major and Minor Course* : As per the Latest Curriculum of the Directives of NEP 2020.

**REFERENCE BOOKS:**

1. Gilbert, Scott's. 10 edition (2014). *Developmental biology.* Sinauer Association, Inc., Publishers.

2. Chattopadhyay.S. 2016. *An Introduction to Developmental Biology*, Books and Allied (P) Ltd, Kolkata. First Edition.

3. M.A. Subramanian (2021) *Developmental Biology*

**WEB LINKS**

1. https://onlinecourses.nptel.ac.in/noc20_bt35/preview
2. https://ugcmoocs.inflibnet.ac.in/index.php/courses/view_ug/154
3. https://www.pharmaguideline.com/2021/11/classification-of-hormones-mechanism-of-hormone-action

**II MSc BIOCHEMISTRY**

**FOURTH SEMESTER**

**Discipline Specific Elective III - Entrepreneurship Course III(C)**

**Course Title: BIOCHEMICAL PHARMACOLOGY AND TOXICOLOGY**

| | | | |
|---|---|---|---|
| **Course code** | **2524421(C)** | **Credits** | **03** |
| **L:T:P:S** | **4:0:0:0** | **CIA Marks** | **50** |
| **Exam Hours** | **03** | **ESE Marks** | **100** |

**LEARNING OBJECTIVE**

To understand the principles of drug metabolism, pharmacokinetics, pharmacodynamics, phytochemicals, allopathic drugs, regulatory guidelines for drug discovery, and toxicology, while exploring their applications in medicine, clinical trials, and preclinical studies

**Entrepreneurship Opportunities**

- Biopharma Innovation: Develop novel drug delivery systems or AI-driven platforms for optimizing drug metabolism and pharmacokinetics.
- Natural Product Startups: Commercialize phytochemicals and plant-based bioactives as supplements, therapeutics, or skincare products.
- Regulatory & Clinical Tech: Build tools or consultancies to streamline clinical trials, ensure regulatory compliance, and support ethical biotech ventures.

**COURSE OUTCOMES: On the successful completion of the course, student will be able to:**

| | |
|---|---|
| **CO1** | Explain the basic principles involved in pharmacokinetics and routes of drug administration processes. |
| **CO2** | Outline the metabolism and excretion of drugs |
| **CO3** | Discuss the mechanism of drug action, drug receptor interactions, and factors affecting the drug receptor interaction |
| **CO4** | Explain the drug discovery process and ethical issues |
| **CO5** | Outline the Principles of toxicology |

**Mapping of Course Outcomes to Program Outcomes and Program-Specific Outcomes:**

| CO/PO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| CO2 | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| CO3 | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| CO4 | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| CO5 | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |

**CORRELATION : 3-STRONG 2- MEDIUM 1- LOW**

| MO. NO. | CONTENTS OF MODULE | HRs | COs |
|---|---|---|---|
| I | **Drug metabolism:** Drug, Definition-Basic principles of drug action-Pharmacokinetics: Absorption, distribution , metabolism(Phase I and Phase II reactions) and elimination of drugs, First BY pass effect. Various routes of drug administration-conventional and nonconventional routes of drug administration. Alternative delivery systems as market opportunities-Transdermal patches, inhalable insulin wearable drug pumps:. | **10** | **CO1** |
| II | **Pharmacodynamics** - receptor concepts, theory, drug receptor interaction (DRI), Factors affecting DRI, Cholinergic and anticholinergic drugs, Adrenergic and adrenergic blockers, General anesthetics, Local anesthetics. Adverse reactions to drugs. | **10** | **CO2** |
| III | **Phytochemicals & allopathic drugs**-Classification-Flavonoids, alkaloids, saponins, tannins and glycosides-Structures and functions, their use as medicine. Allopathic drugs for treatment of fever & Pain, Ulcer, asthma, diabetes and cancer. Antibiotics (Pencillin, Chloramphenicol and streptomycin). Drugs for Skin infections. COVID drugs. Herbal/natural product startups: commercializing plant-based bioactives, Himalaya Wellness, Organic India, Cymbiotika | **10** | **CO3** |
| IV | **Application for New Drug Discovery (NDD)** according to Indian Control Authority and USFDA guidelines. Ethical considerations in utilizing human subjects for drug discovery process. Clinical trial startups and CROs: Building ethically compliant businesses Helsinki‟s declaration. Regulatory requirements for conducting clinical trials. Overview of drugs and cosmetics act. Regulatory process for export of pharmaceutical products and medicines from India. | **10** | **CO4** |
| V | **Toxicology:** Principles of toxicology and treatment of poisoning. Heavy metals and antagonists. Non metallic environmental toxicants. Role of Artificial intelligence in drug discovery. Preclinical toxicological studies: Calculation of LD50 and ED50.Acute, subacute and chronic toxicity studies; Irwin profile test, Pre-clinical pharmacokinetic and dynamic studies. Lipinski‟s rule for drug like molecule, High throughput screening (in-vitro and in-vivo) for pre-clinical pharmacokinetic and pharmacodynamic studies | **10** | **CO5** |

.

**RECOMMENDED BOOKS**


1. Satoskar, R.S and Bhandarkar, S.D. (2000) *Pharmacology and Pharmacotherapeutics*, 13th edition, Vol. I and II, Popular Prakeshan PVT Ltd, Mumbai.
2. Tripathi, K.D. (2013) *Essentials of Medical Pharmacology,* 7th edition, Jaypee Brothers Medical Publishers, New Delhi.
3. Rang, H.P., Dale, M.M., Ritter, J. and Flower, R.J. (2007) *Pharmacology,* 6th edition, Churchill Livingstone Elsevier


**REFERENCE BOOKS**


1. Barar, F.S.K. (2013) *Textbook of Pharmacology*, 1st edition, S.Chand and Company Pvt. Ltd.
2. Shargel,L. et al., 2012. *Applied Biopharmaceutics and Pharmacokinetics*, 6 th Edition, McGraw-Hill
   Medica
3. Sharma, P.D. (2003) *Toxicology,* 2nd edition, Rastogi Publications, Meerut.


**WEB LINKS**

1. https://nptel.ac.in/courses/102108077
2. https://dth.ac.in/medical/courses/pharmacology/1/8/index.php
3. https://onlinecourses.nptel.ac.in/noc23_cy10/preview

**II MSc BIOCHEMISTRY**

**FOURTH SEMESTER**

**Discipline Specific Elective IV - Employability Course IV(A)**

**Course Title: GENE EDITING and GENE THERAPY**

| | | | |
|---|---|---|---|
| **Course Code** | **2524422(A)** | **Credits** | **03** |
| **L:T:P:S** | **4:0:0:0** | **CIA Marks** | **50** |
| **Exam Hours** | **03** | **ESE Marks** | **100** |

**LEARNING OBJECTIVE**

To understand the principles and applications of gene editing, gene and cell therapy, stem cell technologies, and their regulatory and ethical considerations in biomedicine.

**Employability Opportunities:** Gene editing and gene therapy offer strong employability in roles such as research scientists or CRISPR specialists developing innovative therapies. Professionals are also in demand for clinical trial management, regulatory affairs, and ensuring compliance in gene therapy applications. Additionally, opportunities exist in biomanufacturing and bioinformatics, supporting the development, analysis, and production of gene-based treatments.

**COURSE OUTCOME: On the successful completion of the course, student will be able to:**

| | |
|---|---|
| **CO1** | Explain the Basis of gene editing. |
| **CO2** | Outline the Basics of Gene and cell therapy |
| **CO3** | Summarize the role of Vectors for Gene therapy |
| **CO4** | Describe the role of Stem cells and the process of tissue regeneration |
| **CO5** | Discuss and reflect on the ethical and social aspects of using immune, gene or cell therapy. |

**Mapping of Course Outcomes to Program Outcomes and Program-Specific Outcomes:**

| CO/PO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| CO2 | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| CO3 | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| CO4 | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| CO5 | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |

**CORRELATION : 3-STRONG 2- MEDIUM 1LOW**

| MO. NO. | CONTENTS OF MODULE | HRs | COs |
|---|---|---|---|
| I | **Gene Editing:** Basis of gene editing, DNA repair mechanisms, Double strand DNA breaks, Nonhomologous End-Joining (NHEJ), Homology directed repair, Programmable nucleases for gene editing, Meganucleases, Zinc-Finger nucleases, Transcription Activator-Like Effector Nucleases (TALEN), CRISPR-Cas systems, gene editing using CRISPR-Cas | **10** | **CO1** |
| II | **Gene and cell therapy:** Basics of Gene and cell therapy, types of gene therapy, gene therapy strategies, therapeutic targets for gene therapy, choice of the therapeutic target, administration routes, delivery systems, expression of transgene, persistence of the gene therapy, cell targeting, immunological response to the therapy | **10** | **CO2** |
| III | **Vectors for Gene Therapy:** Non-viral and viral vectors for gene therapy, Physical methods of gene delivery, Polymer, Lipid and inorganic material-based chemical systems for gene delivery, Viral vectors, Lentiviral, Adenoviral, Adeno-associated virus, Gene therapy applications, Gene therapy for cancer, suicide and oncolytic gene therapy. | **10** | **CO3** |
| IV | **Stem Cells and Tissue Regeneration:** Adult and fetal stem cells, embryonic stem cells, cell reprogramming, induced pluripotent stem cells (iPSC), Chemically induced pluripotent stem cells (CiPSC), reprogramming factors, iPSC-derived progenitor cells, Organoids, three-dimensional (3D) bioprinting. | **10** | **CO4** |
| V | **Regulatory and Ethical Considerations of stem cell and Gene Therapy,** pluripotent stem cell-based cell replacement therapies. Assessing Human Stem Cell Safety, Use of Genetically Modified Stem Cells in Experimental Gene Therapies. Technological challenges towards the development of pluripotent stem cell-based cell replacement therapies | **10** | **CO5** |

**RECOMMENDED BOOKS**


1. Daniel Marshak, Richard L. Gardner and David Gottlieb. *Stem Cell Biology* .Cold Spring Harbour Laboratory Press
2. Booth C. *Stem cell biology and Gene therapy*, Cell Biology International, Academic Press
3. Alexander Battler. *Stem Cell and Gene-Based Therapy: Frontiers in Regenerative Medicine,*


**REFERENCE BOOKS**


1. J.J. Pasternak, 2005. *An Introduction to Human Molecular Genetics* (2nd Edition),
2. Thomas F. Kresina Upadhyay, S. K. (Ed.) *An Introduction to Molecular Medicine and Gene Therapy* 1st Edition by . (2021).
3. Tom Strachan & Andrew Read, 2010. *Human Molecular Genetics* (4th Edition),


**WEB LINKS**

1. https://onlinecourses.nptel.ac.in/noc22_bt35/preview
2. https://archive.nptel.ac.in/courses/102/103/102103013
3. https://archive.nptel.ac.in/courses/102/108/102108077/

**II MSc BIOCHEMISTRY**

**FOURTH SEMESTER**

**Discipline Specific Elective IV - Employability Course IV(B)**

**Course Title: MOLECULAR BASIS OF DISEASES AND THERAPEUTIC STRATEGIES**

| Course code | 2524422(B) | Credits | 03 |
|---|---|---|---|
| L:T:P:S | 4:0:0:0 | CIA Marks | 50 |
| Exam Hours | 03 | ESE Marks | 100 |

**LEARNING OBJECTIVE**

To understand the risk factors, complications, management, and treatment of diabetes, cancer, nervous system conditions, and renal diseases.

**Employability Opportunities**: Careers in biomedical research focus on identifying drug targets and developing precision therapies. Opportunities exist in biotech and pharma for targeted drug design, biomarker discovery, and therapeutic strategy development. Roles in clinical diagnostics and translational medicine apply molecular insights to personalized patient care.

**COURSE OUTCOMES: At the end of the Course, the Student will be able to:**

| | |
|---|---|
| CO1 | Identify the risk factors that contribute to diabetes mellitus and provide an overall view of the complications of diabetes mellitus and its management. |
| CO2 | Explain the concepts of cancer biology and apply the theoretical concepts. |
| CO3 | Analyze and understand the pathophysiology of conditions that affect the brain |
| CO4 | Relate the renal diseases with emphasis on mechanistic aspects and therapeutic interventions. |
| CO5 | Apply biochemical and molecular tools for diagnostic and therapeutic intervention on cardiovascular diseases |

**Mapping of Course Outcomes to Program Outcomes and Program-Specific Outcomes:**

| CO/PO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| CO2 | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| CO3 | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| CO4 | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| CO5 | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |

**CORRELATION : 3-STRONG 2- MEDIUM 3- LOW**

| MO. NO. | CONTENTS OF MODULE | Hrs | Cos |
|---|---|---|---|
| I | **Diabetes mellitus**- Glucose homeostasis- Mechanism of blood sugar regulation, Pathophysiology of diabetes mellitus, Diabetes – investigation methods. Nutritional care. Complications related to diabetes – Diabetic cardiovascular disease, retinopathy, neuropathy and nephropathy. Management of Type I and Type II diabetes. Oral anti diabetic treatment for diabetes. | **10** | **CO1** |
| II | **Biology of Cancer:** Overview of Cancer. Tumorigenesis, Tumor progression and the mechanism of Metastasis. Proto-oncogene to oncogene. Oncogene- myc and src family. Tumor suppressor gene-Rb and p53 pathway in cancer. Diagnosis- Non-invasive imaging techniques, Tumor diagnosis, Interventional radiology, New imaging technique, Molecular techniques in cancer diagnosis.- Treatment of cancer- surgery, radiotherapy, chemotherapy, hormonal treatment, and biological therapy. Drugs for cancer. | **10** | **CO2** |
| III | **Neurogenerative Diseases-**Brain- neuronal network- memory- Neurogenerative diseases- Parkinson's and Alzheimer's Disease- molecular understanding of the neurodegenerative diseases- treatment modalities. | **10** | **CO3** |
| IV | **Kidney Diseases-** Acute and Chronic Renal Failure, glomerular diseases– glomerulonephritis, nephritic syndrome, diagnosis of kidney diseases, Dialysis, hemo and peritoneal dialysis. | **10** | **CO4** |
| V | **Cardiovascular Diseases-**Introduction**,** Lipids and lipoproteins in coronary heart disease-cardiac enzymes, Molecular changes during cardiac remodeling, hypertrophy of hearts – heart failure- treatment modalities. Hypolipidemic agents. | **10** | **CO5** |

**RECOMMENDED BOOKS**


1. Kaplan. (2010). *Clinical Biochemistry* (6th ed.). Mosby - ISBN-10 : 1464137846, ISBN-13 : 978-1464137846
2. Tietz. (2018). *Clinical Biochemistry* (8th ed.). Saunders
3. Wills' *Biochemical Basis of Medicine*: 2nd edition, Thomas H, Gillham B;Elsevier
4. Feuer G ,de la Iglesia F. (2021)*Molecular Biochemistry of Human Diseases*,, ; CRC Press


**REFERENCE BOOKS**


1. Gupta, P. P. (2013). *Textbook of Biochemistry with Biomedical Significance* (2nd ed.). CBS Publishers and distributors - ISBN 10: 8123922450 / ISBN 13: 9788123922454
2. T.M. Devlin. (2006). *Textbook of Biochemistry with Clinical Correlations.* CBS Publishers and Distributers - ISBN 10: 0471513482 / ISBN 13: 9780471513483
3. Chatterjee Ranashinde. (2012). *Medical Biochemistry(8th ed).* Jaypee - ISBN : 9789350254844


**WEB LINKS**

1. https://onlinecourses.nptel.ac.in/noc24_bt05/preview
2. https://nptel.ac.in/courses/102106652
3. https://onlinecourses.nptel.ac.in/noc22_ee87/preview

**II M.Sc., BIOCHEMISTRY**
**FOURTH SEMESTER**

**Discipline Specific Elective IV - Employability Course IV(C)**

**Course Title: N U T R I G E N O M I C S**

| Course code | 2524422(C) | Credits | 03 |
|---|---|---|---|
| L:T:P:S | 4:0:0:0 | CIA Marks | 50 |
| Exam Hours | 03 | ESE Marks | 100 |

**LEARNING OBJECTIVE**

To understand the interaction between nutrition, genetics, and epigenetics, and their roles in health, disease prevention, and personalized dietary interventions.

**Employability opportunities:** Nutrigenomics explores the interaction between nutrition and genes, offering opportunities in research, personalized nutrition, and biotechnology. Careers include roles in developing gene-based dietary recommendations, creating functional foods, and working in nutraceutical companies. There's also potential in health tech, focusing on apps or platforms for personalized nutrition based on genetic profiles.

**COURSE OUTCOMES: At the end of the Course, the Student will be able to:**

| | |
|---|---|
| **CO1** | Apply the knowledge of the basics of genetics, epigenetics in the context of nutrigenomics |
| **CO2** | Differentiate between genetics and genomics in the context of diseases with an idea on SNPs |
| **CO3** | Explain the concept of nutrigenomics and the genes associated with a few biochemical disorders |
| **CO4** | Assess the relationship between various nutrients and their role in gene regulation- the core concept of nutrigenomics |
| **CO5** | Interpret the relationship and interactions between food (diet) and genes in humans |

**Mapping of Course Outcomes to Program Outcomes and Program-Specific Outcomes:**

| CO/PO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 2 | 3 | 3 |
| CO2 | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 2 | 3 | 3 |
| CO3 | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 2 | 3 | 3 |
| CO4 | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 2 | 3 | 3 |
| CO5 | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 2 | 3 | 3 |

**CORRELATION : 3 STRONG 2 MEDIUM 1 LOW**

| MO. NO. | CONTENTS OF MODULE | HRs | COs |
|---|---|---|---|
| I | **Basics of Genetics -** Branches of Genetics –History of Dietetics And Genetics. Chromatin remodeling and histone modifications -Nutrients and DNA methylation. Nutrition, epigenetics, and embryonic development. Nutrition, epigenetics, and aging. Nutrition, epigenetics, and cancer | 10 | CO1 |
| II | **Nutrigenetics** – Introduction, Applications<br>Nutrigenetics And Type 2 Diabetes Mellitus. Nutrigenetics And Cardiovascular Diseases - Nutrigenetics And Cancer. Diet–SNP interaction involving methylenetetrahydrofolate reductase (*MTHFR*) gene. | 10 | CO2 |
| III | **Nutrigenomics –** Introduction -Rationale And Aims Of Nutrigenomics.<br>Genes Associated With Various Diseases- Genes Associated With Lipid Metabolism, Antioxidant Function And Detoxification, Inflammatory Response, Glucose Balance. Importance of nutrigenomics and nutrigenetics in food Science | 10 | CO3 |
| IV | **Nutrition and Gene Regulation** - Effect Of Carbohydrates on Gene Expression. Regulation of Gene Expression By Dietary Fat - Effect Of Protein On Gene Expression -Effect Of Minerals On Gene Expression (Only Zinc)- Effect Of Vitamins On Gene Expression (Only Vitamins A and D) | 10 | CO4 |
| V | **Gene- Diet Interactions -** Nutrient Intake Values (Nivs): A Recommended Terminology - Complexity Of Diet - Diet- Disease Relationships. Nutraceuticals - Sources of Nutraceuticals. Relation of Nutraceutical Science with Other Sciences: Medicine, Human Physiology, Genetics, Food Technology, Chemistry and Nutrition. Nutraceuticals Bridging the Gap between Food and Drug, Nutraceuticals in Treatment for Cognitive Disorders.Taste strips- Biomarkers - Genetic Tests – Ethical Issues | 10 | CO5 |

**RECOMMENDED BOOKS**


1. Tsankova, N. R. (2007). *Epigenetic regulation in psychiatric disorders*. Nature Reviews Neuroscience, 8:355- 367.
2. German JB, Y. C. (2004). *Personalizing foods - for health and preference*. Food technol 58:26-31
3. Raffaele De Caterina (Editor), J. A. (2019). *Principles of Nutrigenetics and Nutrigenomics: Fundamentals of Individualized Nutrition* (1st ed.). Academic Press.


**REFERENCE BOOKS**


1. Caterina, R. D. (2019). *Principles of Nutrigenetics and Nutrigenomics*. Elsevier Science and Technology - ISBN 10: 0128045728 / ISBN 13: 9780128045725
2. Lévesque L, O. V. (2008). *Integrating anticipated nutrigenomics bioscience applications with ethical aspects.* OMICS.


**WEB LINKS**

1. http://www.ncbi.nlm.nih.gov/projects/GeneTests/static/about/whatis/mission.shtml
2. https://www.sciencedirect.com/topics/agricultural-and-biological-sciences/nutrigenomics
3. https://pmc.ncbi.nlm.nih.gov/articles/PMC3481686

**II MSc BIOCHEMISTRY**

**FOURTH SEMESTER**

**Skill Enhancement Course- Discipline Specific-II**

**Course Title: BIOSTATISTICS AND RESEARCH METHODOLOGY**

| | | | |
|---|---|---|---|
| **Course Code** | **2524424** | **Credits** | **03** |
| **L: T:P:S** | **3:0:0::0** | **CIA Marks** | **50** |
| **Exam Hours** | **1.5** | **ESE Marks** | **50** |

**LEARNING OBJECTIVE**

To develop a comprehensive understanding of biostatistics, research methodologies, and scientific communication, including data collection, statistical analysis, hypothesis testing, research design, thesis writing, and ethical considerations, while gaining practical skills in using tools like MS Excel and SPSS for data analysis and interpretation.

**COURSE OUTCOMES: At the end of the Course, the Student will be able to**

| | |
|---|---|
| CO1 | Explain the definition of biostatistics and its scope, and ascertain the methods of data collection and presentation |
| CO2 | Examine the usage of statistical tools like measures of central tendency, measures of dispersion and infer the results of skewness, kurtosis, correlation and regression |
| CO3 | Evaluate the concept of hypothesis testing and deduce the t-test, chi-square test, and ANOVA to make statistical decisions |
| CO4 | Analyze the components of research and factors affecting research design |
| CO5 | Describe thesis writing and scientific conduct |

**Mapping of Course Outcomes to Program Outcomes and Program-Specific Outcomes:**

| CO/PO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| CO2 | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| CO3 | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| CO4 | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| CO5 | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |

**CORRELATION: 3-STRONG 2- MEDIUM 3- LOW**

| MO. NO. | CONTENTS OF MODULE | HRS | COS |
|---|---|---|---|
| I | **Biostatistics—**Definition and scope. Data collection—primary and secondary. Sampling, Classification, and Tabulation of Data. Presentation of data- graphical and diagrammatic representation. Charting of data using MS Excel. | **10** | **CO1** |
| II | **Measures of Central Tendency and Dispersion** -individual, discrete and continuous series-mean, median, mode, range, Quartile deviation, Standard deviation, Standard error. Use of Excel in measures of central tendency and dispersion. Normal distribution | **10** | **CO2** |
| III | **Testing of Hypothesis-** Null and Alternate Hypotheses. Steps involved in hypothesis testing. Student's t-test, Chi square test, ANOVA (One way). SPSS in hypothesis testing. | **10** | **CO3** |
| IV | **Fundamentals of Research-** Definition, Objectives, Characteristics. Types of research: Descriptive, Analytical, Applied, Fundamental, Quantitative, Qualitative, Conceptual, Empirical. Problems encountered in research. Research design- steps involved, types: Exploratory, Descriptive, Experimental, Causal research design. | **10** | **CO4** |
| V | **Thesis Writing and Scientific Conduct**-Thesis- Components of a thesis – format for writing thesis, reference styles (APA, Chicago, MLA). Journals-impact factor, citation, index (h, i10). Scientific misconduct: Falsification, Fabrication and Plagiarism (FFP). Research funding agencies- DST- Major funding schemes (SERB, INSPIRE), CSIR(fellowships and grant overview). | **10** | **CO5** |

**RECOMMENDED BOOKS**


1. Ramakrishnan, P. (2015). *Biostatistics.* Saras publication - ISBN-10 : 9384826049 / ISBN-13 : 978-9384826048
2. Pranabkumar Banerjee. (2011). *Introduction to Biostatistics.* S. Chand & Co Ltd -
3. Sundaram. (2014). *Medical Statistics.* Wolters Kluwer India Pvt. Ltd –


**REFERENCE BOOKS**


1. Gurumani, N. (2006). *Research Methodology for Biological Science.* MJP Publisher - ISBN 10: 8180940160 / ISBN 13: 9788180940163
2. Jerrold H Zar, (2003) *Biostatistical analysis* – Pearson Publishers, Fourth Edition, First Indian Reprint
3. Kothari CR (2004).*Research methodology*: methods and techniques, 2nd edition-, New Age International (P) Ltd. Publishers, New Delhi,


**WEB LINKS:**

1. https://onlinecourses.nptel.ac.in/noc24_bt11/preview
2. https://onlinecourses.nptel.ac.in/noc25_hs70/preview
3. https://onlinecourses.nptel.ac.in/noc23_ge36/preview

# APPENDIX

## OUTCOME-BASED EDUCATION (OBE)

Outcome-Based Education (OBE) is a student-centric teaching and learning methodology in which the course delivery, assessment are planned to achieve stated objectives and outcomes. It focuses on measuring student performance i.e. outcomes at different levels.

Outcome-based education (OBE) is an educational theory that bases each part of an educational system around goals (outcomes). By the end of the educational experience each student should have achieved the goal. There is no specified style of teaching or assessment in OBE; instead classes, opportunities, and assessments should all help students achieve the specified outcomes.

There are three educational Outcomes as defined by the National Board of Accreditation.

**Program Educational Objectives (PEOs)**

The Programme Educational Objectives of a program are the statements that describe the expected achievements of graduates in their career, and also in particular, what the graduates are expected to perform and achieve during the first few years after graduation.

**Programme Outcomes (POs)**

Program outcomes are finer statements that designate what students are expected to be able to do by the time of graduation. POs are expected to be aligned closely with Graduate Attributes.

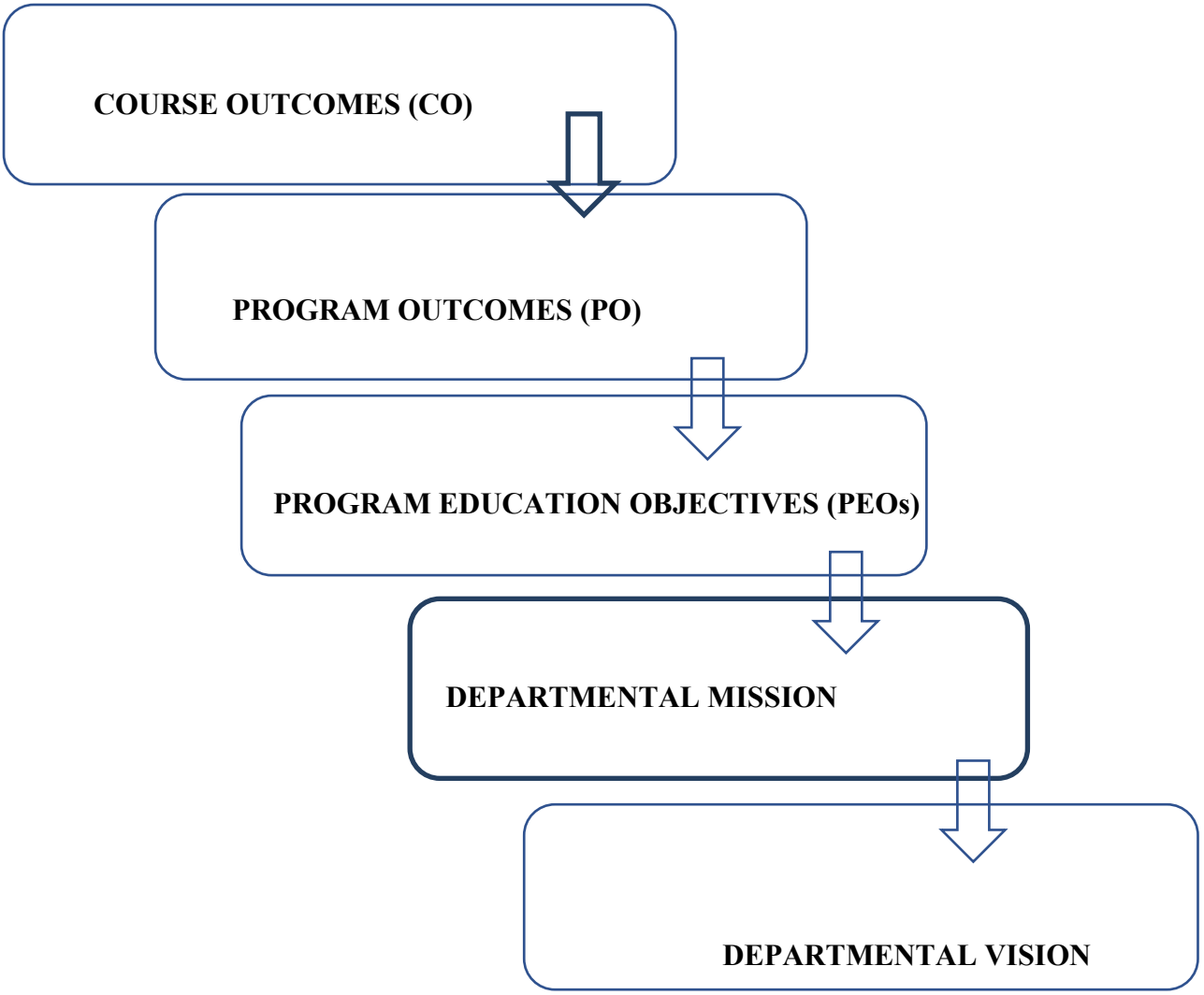
**Programme Specific Outcomes (PSO)**

Programme Specific Outcomes are what the students should be able to do at the time of graduation with reference to a specific discipline.

**Course Outcome (CO)**

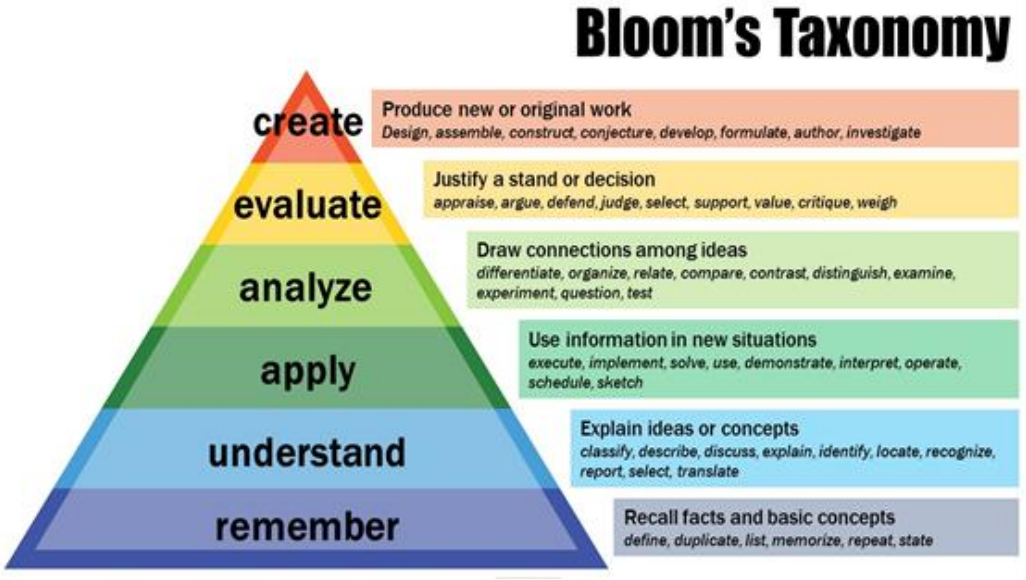
Course outcomes are statements that describe significant and essential learning that learners have achieved, and can reliably demonstrate at the end of a course.

## MAPPING OF OUTCOMES



## BLOOM'S TAXONOMY

**Bloom's taxonomy** is a classification system used to define and distinguish different levels of human cognition—i.e., thinking, learning, and understanding. Educators have typically used Bloom's taxonomy to inform or guide the development of assessments (tests and other evaluations of student learning), curriculum (units, lessons, projects, and other learning activities), and instructional methods such as questioning strategies. [eduglosarry.org]




**Knowledge levels for assessment of Outcomes based on Blooms Taxonomy**

| Level | Parameter | Description |
|---|---|---|
| K1 | Knowledge | It is the ability to remember the previously learned material/information |
| K2 | Comprehension | It is the ability to grasp the meaning of material |
| K3 | Application | It is the ability to use learned material in new and concrete situations |
| K4 | Analysis | It is the ability to break down material/concept into its component parts/subsections so that its organizational structure may be understood |
| K5 | Synthesis | It is the ability to put parts/subsections together to form a new whole material/idea/concept/information |
| K6 | Evaluation | It is the ability to judge the value of material/concept/statement/creative material /research report) for a given purpose |