

தந்தை பெரியார் அரசு கலை மற்றும் அறிவியல் கல்லூரி  
(தன்னாட்சி)

திருச்சிராப்பள்ளி - 620 023



## M. Sc., BIOCHEMISTRY SYLLABUS

(For the students admitted from 2023-2024 onwards)



**PG AND RESEARCH DEPARTMENT OF BIOCHEMISTRY,  
THANTHAI PERIYAR GOVERNMENT ARTS AND SCIENCE  
COLLEGE (AUTONOMOUS),  
TIRUCHIRAPPALLI – 620 023.**

May 2023

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## PREAMBLE

Curriculum updating and adoption of innovative pedagogy are major components of academic excellence aimed at providing exposure to cutting edge technological advancements. The Board of Studies in Biochemistry (PG) is pleased to submit the revised syllabus for M.Sc. Biochemistry course in the PG and Research Department of Biochemistry, Thanthai Periyar Government Arts and Science College (Autonomous), Tiruchirappalli - 23 with effect from 2023-2024. Keeping in mind, the advancements in the subject over the past decade, the board has gone through the existing syllabus and has incorporated few recent developments to provide a broader perspective of the subject to the students.

### **About the department:**

The Department of Studies in Biochemistry was established in the year 2018 with M.Sc., programme, and has completed 3 and half years of inception and Ph.D course started in the year March 2022. The department is presently offering M.Sc., and Ph.D., programmes in major fields of Biochemistry such as Cancer Biology & Neurobiology, Food & Drug Nanotechnology, Cardiovascular biology, Antidiabetic studies, Plant Biochemistry & Natural Products and Bioremediation and Biocatalysis. The Department has produced about 15 Biochemistry post-graduates, 100% of them passing in I class or higher. Many of them are pursuing job in reputed Institutes and Companies in Tamilnadu. In addition many students are trained for CSIR- UGC/NET, ICAR-JRF and GATE examinations. The faculty of the department are active in teaching and research. Faculty members of the Department have published more than 15 papers in refereed journals of international and national repute. Major research projects have been applied to faculty members in the department by DBT, DST, UGC and ICMR. The department has adequate research facilities viz., Clinical Biochemistry, Molecular biology and Advanced Nanotechnology Laboratory. The Department has also entered into collaborative research with Industries, pioneer Institutes of Tamilnadu and India. The Department organizes International/National seminars, conferences, symposia and workshops inviting eminent scientists and academicians from various Institutes, Universities and Industries across the country.

### **Program Introduction:**

The two-year full-time **M.Sc. programme in Biochemistry** endeavors to provide students with excellent training in Biochemistry emphasizing on solid background of basic concepts as well as rapid advancement in the field. In addition to theoretical knowledge, considerable emphasis is given on hands on experience in the forefront areas of Biochemistry through practical training. One of the basic science disciplines which lead to biotechnological advancement is **BIOCHEMISTRY**, a hybrid of biology and chemistry. Considering its pivotal role in biological sciences, it is imperative to strengthen the fundamental concepts of biochemistry at Postgraduate level with clear and tangible pedagogical approaches. The present curriculum for M.Sc. Biochemistry has been prepared with the objective of providing comprehensive knowledge of biochemistry including biochemical mechanistic basis of genetic and physiological processes, metabolism under normal and pathological conditions, drug discovery, cell signalling and clinical research. Apart from its traditional approach of providing more weightage to metabolism and molecular physiological aspects, the curriculum has greater emphasis on recent advancement in techniques of biochemistry and molecular biology which enable the students to better understand the core biochemistry and the

offshoots such as genomics, metabolomics, proteomics, and bioinformatics. It is hoped, that during the two year program, typical attributes of a competent science postgraduate such as; spirit of inquiry, critical thinking, problem solving, analytical and scientific reasoning, research/industry related skills are discovered and nurtured. For the design of curriculum, selection of papers and drafting of syllabus for each course, suggestions from stakeholders was obtained at each stage. The course structure was initially framed in a faculty meeting and suggestions were sought from subject experts across the universities from panel. Based on the suggestions, the course structure was re-framed and syllabus for each course was drafted. Subsequently, the revised draft was shown to selected peers and stakeholders for access of suggestions. The re-revised draft was deliberated in a meeting of the Committee of Courses and the final draft was prepared.

### **Program Objectives:**

The proposed programme shall be governed by the PG and Research Department of Biochemistry, Thanthai Periyar Government Arts and Science College (Autonomous), Tiruchirappalli - 23. A two-year program will lead to the award of a M.Sc. degree in Biochemistry. Students will be offered advanced level theory and practical courses in subjects like proteins, cell biology, immunology and, cell signalling, enzymes and their biochemical applications, molecular biology, recombinant DNA technology and applications in biotechnology, developmental biology, proteomics and metabolomics and advanced techniques in genomics. The emphasis is on training students for research. Students will be trained adequately in the various basic tools, techniques and instrumentation in specific research frontiers. Students are also required to present critical reviews on various current and significant topics in seminars for evaluation. The department also offers a basic course in biochemistry for interested students across the University with background in life sciences.

The Department strives to achieve the following programme Specific objectives:

1. The foremost objective of the programme is to empower students with clear understanding of the basic concepts of biochemistry and provide them knowledge of the recent advances so that they can independently assess the vast scope in the field.
2. The programme aims to train students to enable them to apply biochemical principles, theoretically and experimentally, to understand various complex life processes, while providing biochemical solutions to combat various human diseases.
3. It is expected that at the time of completion of the programme each student is confident and independent in their thought processes and can make an informed choice about their subsequent career.
4. The program is expected to motivate students for higher education, especially research and provide trained manpower for biotechnology industry. They are expected to be ethically sound and ready for the next phase of their development, skilled in the art of self-reading, oration and scientific writing.

### **Programme Outcomes (POs):**

A post-graduate student upon completion of the programme is expected to gain the following attributes: In-depth knowledge of Biochemistry with inter-disciplinary perspective of other branches of life sciences. Competence for research and innovation in Biochemistry as a skilled

experimentalist. Analytical and problem solving skills with regard to biochemical principles of life processes and technologies for combating human diseases. Critical thinking about the concepts in Biochemistry and ability to critically review scientific literature for development of new theories and testable hypothesis. Capacity for decision making with regard to scientific progress, personal development and career choice. Ability to work independently, while still promoting team work and collaboration skills. Improving oratory (public speaking), scientific conversation and writing skills. Leadership and organizational skills. Demonstration of integrity, honesty, ethical behavior and sense of responsibility. Appreciation of diversity in scientific community and responsibility towards society and nation. Environmental awareness bio-waste generation, disposal and management and safety and security issues

**Eligibility:**

A candidate for being eligible for admission to the MSc Biochemistry must have taken either:

- a) Bachelor of Science with either Biochemistry or chemistry as one of the mandatory optional subject studied during undergraduate programme.
- b) Bachelor of Science in Life Sciences (Botany, Zoology, Microbiology, and Biotechnology) with a combination of the available subjects with Chemistry
- e) Bachelor of Science of another Medical and Veterinary University recognized as equivalent thereto.

**Fee structure:**

As prescribed by the Tamilnadu Government.

**Intake: 25 Seats** (As per the Regulations of Bharathidasan University)

**Admission:**

As per the Admission Regulations given by the Government of Tamilnadu and Bharathidasan University.

**Duration of the programme:** The duration of the MSc Programme shall be two – year. The Programme shall not be conferred upon a candidate unless he has passed in the entire course subjects; practical's and has to full fill all the requirements as stated in the programme structure.

**Project:** Each candidate shall be required to take up a Project Work; submit Project Report at the end of the second year. The Head of the Department shall assign the Guide who in turn will suggest the Project Work to the student in the beginning of fourth semester. Two typed copies of the Project Report shall be submitted to the Department on or before the date fixed by the Department Head. The Dissertation will be evaluated by Examiners, nominated by the Department. The candidate concerned will have to defend his project in a Viva-Voce examination.

**Industrial visit:** The Head of the Department shall assign the faculty members who in turn will take up the student's to the industrial visit in State level or National level in the middle of second semester.

# **POSTGRADUATE AND RESEARCH DEPARTMENT OF BIOCHEMISTRY**

## **THANTHAI PERIYAR GOVERNMENT ARTS AND SCIENCE COLLEGE**

**(AUTONOMOUS), TIRUCHIRAPPALLI – 620 023**

### **MINUTES OF THE MEETING OF THE BOARD OF STUDIES**

**HELD ON 17<sup>TH</sup> MAY 2023**

The Board of Studies meeting of M.Sc., Biochemistry was held in the PG and Reserch Department of Biochemistry, Thanthai Periyar Government Art and Science College (Autonomous), Tiruchirappalli - 23 on 17.05.2023 (Wednesday) at 10.00 am. Dr. R. Senthilkumar, Chariman (BoS) and Head, PG and Research Department of Biochemistry, Thanthai Periyar Government Arts and Science College (A), Tiruchirappalli chaired the meeting and welcomed all the board members to the meeting. The Chairman of the board briefed the agenda to board for deliberations. The board has thoroughly discussed about each point in detail. Proceedings have been recorded and provided as hereunder.

The following agenda were taken up for the discussion and the following resolutions were passed.

1. The board has approved for the course structure, syllabus question paper pattern for the M.Sc., Biochemistry and to be implemented those students who are admitted from 2023-2024 onwards.
2. The board has considered to enrich the emerging study area in the syllabi of M.Sc., Biochemistry.
3. The board has approved to include or eliminate (25% ) part of the course papers from the existing syllabi of TANSICHE Model syllabus.
4. The board has approved of total credits of this M.Sc., Biochemistry course.
5. The board has considered the requests and approved for research centre of this PG and Research Department of Biochemistry, Thanthai Periyar Government Arts and Science College (A), Tiruchirappalli -23.
6. The board has approved for granting the admission of candidates for Ph.D course (FT & PT) in this department.
7. The board has considered the request of Dr. R.Senthilkumar, Assistant Professor & Head, PG and Research Department of Biochemistry, and Dr. C.Aiyavu, Assistant Professor, PG and Research Department of Biochemistry, has approved to supervise the candidates and accord the recognition as research guide in the PG and Research Department of Biochemistry, Thanthai Periyar Government Arts and Science College (Autonomous), Tiruchirappalli -23 as per the regulations of Bharathidasan University.
8. The board has considered to suggest the department and given approval for establishing Memoranda of Understandings (MoUs) with reputed Universities, Institutions, Research Organizations,, Industries and Hospitals with the state, from India and abroad, through the PG and Research Department of Biochemistry, Thanthai Periyar Government Arts and Science College (A), Tiruchirappalli. As these MoUs are necessary for PG Biochemistry course and Ph.D academic and research collaborations.

After scrutiny, the board of studies members were approved the existing syllabi and question paper pattern with some minor corrections. Title of the papers and content of the core syllabus were discussed. The total credit of 90 for this PG Biochemistry course was approved by the board

members. The board has decided to implement the new syllabi from the academic year 2023 -2024 with the concurrence of the both internal and external board members.

P.G Theory Question paper pattern (SEM.: 75 marks + CIA: 25 marks = Total: 100 marks)

Section – A Ten questions (two questions for each unit) – 10 X 2 =20 marks

Section – B Five questions (two questions for each unit- either or type)-5X5=25 marks

Section – C Three questions (3 out of 5 questions - one question is compulsory from each unit) – 3X10 = 30 marks

P.G Practical Question paper pattern (SEM.: 60 marks + CIA: 40 marks = Total: 100 marks)

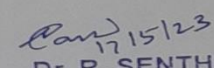
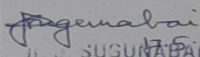
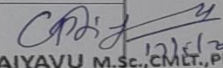
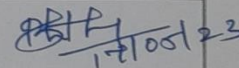
Major Practical 1 – One question from whole paper – 1 X 30 = 30 marks

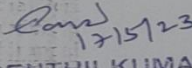
Minor Practical 2 – One question from whole paper – 1 X 20 = 20 marks

Viva voce - 5 marks

Record – 5 marks

The Board of studies members of M.Sc., Biochemistry Course – 2023-2024

| Sl.No. | Name & Designation                                                                                                                                                                      | Nature of Work | Signature                                                                                                                                                                                                                                                                                  |
|--------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1.     | Dr. R.SENTHILKUMAR,<br>Head & Assistant Professor,<br>PG & Research Department of<br>Biochemistry,<br>Thanthai Periyar Government Arts<br>and Science College(A),<br>Tiruchirappalli-23 | Chairman       | <br>17/15/23<br>Dr. R. SENTHILKUMAR,<br>Assistant Professor & Head,<br>Department of Biochemistry,<br>Thanthai Periyar Govt. Arts & Science College (A)<br>Tiruchirappalli - 620 023.                   |
| 2.     | Dr. J.SUGUNABAI,<br>Head,<br>Department of Biochemistry,<br>Seethalakshmi Ramasamy<br>college(A),<br>Tiruchirappalli.                                                                   | Subject Expert | <br>17/15/2023<br>Dr. J. SUGUNABAI, M.Sc., M.Phil., F.I.C.<br>Associate Professor & H.C.D<br>Department of Biochemistry<br>Seethalakshmi Ramaswami College<br>Tiruchirappalli-620 002.                 |
| 3.     | Dr. C. AIYAVU,<br>Assistant professor,<br>PG & Research Department of<br>Biochemistry,<br>Thanthai Periyar Government<br>Arts and Science College(A),<br>Tiruchirappalli -23            | Member         | <br>17/15/23<br>Dr.C.AIYAVU M.Sc., CMLT, Ph.D<br>Assistant Professor<br>PG & Research Dept. of Biochemistry<br>Thanthai Periyar Govt. Arts & Science College<br>Tiruchirappalli - 620 023, TN, India. |
| 4.     | Dr. V.BHARATHI,<br>Guest Lecturer,<br>PG & Research Department of<br>Biochemistry,<br>Thanthai Periyar Government Arts<br>and Science College(A),<br>Tiruchirappalli-23                 | Member         | <br>17/10/23                                                                                                                                                                                          |

  
17/15/23  
Dr. R. SENTHILKUMAR,  
Assistant Professor & Head,  
Department of Biochemistry,  
Thanthai Periyar Govt. Arts & Science College (A),  
Tiruchirappalli - 620 023.

|                            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|----------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Programme:</b>          | <b>M.Sc BIOCHEMISTRY</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| <b>Programme Code:</b>     | <b>LIFC</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| <b>Duration:</b>           | <b>2 years</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| <b>Programme Outcomes:</b> | <p><b>PO1.</b> To make students understand the importance of biochemistry as a subject that deals with life processes, as well as the concepts, theories and experimental approaches followed in biochemistry, in order to pursue a research career, either in an industry or academic setting.</p> <p><b>PO2.</b> To develop analytical and problem-solving skills</p> <p><b>PO3.</b> To create an awareness among the students on the interconnection between the interdisciplinary areas of biochemistry.</p> <p><b>PO4.</b> To give the necessary practical skills required for biochemical techniques and analysis.</p> <p><b>PO5.</b> To develop a communication and writing skills in students.</p> <p><b>PO6.</b> To develop leadership and teamwork skills</p> <p><b>PO7.</b> To emphasize the importance of good academic and work ethics and their social implications.</p> <p><b>PO8.</b> To emphasize the importance of continuous learning and to promote lifelong learning and career development.</p> <p><b>PO9.</b> To teach students how to retrieve information from a variety of sources, including libraries, databases and the internet.</p> <p><b>PO10.</b> To teach students to identify, design and execute a research problem, analyze and interpret data and learn time and resource management.</p> |



|                                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|-------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Programme Specific Outcomes:</b> | <b>Programme Specific Outcomes (PSO)</b><br><br><b>On successful completion of this course, students should be able to:</b><br><br><b>PSO1.</b> Understand the principles and methods of various techniques in Biochemistry, Immunology, Microbiology, Enzyme kinetics and Molecular Cell Biology. Based on their understanding, the students may would be able to design and execute experiments during their final semester project, and further research programs.<br><br><b>PSO2.</b> Insight on the structure-function relationship of biomolecules, their synthesis and breakdown, the regulation of these pathways, and their importance in terms of clinical correlation. Students will also acquire knowledge of the principles of nutritional biochemistry and also understand diseases and their prevention.<br><br><b>PSO3.</b> To understand the concepts of cellular signal transduction pathways and the association of aberrant signal processes with various diseases. Acquire insight into the immune system and its responses, and use this knowledge in the processes of immunization, vaccine development, transplantation and organ rejection.<br><br><b>PSO4.</b> To visualize and appreciate the central dogma of molecular biology, regulation of gene expression, molecular techniques used in rDNA technology, gene knock-out and knock-in techniques.<br><br><b>PSO5.</b> To create awareness in students about the importance of good laboratory practices and the importance of ethical and social responsibilities of a researcher. Teach them how to review literature and the art of designing and executing experiments independently and also work as a part of a team. |
|-------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

**List of Courses:**

| <b>GENERAL COURSE PATTERN FOR PG - SCIENCE - 2023-2024</b> |             |               |       |                 |                                                                                            |             |                |            |                  |              |
|------------------------------------------------------------|-------------|---------------|-------|-----------------|--------------------------------------------------------------------------------------------|-------------|----------------|------------|------------------|--------------|
| <b>SL. NO.</b>                                             | <b>PART</b> | <b>COURSE</b> |       | <b>Sub-Code</b> | <b>COURSE TITLE</b>                                                                        | <b>Hrs.</b> | <b>Credits</b> | <b>CIA</b> | <b>Sem. Exam</b> | <b>Total</b> |
| <b>I SEMESTER</b>                                          |             |               |       |                 |                                                                                            |             |                |            |                  |              |
| 1                                                          | -           | Core          | I     |                 | Basics of Biochemistry                                                                     | 6           | 5              | 25         | 75               | 100          |
| 2                                                          | -           | Core          | II    |                 | Biochemical and Molecular Biology Techniques                                               | 6           | 5              | 25         | 75               | 100          |
| 3                                                          | -           | Core          | III   |                 | Physiology and Cell Biology (To include Hormones)                                          | 5           | 4              | 25         | 75               | 100          |
| 4                                                          | -           | Core          | IV    |                 | Enzymology                                                                                 | 5           | 4              | 25         | 75               | 100          |
| 5                                                          | -           | Core          | V-P   |                 | Practical-I                                                                                | 6           | 4              | 40         | 60               | 100          |
| 6                                                          |             | SEC           | I     |                 | Nutritional Biochemistry                                                                   | 2           | 2              | 25         | 75               | 100          |
| <b>TOTAL</b>                                               |             |               |       |                 |                                                                                            | <b>30</b>   | <b>24</b>      | <b>165</b> | <b>435</b>       | <b>600</b>   |
| <b>II SEMESTER</b>                                         |             |               |       |                 |                                                                                            |             |                |            |                  |              |
| 7                                                          | -           | Core          | VI    |                 | Cellular Metabolism                                                                        | 5           | 5              | 25         | 75               | 100          |
| 8                                                          | -           | Core          | VII   |                 | Clinical Biochemistry                                                                      | 5           | 5              | 25         | 75               | 100          |
| 9                                                          | -           | Core          | VIII  |                 | Industrial Microbiology                                                                    | 5           | 4              | 25         | 75               | 100          |
| 10                                                         | -           | Core          | IX-P  |                 | Practical-II                                                                               | 5           | 4              | 40         | 60               | 100          |
| 11                                                         |             | CBE           | I     |                 | Microbiology & Immunology                                                                  | 5           | 3              | 25         | 75               | 100          |
| 12                                                         | -           | NME           | I     |                 | Principles of Computer Science                                                             | 3           | 2              | 25         | 75               | 100          |
| 13                                                         |             | SEC           | II    |                 | Molecular Basis of Disease and Therapeutic strategies (or) Internship -Clinical Laboratory | 2           | 2              | 25         | 75               | 100          |
| <b>TOTAL</b>                                               |             |               |       |                 |                                                                                            | <b>30</b>   | <b>25</b>      | <b>190</b> | <b>510</b>       | <b>700</b>   |
| <b>III SEMESTER</b>                                        |             |               |       |                 |                                                                                            |             |                |            |                  |              |
| 14                                                         | -           | Core          | X     |                 | Molecular Biology                                                                          | 6           | 5              | 25         | 75               | 100          |
| 15                                                         | -           | Core          | XI    |                 | Gene Editing, Cell and Gene therapy                                                        | 5           | 4              | 25         | 75               | 100          |
| 16                                                         | -           | Core          | XII-P |                 | Practical-III                                                                              | 5           | 4              | 40         | 60               | 100          |
| 17                                                         | -           | CBE           | II    |                 | Energy and Drug Metabolism                                                                 | 4           | 3              | 25         | 75               | 100          |
| 18                                                         | -           | CBE           | III   |                 | Biosafety, Lab Safety and IPR                                                              | 5           | 3              | 25         | 75               | 100          |
| 19                                                         |             | NME           | II    |                 | Biostatistics and Data Science                                                             | 3           | 2              | 25         | 75               | 100          |
| 20                                                         |             | SEC           | III   |                 | Industrial Visit (Biotech)                                                                 | 2           | 2              | 25         | 75               | 100          |
| <b>TOTAL</b>                                               |             |               |       |                 |                                                                                            | <b>30</b>   | <b>23</b>      | <b>190</b> | <b>510</b>       | <b>700</b>   |

| <b>IV SEMESTER</b> |   |         |      |  |                                              |            |           |            |             |             |
|--------------------|---|---------|------|--|----------------------------------------------|------------|-----------|------------|-------------|-------------|
| 21                 | - | Core    | XIII |  | Pharmaceutical Biochemistry                  | 6          | 4         | 25         | 75          | 100         |
| 22                 | - | Core    | XIV  |  | Biochemical Toxicology                       | 5          | 4         | 40         | 60          | 100         |
| 23                 | - | CBE     | IV   |  | Developmental Biology                        | 5          | 3         | 25         | 75          | 100         |
| 24                 | - | SEC     | IV   |  | Industrial Visit (Pharma or Food Processing) | 2          | 2         | 25         | 75          | 100         |
| 25                 |   | EA      |      |  | Extension Activity                           | -          | 1         | 25         | 75          | 100         |
| 26                 |   | Project |      |  | Project and Viva                             | 12         | 4         | 25         | 75          | 100         |
| <b>TOTAL</b>       |   |         |      |  |                                              | <b>30</b>  | <b>18</b> | <b>165</b> | <b>435</b>  | <b>600</b>  |
| <b>GRAND TOTAL</b> |   |         |      |  |                                              | <b>120</b> | <b>90</b> | <b>710</b> | <b>1890</b> | <b>2600</b> |

\* Internship will be carried out during the summer vacation of the first year and marks should be sent to the office of the COE by the department and the same will be included in the Third Semester Marks Statement.

|                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|--------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Course</b>                  | <b>CORE PAPER I</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| <b>Title of the Course:</b>    | <b>BASICS OF BIOCHEMISTRY</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| <b>Credits:</b>                | <b>5 - Hrs 6</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| <b>Pre-requisites, if any:</b> | Basic Knowledge of Biochemistry and Biomolecules                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| <b>Course Objectives</b>       | <p>The main objectives of this course are to:</p> <ol style="list-style-type: none"> <li>1. Students will be introduced to the structure of biomolecules.</li> <li>2. The significance of carbohydrates in biological processes will be understood.</li> <li>3. The structure, properties and biological significance of lipids in the biological system will be studied</li> <li>4. Students will learn about the concepts of protein structure and their significance in biological processes and creatively comprehend the role of membrane components with their biological significance.</li> <li>5. Students will gain knowledge about the structures and functional roles of nucleic acids in the biological system</li> </ol> |
| <b>Course Outcomes</b>         | <p>On successful completion of the course, the students should be able to:</p> <p><b>CO1 :</b> Explain the chemical structure and functions of carbohydrates. (K1, K2)</p> <p><b>CO2:</b> Using the knowledge of lipid structure and function, explain how it plays a role in Signalling pathways ( K3,K4)</p> <p><b>CO3:</b> Describe the various levels of structural organisation of proteins and the role of proteins in biological system (K4, K5)</p> <p><b>CO4:</b> Apply the knowledge of proteins in cell-cell interactions.(K3,K4)</p> <p><b>CO5.</b> Applying the knowledge of nucleic acid sequencing in research and diagnosis (K2, K3,K4)</p>                                                                           |

| <b>Units</b> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
|--------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>I</b>     | <p><b>Carbohydrates</b>-Classification, structure (configurations and conformations, anomeric forms), function and properties of monosaccharides, mutarotation, Disaccharides and oligosaccharides with suitable examples . Polysaccharides - Homopolysaccharides (starch, glycogen, cellulose, inulin, dextrin, agar, pectin, dextran). Heteropolysaccharides - Glycosaminoglycans– source, structure, functions of hyaluronic acid, chondroitin sulphates, heparin, keratan sulphate,. Glycoproteins - proteoglycans. O- Linked and N-linked glycoproteins.</p> |

|                                            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|--------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                            | Biological significance of glycan. Blood group polysaccharides. Bacterial cell wall (peptidoglycans, teichoic acid) and plant cell wall carbohydrates.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| <b>II</b>                                  | <b>Lipids</b> – Classification of lipids, structure, properties and functions of fatty acids, triacylglycerols, phospholipids, glycolipids, sphingolipids and steroids – Biological importance. Eicosanoids- classification, structure and functions of prostaglandins, thromboxanes, leukotrienes. Lipoproteins – Classification, structure, transport (endogenous and exogenous Pathway) and their biological significance.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| <b>III</b>                                 | <b>Overview of Amino acids</b> - classification, structure and properties of amino acids, Biological role. Non Protein amino acids and their biological significance. Determination of amino acid sequence. Chemical synthesis of a peptide, Forces involved in stabilization of protein structure. Ramachandran plot. Folding of proteins. Molecular chaperons – Hsp 70 and Hsp 90 - biological role.<br><b>Membrane Proteins</b> - Types and their significance. Cytoskeleton proteins - actin , tubulin , intermediate filaments . Biological role of cytoskeletal proteins. Membrane structure-fluid mosaic model                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| <b>IV</b>                                  | <b>Proteins</b> – classification based on composition, structure and functions. Primary, secondary, super secondary (motifs) (Helix-turn – helix, helix-loop-helix, Beta-alpha-beta motif, Rosemann Rossmann fold , Greek key ), tertiary and quaternary structure of proteins. Structural characteristics of collagen and hemoglobin. Membrane Protein and Ribonucleo protein, Histones<br>Na, K, ATP ase.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| <b>V</b>                                   | <b>Nucleic acids</b> – types and forms (A, B, C and Z) of DNA. Watson-Crick model-Primary, secondary and tertiary structures of DNA. Triple helix and quadruplex DNA. Mitochondrial and chloroplast DNA. DNA supercoiling (calculation of Writhe, linking and twist number). Determination of nucleic acid sequences by Maxam Gilbert and Sanger’s methods. Forces stabilizing nucleic acid structure. Properties of DNA and RNA. C-value, C-value paradox, Cot curve. Structure and role of nucleotides in cellular communications. Major and minor classes of RNA, their structure and biological functions.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| <b>Reading List<br/>(Print and Online)</b> | <ol style="list-style-type: none"> <li>1. <a href="https://bio.libretexts.org/Bookshelves/Biochemistry/Book%3A_Biochemistry_Online_(Jakubowski)">https://bio.libretexts.org/Bookshelves/Biochemistry/Book%3A_Biochemistry_Online_(Jakubowski)</a></li> <li>2. <a href="https://www.thermofisher.com/in/en/home/life-science/protein-biology/protein-biology-learning-center/protein-biology-resource-library/pierce-protein-methods/protein-glycosylation.html">https://www.thermofisher.com/in/en/home/life-science/protein-biology/protein-biology-learning-center/protein-biology-resource-library/pierce-protein-methods/protein-glycosylation.html</a></li> <li>3. <a href="https://ocw.mit.edu/courses/biology/7-88j-protein-folding-and- human-disease-spring-2015/study-materials/">https://ocw.mit.edu/courses/biology/7-88j-protein-folding-and- human-disease-spring-2015/study-materials/</a></li> <li>4. <a href="https://www.open.edu/openlearn/science-maths-technology/science/biology/nucleic-acids-and-chromatin/content-">https://www.open.edu/openlearn/science-maths-technology/science/biology/nucleic-acids-and-chromatin/content-</a></li> </ol> |

|                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|--------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                          | section- 3.4.2<br>5. <a href="https://www.genome.gov/genetics-glossary/Cell-Membrane">https://www.genome.gov/genetics-glossary/Cell-Membrane</a><br><a href="https://nptel.ac.in/content/storage2/courses/102103012/pdf/mod3.pdf">https://nptel.ac.in/content/storage2/courses/102103012/pdf/mod3.pdf</a>                                                                                                                                                                                                    |
| <b>Self-Study</b>        | 1. Classification of Sugars<br>2. Nutritional classification of fatty acids                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| <b>Recommended Texts</b> | 1. David L.Nelson and Michael M.Cox (2012) Lehninger Principles of Biochemistry (6th ed) W.H. Freeman.<br>2. Voet.D & Voet. J.G (2010) Biochemistry , (4th ed), JohnWiley & Sons, Inc.<br>3. Metzler D.E (2003). The chemical reactions of livingcells (2nd ed), Academic Press.<br>4. Zubay G.L (1999) Biochemistry , (4th ed), Mc Grew-Hill.<br>5. Lubert Stryer (2010) Biochemistry,(7th ed), W.H.Freeman<br>6. Satyanarayan,U (2014) Biochemistry (4th ed), ArunabhaSen Books & Allied (P) Ltd, Kolkata. |

**Method of Evaluation:**

| Test I | Test II | Assignment | End Semester Examination | Total | Grade |
|--------|---------|------------|--------------------------|-------|-------|
| 10     | 10      | 5          | 75                       | 100   |       |

**Methods of assessment:**

**Recall (K1)** - Simple definitions, MCQ, Recall steps, Concept definitions.

**Understand/ Comprehend (K2)** - MCQ, True/False, Short essays, Concept explanations, short summary or overview.

**Application (K3)** - Suggest idea/concept with examples, Solve problems, Observe, Explain.

**Analyse(K4)** – Problem-solving questions, Finish a procedure in many steps, Differentiate between various ideas.

**Evaluate (K5)** - Longer essay/ Evaluation essay, Critique or justify with pros and cons

**Create (K6)** – Check knowledge in specific or offbeat situations. Discussion.

**Mapping with Programme Outcomes:**

|      | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 |
|------|------|------|------|------|------|------|------|------|------|-------|
| CO 1 | S    | L    | M    | S    | M    | M    | M    | S    | M    | M     |
| CO 2 | S    | M    | L    | S    | M    | M    | M    | S    | M    | M     |
| CO 3 | S    | M    | M    | S    | S    | M    | L    | S    | M    | M     |
| CO 4 | S    | M    | M    | S    | M    | M    | M    | S    | M    | M     |
| CO 5 | S    | S    | M    | S    | S    | M    | M    | S    | M    | M     |

S- Strong

M-Medium

L-Low

|                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|--------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Course</b>                  | <b>CORE PAPER II</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| <b>Title of the Course:</b>    | <b>BIOCHEMICAL AND MOLECULAR BIOLOGY TECHNIQUES</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| <b>Credits:</b>                | <b>5 - Hrs 6</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| <b>Pre-requisites, if any:</b> | Comprehensive Knowledge of Tools of Biochemistry/Molecular Biology                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| <b>Course Objectives</b>       | <p>Biochemical techniques combine various inter-disciplinary methods in biological research and the course aims to provide students with the following objectives:</p> <ol style="list-style-type: none"> <li>1. To understand the various techniques used in biochemical investigation and microscopy.</li> <li>2. To explain chromatographic techniques.\ and their applications</li> <li>3. To explain electrophoretic techniques.</li> <li>4. To comprehend the spectroscopic techniques and demonstrate their applications in biochemical investigations.</li> <li>5. To acquire knowledge of radio labelling techniques and centrifugation.</li> </ol>                                                                                                                                                                                                             |
| <b>Course Outcomes</b>         | <p>After completion of the course, the students should be able to:</p> <p><b>CO1.</b> Attain good knowledge in modern used in biochemical investigation and microscopy and apply the experimental protocols to plan and carry out simple investigations in biological research. (K1, K5)</p> <p><b>CO2.</b> Demonstrate knowledge to implement the theoretical basis of chromatography in upcoming practical course work. (K3, K5)</p> <p><b>CO3.</b> Demonstrate knowledge to implement the theoretical basis of electrophoretic techniques in research work. (K3, K5)</p> <p><b>CO4.</b> Tackle more advanced and specialized spectroscopic techniques that are pertinent to research. (K1, K2 &amp; K5)</p> <p><b>CO5.</b> Tackle more advanced and specialized radioisotope and centrifugation techniques that are pertinent to research work. (K1, K2 &amp; K5)</p> |
| <b>Units</b>                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| <b>I</b>                       | <b>General approaches to biochemical investigation:</b> cell culture techniques and microscopic techniques. Principle, working and applications of light microscope, dark field, phase contrast and fluorescent microscope. Electron microscope- Principle, instrumentation of TEM and SEM, Specimen preparation and applications-shadow casting, negative staining and freeze fracturing. Organ and tissue slice technique, cell distribution and homogenization techniques, cell sorting, and cell counting, tissue Culture techniques. Cryopreservation, Biosensors- principle and applications..                                                                                                                                                                                                                                                                     |
| <b>II</b>                      | <b>Chromatographic Techniques:</b><br>Basic principles of chromatography- adsorption and partition techniques. Chiral Chromatography and counter current Chromatography. Adsorption Chromatography – Hydroxy apatite chromatography and hydrophobic                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |

|                                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
|----------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                        | interaction Chromatography. Affinity chromatography. Gas liquid chromatography- principle, instrumentation, column development, detectors and applications. principle, instrumentation, column packing, detection, quantitation and column efficiency, High pressure liquid chromatography- principle, instrumentation, delivery pump, sample injection unit, column packing, development, detection and application. Reverse HPLC, capillary electro chromatography and perfusion chromatography.                                                                                                                                                                                                                            |
| <b>III</b>                             | <b>Electrophoretic Techniques:</b><br>General principles of electrophoresis, supporting medium, factors affecting electrophoresis, Isoelectric focusing-principle, ampholyte, development of pH gradient and application. PAGE-gel casting-horizontal, vertical, slab gels, sample application, detection-staining using CBB, silver, fluorescent stains. SDS PAGE-principle and application in molecular weight determination principle of disc gel electrophoresis, 2D PAGE. Electrophoresis of nucleic acids-agarose gel electrophoresis of DNA, pulsed field gel electrophoresis- principle, apparatus, application. Electrophoresis of RNA. Microchip electrophoresis and 2D electrophoresis, Capillary electrophoresis. |
| <b>IV</b>                              | <b>Spectroscopic techniques:</b><br>Basic laws of light absorption- principle, instrumentation and applications of UV-Visible, IR, ESR, NMR, Mass spectroscopy, Luminometry (Luciferase system, chemiluminescence). X - ray diffraction. Atomic absorption spectroscopy - principle and applications - Determination of trace elements.                                                                                                                                                                                                                                                                                                                                                                                       |
| <b>V</b>                               | <b>Radiolabeling Techniques and Centrifugation:</b><br>Nature of radioactivity-detection and measurement of radioactivity, methods based upon ionisation (GM counter) and excitation (scintillation counter), autoradiography and applications of radioactive isotopes, Biological hazards of radiation and safety measures in handling radioactive isotopes.<br>Basic principles of Centrifugation. Preparative ultracentrifugation - Differential centrifugation, Density gradient centrifugation. Analytical ultracentrifugation - Molecular weight determination.                                                                                                                                                         |
| <b>Reading List (Print and Online)</b> | Principles and techniques of biochemistry and molecular biology:<br><a href="https://www.kau.edu.sa/Files/0017514/Subjects/principals%20and%20techniques%20of%20biochemistry%20and%20molecular%20biology%207th%20ed%20">https://www.kau.edu.sa/Files/0017514/Subjects/principals%20and%20techniques%20of%20biochemistry%20and%20molecular%20biology%207th%20ed%</a>                                                                                                                                                                                                                                                                                                                                                           |
| <b>Self-Study</b>                      | 1. Types of rotors<br>2. Colorimetry – principle and applications                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| <b>Recommended Texts</b>               | 1.Keith Wilson , John Walker (2010) Principles and Techniques of Biochemistry and Molecular Biology (7th ed) Cambridge University Press<br>2.David Sheehan (2009), Physical Biochemistry: Principles and Applications (2nd ed), Wiley-Blackwell<br>3.David M. Freifelder (1982) Physical Biochemistry: Applications to Biochemistry and Molecular Biology, W.H.Freeman<br>4.Rodney F.Boyer (2012), Biochemistry Laboratory: Modern Theory and                                                                                                                                                                                                                                                                                 |



|  |                                                                                                                                                                                                                                                                                                                          |
|--|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|  | techniques,(2nd ed),Prentice Hall<br>5.Kaloch Rajan (2011), Analytical techniques in Biochemistry and Molecular Biology, Springer<br>6. Segel I.H (1976) Biochemical Calculations (2nd ed),John Wiley and Sons<br>7. Robyt JF (2015) Biochemical techniques: Theory and Practice (1st ed), CBS Publishers & Distributors |
|--|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

**Method of Evaluation:**

| Test I | Test II | Assignment | End Semester Examination | Total | Grade |
|--------|---------|------------|--------------------------|-------|-------|
| 10     | 10      | 5          | 75                       | 100   |       |

**Methods of assessment:**

**Recall (K1)** - Simple definitions, MCQ, Recall steps, Concept definitions.

**Understand/ Comprehend (K2)** - MCQ, True/False, Short essays, Concept explanations, short summary or overview.

**Application (K3)** - Suggest idea/concept with examples, Solve problems, Observe, Explain.

**Analyse(K4)** – Problem-solving questions, Finish a procedure in many steps, Differentiate between various ideas.

**Evaluate (K5)** - Longer essay/ Evaluation essay, Critique or justify with pros and cons

**Create (K6)** – Check knowledge in specific or offbeat situations. Discussion.

**Mapping with Programme Outcomes:**

|      | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 |
|------|------|------|------|------|------|------|------|------|------|-------|
| CO 1 | S    | L    | M    | S    | M    | M    | M    | S    | M    | M     |
| CO 2 | S    | M    | L    | S    | M    | M    | M    | S    | M    | M     |
| CO 3 | S    | M    | M    | S    | S    | M    | L    | S    | M    | M     |
| CO 4 | S    | M    | M    | S    | M    | M    | M    | S    | M    | M     |
| CO 5 | S    | S    | M    | S    | S    | M    | M    | S    | M    | M     |

S- Strong

M-Medium

L-Low

|                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
|--------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Course</b>                  | <b>CORE PAPER -III</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| <b>Title of the Course:</b>    | <b>PHYSIOLOGY AND CELL BIOLOGY</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| <b>Credits:</b>                | <b>4- Hrs 5</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| <b>Pre-requisites, if any:</b> | Anatomy, Cells and Biological Compounds                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| <b>Course Objectives</b>       | To understand the functions and activities of organs, tissues or cells and of physical and chemical phenomena involved in the human body                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| <b>Course Outcomes</b>         | <p>After completion of the course, the students should be able to:</p> <p><b>CO1.</b> specifically understand the biological and chemical processes within a human cell (K1, K2, K5, K6)</p> <p><b>CO2.</b> identify and prevent diseases (K2, K3, K4, k5, K6)</p> <p><b>CO3.</b> understand defects in digestion, nutritional deficiencies and intolerances, and gastrointestinal pathologies (K1, K2, K3, K4, K5, K6)</p> <p><b>CO4.</b> identify general characteristics in individuals with imbalances of acid- base, fluid and electrolytes.(K1 , K2 , K3 , K4, K5, K6)</p> <p><b>CO5.</b> process the mechanism: the transmission of biochemical information between cell membrane and nucleus. (K1, K2, K5)</p>                                                           |
| <b>Units</b>                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| <b>I</b>                       | <p><b>Major classes of cell junctions-</b> anchoring, tight and gap junctions. Major families of cell adhesion molecules (CAMs)- cadherins, integrins. Types of tissues. Epithelium- organisation and types. The basement membrane. Cell cycle- mitosis and meiosis, Cell cycle-phases and regulation. Cell death mechanisms- an overview-apoptosis, necrosis.</p> <p><b>Body Fluids</b> -Composition of blood, Plasma, Serum, lymph and CSF.</p> <p><b>Digestive System-</b> structure and functions of different components of digestive system, digestion and absorption of carbohydrates, lipids and proteins, role of bile salts in digestion and absorption, mechanism of HCl formation in stomach, role of various enzymes and hormones involved in digestive system.</p> |
| <b>II</b>                      | <p><b>Respiratory system-</b>Gaseous transport and acid-base homeostasis. Mechanism of the movement of O<sub>2</sub> and CO<sub>2</sub> through lungs, arterial and venous circulation. oxygen and carbon dioxide binding haemoglobin. Phosphate and bicarbonate buffers <b>Cardio-vascular physiology-</b> Properties of cardiac muscle, cardiac cycle, Functioning of Heart, Heart beat origin, Generation &amp; conduction of cardiac impulse.</p>                                                                                                                                                                                                                                                                                                                            |
| <b>III</b>                     | <p><b>Reproductive system</b> - Male Reproductive system sperm capacitation, Female Reproductive system- Clinical relevance of female reproductive physiology- menstrual cycle, pregnancy and menopause. <b>Renal physiology:</b></p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |

|                                            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
|--------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                            | Structure and function of kidney - Structure of nephron, glomerular filtration, tubular reabsorption of glucose, water and electrolytes. Tubular secretion. Homeostatic regulation of water and electrolytes, Urine formation. Micturition.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| <b>IV</b>                                  | <b>Muscle Contraction and relaxation and Nerve impulse transmission-</b> nerve cells, synapses, reflex arc structure, resting membrane potential, Nernst equation, action potential, voltage gated ion-channels, impulse transmission, neurotransmission, neurotransmitter receptors, synaptosomes, Chemistry of muscle contraction – actin and myosin filaments, theories involved in muscle contraction, mechanism of muscle contraction, energy sources for muscle contraction.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| <b>V</b>                                   | <b>Hormones</b> – Classification, Biosynthesis, circulation in blood, Mechanism of hormone action, Target cell concept. Hormones of Hypothalamus, pituitary, Pancreatic, thyroid & parathyroid, adrenal and gonadal hormones. Biological Functions                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| <b>Reading List<br/>(Print and online)</b> | <a href="https://www.genome.gov/genetics-glossary/Cell-Cycle">https://www.genome.gov/genetics-glossary/Cell-Cycle</a><br><a href="https://my.clevelandclinic.org/health/diseases/16083-infertility-causes">https://my.clevelandclinic.org/health/diseases/16083-infertility-causes</a><br><a href="https://www.webmd.com/heartburn-gerd/reflux-disease">https://www.webmd.com/heartburn-gerd/reflux-disease</a><br><a href="https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5760509/">https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5760509/</a><br><a href="https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3249628/">https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3249628/</a>                                                                                                                                                                                                                                                                                                         |
| <b>Self-Study</b>                          | <ol style="list-style-type: none"> <li>Variation in cell differentiation and progression</li> <li>Lesch Nyhan syndrome , orotic aciduria and GERD</li> </ol>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| <b>Recommended Texts</b>                   | <ol style="list-style-type: none"> <li>Karp, G. (2010). Cell and Molecular Biology: Concepts and Experiments (6th ed). John Wiley &amp; Sons. Inc.</li> <li>Bruce Alberts and Dennis Bray (2013),Essential Cell Biology,(4<sup>th</sup> ed),Garland Science.</li> <li>De Robertis, E.D.P. and De Robertis, E.M.F. (2010). Cell and Molecular Biology.(8<sup>th</sup> ed). Lippincott Williams and Wilkins, Philadelphia.</li> <li>Cooper, G.M. and Hausman, R.E. (2009). The Cell: A Molecular Approach. (5<sup>th</sup> ed). Sunderland, Mass. Sinauer Associates, Inc.</li> <li>Wayne M. Baker (2008) the World of the Cell. (7<sup>th</sup> ed). Pearson Benjamin Cummings Publishing, San Francisco. Cell Biology</li> <li>John E. Hall (2010). Guyton and Hall Textbook of Medical Physiology (12<sup>th</sup> ed), Saunders</li> <li>Harrison’s Endocrinology by J. Larry Jameson Series: Harrison’s Specialty, 19th Edition Publisher: McGraw-Hill, Year: 2016.</li> </ol> |

**Method of Evaluation:**

|        |         |            |                          |       |       |
|--------|---------|------------|--------------------------|-------|-------|
| Test I | Test II | Assignment | End Semester Examination | Total | Grade |
| 10     | 10      | 5          | 75                       | 100   |       |

**Methods of assessment:**

**Recall (K1)** - Simple definitions, MCQ, Recall steps, Concept definitions.

**Understand/ Comprehend (K2)** - MCQ, True/False, Short essays, Concept explanations, Short summary or overview.

**Application (K3)** - Suggest idea/concept with examples, Solve problems, Observe, Explain.

**Analyse (K4)** - Problem-solving questions, Finish a procedure in many steps, Differentiate between various ideas.

**Evaluate (K5)** - Longer essay/ Evaluation essay, Critique or justify with pros and cons.

**Create (K6)** - Check knowledge in specific or offbeat situations. Discussion

**Mapping with Programme Outcomes:**

|             | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 |
|-------------|------|------|------|------|------|------|------|------|------|-------|
| <b>CO 1</b> | S    | S    | S    | S    | S    | M    | S    | S    | S    | M     |
| <b>CO 2</b> | S    | S    | S    | S    | S    | L    | S    | S    | S    | M     |
| <b>CO 3</b> | S    | S    | S    | S    | S    | M    | M    | S    | S    | M     |
| <b>CO 4</b> | S    | S    | S    | S    | S    | M    | M    | S    | S    | M     |
| <b>CO 5</b> | M    | S    | L    | S    | S    | L    | M    | M    | L    | L     |

**S-Strong      M-Medium      L-Low**

|                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
|-----------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Course</b>               | <b>CORE PAPER IV</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| <b>Title of the Course:</b> | <b>ENZYMOLGY</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| <b>Credits:</b>             | <b>4 - Hrs 5</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| <b>Pre-requisites</b>       | Basic knowledge about catalysis, kinetics and chemical reaction mechanisms.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| <b>Course Objectives</b>    | <ol style="list-style-type: none"> <li>1. Students will be introduced to the theory and practice of enzymology.</li> <li>2. Mechanisms of catalysis and factors affecting catalysis will be understood</li> <li>3. The kinetics of enzyme catalyzed reactions in the absence and presence of inhibitors will be studied and the options for applying enzymes and their inhibitors in medicine will be analyzed.</li> </ol>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|                             | <ol style="list-style-type: none"> <li>4. Students will learn about the applications of enzymes in research, medicine, and industry, which will prepare them for careers in industrial and biomedical research.</li> <li>5. The control of metabolic pathways and cellular responses through enzyme regulation will be emphasized.</li> </ol>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| <b>Course Outcomes</b>      | <p><b>On successful completion of this course, students should be able to:</b></p> <p><b>CO1:</b> Describe the catalytic mechanisms employed by enzymes (K1, K2 &amp; K5)</p> <p><b>CO2:</b> Choose and use the appropriate methods to isolate and purify enzymes and check the purity of the enzyme. (K1,K2 , K3,K4 &amp; K5)</p> <p><b>CO3:</b> Analyze enzyme kinetic data graphically, calculate kinetic parameters, determine the mechanism of inhibition by a drug/chemical and analyze options for applying enzymes and their inhibitors in medicine (K1, K2, K3 &amp;K4)</p> <p><b>CO4:</b> Explain allosterism and cooperativity and differentiate Michaelis-Menten kinetics from sigmoidal kinetics. The role played by enzymes in the regulation of vital cellular processes will be appreciated. (K1, K2 , K5, K6)</p> <p><b>CO5:</b> Highlight the use of enzymes in industries and biomedicine (K1,K2 &amp; K3)</p> |

**Units**

|                                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|----------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>I</b>                               | <p>Introduction of enzymes<sup>22</sup> and Classification -Holoenzyme, apoenzyme, cofactors, coenzyme, prosthetic groups, Classification and Nomenclature, Specificity of enzyme action-group specificity, absolute specificity, substrate specificity, Active site, Identification of amino acids at the active site-trapping of ES complex.</p> <p>Mechanisms of enzyme catalysis: acid-base catalysis, covalent catalysis, electrostatic catalysis, metal ion catalysis, proximity and orientation effects, Mechanism of action of chymotrypsin</p>                                                                                                                                             |
| <b>II</b>                              | <p>Enzyme techniques: Isolation and purification of enzymes - Importance of enzyme purification, methods of purification- choice of source , extraction, fractionation methods-based on size or mass (centrifugation, gel filtration); based on polarity (ion-exchange chromatography, hydrophobic interaction chromatography); based on solubility (change in pH, change in ionic strength); based on specific binding sites (affinity chromatography) ,choice of methods, Criteria of purity of enzymes. Enzyme units - Katal, IU. Measurement of enzyme activity - discontinuous, continuous, coupled assays; Isoenzymes -LDH</p>                                                                |
| <b>III</b>                             | <p>Enzyme kinetics I: Thermodynamics of enzyme action, Activation energy, transition-state theory, steady-state kinetics &amp; pre-steady-state kinetics. Single substrate enzyme catalyzed reactions -assumptions, Michaelis-Menten and Briggs-Haldane kinetics, derivation of Michaelis-Menten equation . Double reciprocal (Lineweaver-Burk) and Analysis of kinetic data- determination of Km, Vmax, kcat, and their physiological significance, Importance of kcat/Km. Enzyme inhibition: Irreversible inhibition. Reversible inhibition-Competitive, uncompetitive, noncompetitive, mixed and substrate inhibition. Demonstration :Using Microsoft Excel to Plot and Analyze Kinetic Data</p> |
| <b>IV</b>                              | <p>Enzyme kinetics II: Allosteric enzymes: Cooperativity, MWC and KNF models of allosteric enzymes, Sigmoidal kinetics taking ATCase as an example. Regulation of amount and catalytic activity by - extracellular signal, transcription, stability of mRNA, rate of translation and degradation, compartmentation, pH, temperature, substrate concentration, allosteric effectors, covalent modification. Feedback inhibition-sequential, concerted, cumulative, enzyme-multiplicity with examples.</p>                                                                                                                                                                                            |
| <b>V</b>                               | <p>Enzyme technology: Immobilization of enzymes – methods - Reversible immobilization (Adsorption, Affinity binding), Irreversible immobilization (Covalent coupling, Entrapment and Microencapsulation, Crosslinking, Advantages and Disadvantages of each method, Properties of immobilized enzymes,. Designer enzymes- ribozymes and deoxyribozymes, abzymes, synzymes. Enzymes as therapeutic agents-therapeutic use of asparaginase and streptokinase. Application of enzymes in industry- Industrial application of rennin, lipases, lactases, invertase, pectinases, papain.</p>                                                                                                             |
| <b>Reading List (Print and Online)</b> | <p><b>Enzymes</b>   MIT OpenCourseWare   Free Online Course Materials<br/> <a href="https://ocw.mit.edu/high-school/biology/exam-prep/chemistry-of-life/enzymes/">https://ocw.mit.edu/high-school/biology/exam-prep/chemistry-of-life/enzymes/</a><br/> <b>Enzymology</b></p>                                                                                                                                                                                                                                                                                                                                                                                                                       |

|                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|--------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                          | <p><a href="https://onlinecourses.swayam2.ac.in/cec20_bt20/preview">https://onlinecourses.swayam2.ac.in/cec20_bt20/preview</a><br/> <a href="https://mooc.es/course/enzymology/">https://mooc.es/course/enzymology/</a><br/> <b>The active site of enzymes</b><br/> <a href="https://dth.ac.in/medical/courses/biochemistry/block-1/1/index.php">https://dth.ac.in/medical/courses/biochemistry/block-1/1/index.php</a><br/> <b>Enzymes and Enzyme Kinetics</b><br/> <a href="https://www.lecturio.com/medical-courses/enzymes-and-enzyme-kinetics.course#/">https://www.lecturio.com/medical-courses/enzymes-and-enzyme-kinetics.course#/</a><br/> Mechanistic enzymology in drug discovery: a fresh perspective<br/> <a href="https://www.nature.com/articles/nrd.2017.219">https://www.nature.com/articles/nrd.2017.219</a><br/> Enzyme Biosensors for Biomedical Applications: Strategies for Safeguarding Analytical Performances in Biological Fluids<br/> <a href="https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4934206/">https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4934206/</a></p> |
| <b>Self-Study</b>        | <ol style="list-style-type: none"> <li>1. Mechanistic enzymology in drug discovery</li> <li>2. Enzyme Biosensors for Biomedical Applications</li> </ol>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| <b>Recommended Texts</b> | <ol style="list-style-type: none"> <li>1. Enzymes: Biochemistry, Biotechnology and Clinical chemistry, 2nd edition, 2007, Palmer T and Bonner P; Affiliated- East West press private Ltd, New Delhi</li> <li>2. Fundamentals of Enzymology, 3rd edition, 2003, Price NC and Stevens L; Oxford University Press, New York</li> <li>3. Voet's Biochemistry, Adapted ed, 2011, Voet, D and Voet JG; Wiley, India</li> <li>4. Lehninger Principles of Biochemistry, 8th edition, 2021, Nelson DL and Cox MM; WH Freeman &amp; Co, New York</li> <li>5. Biochemistry, Berg JM, Stryer L, Gatto, G, 8th ed, 2015; WH Freeman &amp; Co., New York.</li> <li>6. Enzyme Kinetics and Mechanism; Cook PF, Cleland W, ;2007; Garland Science, London</li> </ol>                                                                                                                                                                                                                                                                                                                                           |

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|-----------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Course</b>               | <b>CORE PAPER V P</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| <b>Title of the Course:</b> | <b>LABORATORY COURSE ON BIOMOLECULES AND BIOCHEMICAL TECHNIQUES</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| <b>Credits:</b>             | <b>4 - Hrs 6</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| <b>Pre-requisites</b>       | Knowledge on basic principles, Instrumentation of Biochemical techniques and metabolic reactions                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| <b>Course Objectives</b>    | <ol style="list-style-type: none"> <li>1. To instill skill in students enabling them to apprehend the wider knowledge about principles and techniques to be employed for the biomolecules under investigation.</li> <li>2. To inculcate the knowledge of various isolation and purification techniques of macromolecules like DNA, RNA, Glycogen and Starch,</li> <li>3. To perform colorimetric estimations to quantify important metabolites like lactate and tryptophan and minerals like calcium and iron from various sources.</li> <li>4. To achieve training in subcellular fractionation and to identify them by markers.</li> <li>5 To achieve training in various chromatographic techniques.</li> <li>6. To perform the isolation and identification of the organelles of a cell using differential centrifugation.</li> <li>7. To perform phytochemical screening and quantification enabling them to give an insight on phytochemicals this will be useful for future research.</li> </ol> |
| <b>Course Outcomes</b>      | <p><b>On successful completion of this course, students should be able to:</b></p> <p>After completion of the course, the students should be able to:</p> <p><b>CO1.</b>The student will be able to acquire knowledge and skill in the techniques used in the isolation, purification and estimation of different biomolecules that are widely employed in research (K1, K2, K4)</p> <p><b>CO2.</b>The students will get acquainted with Principle, Instrumentation and method of Performing UV absorption studies of DNA, Protein and interpreting the alteration occurred during the process of denaturation (K1,K2, K 3, K4).</p>                                                                                                                                                                                                                                                                                                                                                                    |



|                                            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|--------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                            | <p><b>CO3.</b>The student will be fine-tune in handling the instruments like colorimeter, spectrophotometer and will be able to estimate the biomolecules and minerals from the given samples (K1,K2,K4,)</p> <p><b>CO4.</b> The student, in addition to acquiring skill in performing various biochemical techniques can also learn to detect presence of phytochemicals and quantify them in the plant sample. (K1,K2,K3,K4 &amp; K6)</p> <p><b>CO5.</b>The students will develop skill in analytical techniques like subcellular fractionation, Paper, Column and Thin layer Chromatography and the group experiments will enable them to build learning skills like team work, Problem solving, Communication ability. (K1, K2,K3,K4 &amp; K6)</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| <b>Units</b>                               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| <b>I</b>                                   | <p>Biochemical studies and estimation of macromolecules</p> <ol style="list-style-type: none"> <li>1. Isolation and estimation of glycogen from liver.</li> <li>2. Estimation of proteins by Lowry's method</li> <li>3. Estimation of Acid value of oil.</li> <li>4. Isolation and estimation of DNA from animal tissue.</li> <li>5. Isolation and estimation of RNA from yeast.</li> </ol>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| <b>II</b>                                  | <p>UV absorption</p> <ol style="list-style-type: none"> <li>1. Denaturation of DNA and absorption studies at 260nm.</li> <li>2. Denaturation of Protein and absorption studies at 280nm.</li> </ol>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| <b>III</b>                                 | <p>Group Experiments</p> <ol style="list-style-type: none"> <li>1. Fractionation of sub-cellular organelles by differential centrifugation-Mitochondria and nucleus</li> <li>2. Identification of the separated sub-cellular fractions using marker enzymes (any one)</li> <li>3. Identification of Sugars by Paper Chromatography</li> <li>4. Identification of Amino acids by Paper Chromatography</li> <li>5. Separation of identification of lipids by thin layer chromatography..</li> </ol>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| <b>Reading List<br/>(Print and Online)</b> | <ol style="list-style-type: none"> <li>1. <a href="https://www.researchgate.net/publication/313745155_Practical_Biochemistry_A_Student_Companion">https://www.researchgate.net/publication/313745155_Practical_Biochemistry_A_Student_Companion</a></li> <li>2. <a href="https://doi.org/10.1186/s13020-018-0177-x">https://doi.org/10.1186/s13020-018-0177-x</a></li> <li>3. <a href="https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5368116/">https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5368116/</a></li> <li>4. <a href="https://www.life.illinois.edu/biochem/455/Lab%20exercises/2Photometry/spectrophotometry.pdf">https://www.life.illinois.edu/biochem/455/Lab%20exercises/2Photometry/spectrophotometry.pdf</a></li> <li>5. <a href="https://ijpsr.com/bft-article/determination-of-total-flavonoid-and-phenol-content-in-mimusops-elengi-linn/?view=fulltext">https://ijpsr.com/bft-article/determination-of-total-flavonoid-and-phenol-content-in-mimusops-elengi-linn/?view=fulltext</a></li> <li>6. <a href="https://skyfox.co/wp-content/uploads/2020/12/Practical-Manual-of-Biochemistry.pdf">https://skyfox.co/wp-content/uploads/2020/12/Practical-Manual-of-Biochemistry.pdf</a></li> </ol> |

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|--------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Self-Study</b>        | <ol style="list-style-type: none"> <li>1. Laboratory Safety Rules, Requirements and Regulations.</li> <li>2. Preparation of standard solutions and reagent</li> </ol>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| <b>Books Recommended</b> | <ol style="list-style-type: none"> <li>1. David Plummer (2001) An Introduction to Practical Biochemistry (3rd ed) McGraw Hill Education (India) Private Ltd</li> <li>2. Jayaraman, J (2011), laboratory Manual in Biochemistry, New age publishers</li> <li>3. Varley H (2006) Practical Clinical Biochemistry (6th ed) , CBS Publishers</li> <li>4. O. Debiyi and F. A. Sofowora, (1978 )“Phytochemical screening of medical plants,” Iloyidia, vol. 3, pp. 234–246,</li> <li>5. Prof. Sarin A. Chavhan, Prof. Sushilkumar A. Shinde (2019) A Guide to Chromatography Techniques Edition:1</li> <li>6. Analytical techniques in Biochemistry and Molecular Biology; Katoch, Rajan. Springer (2011)</li> </ol> |

**Method of Evaluation:**

| Test I | Test II | End Semester Examination | Total | Grade |
|--------|---------|--------------------------|-------|-------|
| 20     | 20      | 40                       | 100   |       |

**Methods of assessment:**

**Recall (K1)** - Simple definitions, MCQ, Recall steps, Concept definitions.

**Understand/ Comprehend (K2)** - MCQ, True/False, Short essays, Concept explanations, Short summary

**Application (K3)** - Suggest idea/concept with examples, Solve problems, Observe, Explain.

**Analyse (K4)**- Problem-solving questions, Finish a procedure in many steps, Differentiate between various ideas

**Evaluate (K5)** - Longer essay/ Evaluation essay, Critique or justify with pros and cons.

**Create (K6)**- Check knowledge in specific or offbeat situations, Discussion.

**Mapping with Programme Outcomes:**

|             | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 |
|-------------|------|------|------|------|------|------|------|------|------|-------|
| <b>CO 1</b> | S    | S    | S    | S    | M    | S    | L    | S    | M    | S     |
| <b>CO 2</b> | S    | S    | S    | S    | M    | S    | L    | S    | M    | S     |
| <b>CO 3</b> | S    | S    | S    | S    | M    | S    | M    | S    | M    | S     |
| <b>CO 4</b> | S    | S    | S    | S    | S    | S    | S    | S    | S    | S     |
| <b>CO 5</b> | S    | S    | S    | S    | S    | S    | S    | S    | S    | S     |

**S-Strong M-Medium L-Low**

|                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
|--------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Course</b>                  | <b>SKILL ENHANCEMENT PAPER-I</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| <b>Title of the Course:</b>    | <b>NUTRITIONAL BIOCHEMISTRY</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| <b>Credits:</b>                | <b>2 - Hrs 2</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| <b>Pre-requisites, if any:</b> | <b>BASIC KNOWLEDGE ON FOOD , NUTRITION &amp; DIETETICS, AND METABOLISM OF NUTRIENTS.</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| <b>Course Objectives</b>       | <p>1. To understand basic concepts involved in growth , health, nutrition, physiology and metabolism</p> <p>2. To discuss the concepts and applications of nutrition in correlation with biochemistry</p> <p>3.To define nutritional needs in healthy individuals and modification of diet during illness.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| <b>Course Outcomes</b>         | <p>After completion of the course, the students should be able to:</p> <p><b>CO1.</b> Plan a balanced diet based on an individual's energy requirement, Assess nutritional status of an individual(K3, K4, K5)</p> <p><b>CO2.</b> Describe the biochemical , physiological and nutritional functions of macronutrients and their integrated role. Understand the role played by antinutritional factors(k! to K6)</p> <p><b>CO3.</b> Evaluate the functions of vitamins and minerals ,and fluids and electrolyte balance in different physiological states and in sports persons(K1 to K6)</p> <p><b>CO4.</b> Identify nutritional deficiency conditions , its prevention and dietary management((K3,K4)</p> <p><b>CO5.</b> Acquire knowledge about the importance of balanced diet and diet therapy (k5,K6)</p> |
| <b>Units</b>                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| <b>I</b>                       | Basic concepts - Nutrition - Food groups and balanced diet. Novel Foods. Calorific value of foods: Direct and indirect calorimetry. Empty calories. Basal metabolic rate: Factors affecting BMR. and physical activity. Nutritional requirement and biochemical changes in different physiological states -infancy, childhood, pregnancy, lactation, and ageing. Sports nutrition.                                                                                                                                                                                                                                                                                                                                                                                                                               |
| <b>II</b>                      | Elements of nutrition - Plant and animal sources of simple and complex carbohydrates, fats and proteins and their requirement. Biological significance, deficiency and toxicity of macronutrients and micronutrients. Role of dietary fibre. Protein sparing action of carbohydrates and fats. Essential amino acids. Essential fatty acids. Effects of naturally occurring food toxins, preservatives, additives, alcohol and tobacco on health.                                                                                                                                                                                                                                                                                                                                                                |
| <b>III</b>                     | Vitamins and Minerals- Dietary sources, classification, biochemical functions, requirements, absorption, metabolism and excretion. Vitamin B complex as coenzyme. Nutritional significance of dietary                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |

|                                            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
|--------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                            | calcium, phosphorus, magnesium, iron, iodine, zinc and copper.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| <b>IV</b>                                  | Malnutrition - Diseases arising due to Protein - Calorie Malnutrition and undernutrition (Kwashiorkor and Marasmus), Prevention of malnutrition. Deficiency diseases associated with vitamin B complex, vitamin C and A, D, E & K vitamins - Mineral deficiency diseases - aetiology, sign and symptoms and dietary supplementation. Enrichment and fortification (vitamins and minerals)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| <b>V</b>                                   | Nutrition in diseases - Aetiology, signs and symptoms , treatment and dietary management during fever(Typhoid and Malaria) and infectious diseases(COVID-19), Jaundice, hyper acidity (Ulcer), Atherosclerosis, Hypertension, kidney diseases and diabetes in adults. Starvation and Obesity. Inter-relationship of nutrition, infection, immunity and poverty                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| <b>Reading List<br/>(Print and Online)</b> | <ol style="list-style-type: none"> <li>1. <a href="https://www.jmedscindmc.com/article.asp?issn=1011-4564;year=2014;volume=34;issue=5;spage=211;epage=213;aulast=Shrivastava">https://www.jmedscindmc.com/article.asp?issn=1011-4564;year=2014;volume=34;issue=5;spage=211;epage=213;aulast=Shrivastava</a></li> <li>2. <a href="https://www.researchgate.net/figure/Relationship-between-malnutrition-infection-and-immunity-Malnutrition-is-considered-the_fig1_280722727">https://www.researchgate.net/figure/Relationship-between-malnutrition-infection-and-immunity-Malnutrition-is-considered-the_fig1_280722727</a></li> <li>3. <a href="https://en.wikipedia.org/wiki/Novel_food">https://en.wikipedia.org/wiki/Novel_food</a></li> <li>4. <a href="https://www.chemicalsafetyfacts.org/preservatives/">https://www.chemicalsafetyfacts.org/preservatives/</a></li> <li>5. <a href="https://www.sciencedirect.com/topics/agricultural-and-biological-sciences/food-enrichment">https://www.sciencedirect.com/topics/agricultural-and-biological-sciences/food-enrichment</a></li> </ol> |
| <b>Self-Study</b>                          | <ol style="list-style-type: none"> <li>1. Antabuse drugs and food</li> <li>2. Selection of foods and market visit, reading and understanding the food labels</li> </ol>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| <b>Recommended Texts</b>                   | <ol style="list-style-type: none"> <li>1. Srilakshmi. E .(2016) Nutrition Science, New Age International Publishers.</li> <li>2. Mahan, Kathleen L. (2004) Krause's Food, Nutrition and Diet Therapy, W.B.Saunders's 11th Edition</li> <li>3. Andreas M. Papas (1998). Antioxidant Status, Diet, Nutrition, and Health (1st ed) CRC Press.</li> <li>4. M. Swaminathan (1995) Principles of Nutrition and Dietetics. Bappco</li> <li>5. Margaret Mc Williams (2012). Food Fundamentals (10th ed) Prentice Hall</li> <li>6. Tom Brody (1998) Nutritional Biochemistry (2nd ed). Academic Press, USA</li> </ol>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |

**Method of Evaluation:**

| Test I | Test II | Assignment | End Semester Examination | Total | Grade |
|--------|---------|------------|--------------------------|-------|-------|
|--------|---------|------------|--------------------------|-------|-------|

|    |    |   |    |     |  |
|----|----|---|----|-----|--|
| 10 | 10 | 5 | 75 | 100 |  |
|----|----|---|----|-----|--|

**Methods of assessment:**

**Recall (K1)** - Simple definitions, MCQ, Recall steps, Concept definitions.

**Understand/ Comprehend (K2)** - MCQ, True/False, Short essays, Concept explanations, Shortsummary or overview.

**Application (K3)** - Suggest idea/concept with examples, Solve problems, Observe, Explain.

**Analyse (K4)** – Problem-solving questions, Finish a procedure in many steps, Differentiate between various ideas.

**Evaluate (K5)** - Longer essay/ Evaluation essay, Critique or justify with pros and cons

**Create(K6)** – Check knowledge in specific or offbeat situations. Discussion.

**Mapping with Programme Outcomes:**

|      | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 |
|------|------|------|------|------|------|------|------|------|------|-------|
| CO 1 | S    | S    | S    | S    | S    | S    | S    | S    | M    | M     |
| CO 2 | S    | S    | S    | S    | S    | S    | S    | S    | M    | M     |
| CO 3 | S    | S    | S    | S    | S    | S    | S    | S    | M    | M     |
| CO 4 | S    | S    | S    | S    | S    | S    | S    | S    | M    | L     |
| CO 5 | S    | S    | S    | S    | S    | S    | S    | S    | M    | M     |

**S-Strong**

**M-Medium**

**L-Low**

|                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|-----------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Course</b>               | <b>CORE PAPER VI</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| <b>Title of the Course:</b> | <b>CELLULAR METABOLISM</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| <b>Credits:</b>             | <b>5 - Hrs 5</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| <b>Pre-requisites</b>       | Basic knowledge on biochemical reactions such as addition, deletion, rearrangement, transfer and breaking of bonds                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| <b>Course Objectives</b>    | <ol style="list-style-type: none"> <li>1. Familiarize on blood glucose homeostasis</li> <li>2. Provide an insight into the metabolic path way of glycogen, glycoprotein, mucopolysaccharide and peptidoglycan with clinical correlation wherever required</li> <li>3. Inculcate knowledge on nucleotide metabolism and disorders associated with it</li> <li>4. Provide a platform to understand the versatile role of PLP in amino acid degradation, formation of specialized products and disorders associated with ammonia detoxification</li> <li>5. Educate on heme and sulphur metabolism with associated clinical manifestation</li> </ol>                                                                                                                                                                                          |
| <b>Course Outcomes</b>      | <p><b>On successful completion of this course, students should be able to:</b></p> <p>After completion of the course, the students should be able to:</p> <p><b>CO1.</b> Appreciate the modes of synthesis and degradation of glucose and will be able to justify the pros and cons of maintain the blood sugar level <b>(K1, K2, K5)</b></p> <p><b>CO2.</b> Gain knowledge on polysaccharide metabolism and glycogen storage disease <b>(K1, K2, K5)</b></p> <p><b>CO3.</b> Acquaint with the making and braking of nucleotides <b>(K1,K2,K4)</b></p> <p><b>CO4.</b> Differentiate the diverse reaction a particular amino acid can experience <b>(K1,K2,K3)</b></p> <p><b>CO5.</b> Correlate the disturbance of metabolic reactions to clinical manifestations with reference to heme and sulphur metabolism <b>(K1, K2, K4, K5)</b></p> |
| <b>Units</b>                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| <b>I</b>                    | Glycolysis – aerobic and anaerobic, inhibitors, and regulation. Feeder pathway- entry of hexoses into glycolysis, Galactosemia, fructosuria, Pyruvate dehydrogenase complex-mechanism and regulation. Glyoxalate cycle and its regulation. Gluconeogenesis- source, key enzymes, reaction sequence and its regulation. Blood glucose                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |

|                                            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|--------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                            | homeostasis and the role of hormones. Pentose phosphate pathway-significance and its regulation. Metabolism of glycogen and its regulation. Biosynthesis of N-linked and O-linked glycoproteins, mucopolysaccharides, Chondroitin sulphate.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| <b>II</b>                                  | Oxidation of fatty acids-oxidation of saturated and unsaturated fatty acids ( $\alpha$ , $\beta$ & $\omega$ oxidation) Oxidation of fatty acids with odd and even numbered carbon atoms. Regulation of $\beta$ oxidation. Ketogenesis and its regulation. Biosynthesis of fatty acid-saturated and unsaturated, chain elongation, regulation. Biosynthesis of prostaglandins, thromboxanes and leukotrienes and hydroxyl eicosanoic acids. Biosynthesis and degradation of triacylglycerol, phosphoglycerolipids-lecithin, cephalin, plasmalogens and phosphatidyl inositol, Sphingolipid-sphingomyelin, cerebroside, sulfatides, and gangliosides. Cholesterol biosynthesis and its regulation. Lipoprotein metabolism-chylomicrons, VLDL, HDL and LDL.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| <b>III</b>                                 | Metabolism of nucleotides- <i>De novo</i> synthesis and salvage pathways of purine and pyrimidine nucleotides. Regulation and inhibitors of nucleotide biosynthesis. Role of ribonucleotide reductase and its regulation. Degradation of purine and pyrimidine nucleotides.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| <b>IV</b>                                  | Biosynthesis of non- essential amino acids.- Role and biological significance of glutamate dehydrogenase, glutamine and asparagine synthetase, lysine, proline and phenylalanine hydroxylase. Interconversion of amino acids - proline to glutamate, methionine to cysteine, serine to glycine. Degradation of amino acids –glucogenic and ketogenic amino acids. Formation of acetate from leucine and aromatic amino acid, pyruvate from cysteine, threonine and hydroxy proline, $\alpha$ -keto glutarate from histidine and proline, succinate from methionine, threonine, valine and isoleucine, Oxaloacetate from aspartate, glycine and serine.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| <b>V</b>                                   | <b>Metabolic integration and hormonal regulation:</b> Key junctions in metabolism– glucose-6-phosphate, pyruvate and acetyl CoA. Metabolic profiles and hormonal regulations of brain, muscle, liver, kidney and adipose tissue.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| <b>Reading List<br/>(Print and Online)</b> | <ol style="list-style-type: none"> <li>1. <a href="https://www.embopress.org/doi/full/10.1038/msb.2013.19">https://www.embopress.org/doi/full/10.1038/msb.2013.19</a></li> <li>2. <a href="https://people.wou.edu/~guralnl/450Glycogen%20metabolism.pdf">https://people.wou.edu/~guralnl/450Glycogen%20metabolism.pdf</a></li> <li>3. <a href="https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3243375/">https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3243375/</a></li> <li>4. <a href="https://www.researchgate.net/publication/334458898_Urea_Cycle">https://www.researchgate.net/publication/334458898_Urea_Cycle</a></li> <li>5. <a href="https://www.researchgate.net/publication/51233381_Heme_biosynthesis_and_its_regulation_Towards_understanding_and_improvement_of_heme_biosynthesis_in_filamentous_fungi">https://www.researchgate.net/publication/51233381_Heme_biosynthesis_and_its_regulation_Towards_understanding_and_improvement_of_heme_biosynthesis_in_filamentous_fungi</a></li> <li>6. <a href="https://www.researchgate.net/publication/349746691_Microbial_Sulfur_Metabolism_and_Environmental_Implications">https://www.researchgate.net/publication/349746691_Microbial_Sulfur_Metabolism_and_Environmental_Implications</a></li> </ol> |

|                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|--------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Self-study</b>        | 1. Cori's Cycle and Glucose- Alanine Cycle<br>2. Coenzymes involved in Methanogenesis                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| <b>Books Recommended</b> | 1. David L. Nelson and Michael M. Cox (2012) Lehninger Principles of Biochemistry (6th ed), W.H. Freeman<br>2. Voet. D and Voet. J.G (2010) Biochemistry , (4th ed), John Wiley & Sons, Inc.<br>3. Metzler D.E (2003). The chemical reactions of living cells (2nd ed), Academic Press.<br>4. Zubay G.L (1999) Biochemistry , (4th ed), Mc Graw-Hill.<br>5. Textbook of Biochemistry with Clinical Correlations, 7th Edition, Thomas M. Devlin (Editor), Wiley<br>6. Human Biochemistry – James M. Orten & Otto.W. Neuhan- 10th edn- The C.V. Mosby Company |

**Method of Evaluation:**

| Test I | Test II | Assignment | End Semester Examination | Total | Grade |
|--------|---------|------------|--------------------------|-------|-------|
| 10     | 10      | 5          | 75                       | 100   |       |

**Methods of assessment:**

**Recall (K1)** - Simple definitions, MCQ, Recall steps, Concept definitions.

**Understand/ Comprehend (K2)** - MCQ, True/False, Short essays, Concept explanations, Short summary or overview.

**Application (K3)** - Suggest idea/concept with examples, Solve problems, Observe, Explain.

**Analyse (K4)**- Problem-solving questions, Finish a procedure in many steps, Differentiate between various ideas

**Evaluate (K5)** - Longer essay/ Evaluation essay, Critique or justify with pros and cons.

**Create (K6)**- Check knowledge in specific or offbeat situations, Discussion.

**Mapping with Programme Outcomes:**

|      | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 |
|------|------|------|------|------|------|------|------|------|------|-------|
| CO 1 | S    | M    | S    | M    | S    | M    | S    | S    | S    | M     |
| CO 2 | S    | M    | S    | S    | S    | M    | S    | S    | S    | M     |
| CO 3 | S    | M    | S    | S    | S    | M    | S    | S    | S    | S     |
| CO 4 | S    | M    | S    | M    | S    | M    | S    | S    | S    | M     |
| CO 5 | S    | M    | S    | S    | S    | M    | S    | S    | S    | S     |

**S-Strong M-Medium L-Low**



|                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
|--------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Course I</b>                | <b>CORE PAPER – VII</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| <b>Title of the Course:</b>    | <b>CLINICAL BIOCHEMISTRY</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| <b>Credits:</b>                | <b>5 - Hrs 5</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| <b>Pre-requisites, if any:</b> | The student should have a basic knowledge of body fluids and their composition and metabolism; anatomy and physiology of vital organs.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| <b>Course Objectives</b>       | <ol style="list-style-type: none"> <li>1. To understand the need and methods of various biological sample collection.</li> <li>2. To explicitly understand the etiopathogenesis, symptoms and complications of metabolic and hormonal disorders and the relevant diagnostic markers</li> <li>3. To emphasize the diagnostic significance of serum enzymes in different pathologies and other Laboratory investigations of diagnostic importance so as to differentiate normal from disease</li> <li>4. To conceive the role of inherited genes in inborn errors of metabolism and methodologies pertaining to <i>in utero</i> diagnosis and post-natal screening.</li> <li>5. To get updated about electrolyte and hormonal imbalances and the biochemical tests to diagnose them.</li> </ol> |
| <b>Course Outcomes</b>         | <p><b>CO1.</b> To appreciate the biological significance of sample collection and awareness of the diagnostic/screening tests to detect common non-communicable diseases so as to understand role of laboratory investigations for biochemical parameters and understand the disorders associated with blood cells</p> <p><b>CO2.</b> To understand the etiology of metabolic diseases like diabetes and atherosclerosis and avoid such lifestyle disorders by healthy eating and correlate the symptoms with underlying pathology based on diagnostic and prognostic markers.</p> <p><b>CO3.</b> To understand the diagnostic application of serum/plasma enzymes to correlate their levels with the organ pathologies associated with specific diseases.</p>                                |

|              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
|--------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|              | <p><b>CO4.</b> To appreciate the role of pre and post-natal diagnosis leading to healthy progeny.</p> <p><b>CO5.</b> To link the serum hormone levels and clinical symptoms with underlying hormonal disturbances. To review the onward transmission of signal via downstream signaling molecules from cell surface to the nucleus by different pathways by comparing and contrasting them and critically evaluate the network between them resulting in the biological outcome.</p>                                                                                                                                                                                                                                                 |
| <b>Units</b> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| <b>I</b>     | <p><b>Biochemical investigations in diagnosis, prognosis, monitoring, screening:</b> Specimen collection – blood, (primary /Secondary specimen),, urine and CSF. Preservation of biological specimens -blood, urine, CSF and amniotic fluid. Biological reference ranges;</p> <p><b>Disorders of blood cells:</b> Hemolytic, iron deficiency and aplastic anemia and diagnosis, sickle cell anaemia, thalassemia, HBA1C variants. Porphyrrias, Thrombocytopenia, Causes of leucopenia, leukemia and leucocytosis. Disorders of blood clotting mechanism - Von willebrand's disease, Hemophilia A, B and C, diagnostic test for clotting disorders.</p>                                                                               |
| <b>II</b>    | <p><b>Diabetes mellitus: pathology and complications:</b> Acute changes; Chronic complications: Diabetic nephropathy, neuropathy, retinopathy and Diabetic foot ulcers, Random/Fasting/PP glucose testing, Impaired glucose tolerance (IGT), Impaired fasting glucose (IFT), Diagnosis-by GTT, Pre-diabetes, Gestational DM ,Glycosylated Haemoglobin (HBA1c) ; Glycated albumin., Hypoglycaemia ,Glycogen Storage Disease,Markers of complications of Diabetes mellitus: Metabolic syndrome, Diabetic nephropathy, Microalbuminuria, Lipid profile &amp; lipoproteinemia, Atherosclerosis.</p>                                                                                                                                      |
| <b>III</b>   | <p><b>Diagnostic Enzymology:</b> Clinically Important Enzymes and Isoenzyme as diagnostic markers: Clinical significance of AST, ALT, ALP, ACP, CK, <math>\gamma</math>-GT, amylase, pseudocholinesterase and their pattern in Myocardial infarction; Bone disease, Muscle disease, Cancer (tumor markers), GI tract pancreatitis); Enzymes as therapeutic agents.</p> <p><b>Pre- and post-natal testing:</b> Amniocentesis, prenatal detection of inborn errors of metabolism in developing fetus- Autosomal recessive mode of inheritance- cystic fibrosis, X linked recessive inheritance-Duchenne muscular dystrophy. New born screening (NBS) for In born errors of metabolism, Tandem mass spectrometry application in NBS</p> |
| <b>IV</b>    | <p><b>Liver function tests:</b> Liver function test panel, Fatty liver . Plasma protein changes in liver diseases. Hepatitis A, B and C. Cirrhosis and fibrosis. Portal hypertension and hepatic coma. Acute phase proteins -CRP, Haptoglobins, <math>\alpha</math>-fetoprotein, ferritin and transferrin and their clinical significance, Interpreting serum protein electrophoresis. Inflammatory markers (cytokines such as TNF-alpha IL6 and others)</p>                                                                                                                                                                                                                                                                         |

|                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|---------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| V                               | <p><b>Renal function tests</b> - tests for glomerular and tubular function- GFR, Acute and chronic renal failure- Glomerulonephritis, Nephrotic syndrome, uremia- urinary calculi- Nephrocalcinosis and Nephrolithiasis- causes, pathology and symptoms. Chronic kidney disease. Dialysis- Hemodialysis and peritoneal dialysis.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| Reading List (Print and Online) | <p><b>1. Utility of HIL in Clinical Chemistry:</b><br/> <a href="https://www.aacc.org/science-and-research/clinical-chemistry-trainee-council/trainee-council-in-english/pearls-of-laboratory-medicine/2018/utility-of-hil-in-clinical-chemistry">https://www.aacc.org/science-and-research/clinical-chemistry-trainee-council/trainee-council-in-english/pearls-of-laboratory-medicine/2018/utility-of-hil-in-clinical-chemistry</a></p> <p><b>2. Pre, Post and Analytical Errors in Clinical Chemistry laboratory</b><br/><br/>         DOI: 10.7860/NJLM/2016/22587:2173<br/> <a href="https://doi.org/10.2147/JMDH.S286679">https://doi.org/10.2147/JMDH.S286679</a></p> <p><b>3. Standards of Medical Care in Diabetes—2022 Abridged for Primary Care Providers</b><br/> <a href="https://diabetesjournals.org/clinical/article/40/1/10/139035/Standards-of-Medical-Care-in-Diabetes-2022">https://diabetesjournals.org/clinical/article/40/1/10/139035/Standards-of-Medical-Care-in-Diabetes-2022</a><br/> <a href="https://doi.org/10.2337/diaspect.16.1.32">https://doi.org/10.2337/diaspect.16.1.32</a><br/> <a href="http://www.ngsp.org/">http://www.ngsp.org/</a></p> <p><b>4. Quality control in clinical laboratory</b><br/> <a href="https://www.researchgate.net/publication/335830829_Quality_Control_in_a_Clinical_Laboratory">https://www.researchgate.net/publication/335830829_Quality_Control_in_a_Clinical_Laboratory</a><br/> <a href="https://labpedia.net/quality-control-of-the-clinical-laboratory/">https://labpedia.net/quality-control-of-the-clinical-laboratory/</a><br/> <a href="https://journals.sagepub.com/doi/full/10.1016/j.jala.2008.12.001">https://journals.sagepub.com/doi/full/10.1016/j.jala.2008.12.001</a><br/> <a href="https://doi.org/10.1016/B978-0-12-407821-5.00004-8">https://doi.org/10.1016/B978-0-12-407821-5.00004-8</a><br/> <a href="https://www.westgard.com/clia.htm">https://www.westgard.com/clia.htm</a><br/> <a href="https://www.labroots.com/webinar/bio-rad-unity-solution-molecular-quality-control-data-management">https://www.labroots.com/webinar/bio-rad-unity-solution-molecular-quality-control-data-management</a></p> |
| Self-Study                      | <p><b>1. Potential sources of variability in the estimation of the analytes:</b><br/>         Pre-analytical phase: acceptance rejection criteria in terms of haemolysis/icteric/lipemia (HIL) interferences<br/>         Analytical phase: Linearity, detection limits precision, accuracy, specificity, sensitivity; Total Allowable Error. (Definitions and examples).<br/>         Post-analytical phase : Units of reporting of clinical chemistry parameters-</p> <p><b>2. Interpretation of results in clinical chemistry based on laboratory investigations and quality control:</b></p> <ul style="list-style-type: none"> <li>• critical / alert values</li> <li>• American Diabetes Association (ADA) Standards of Medical Care in Diabetes (yearly update); HBA1C testing :NGSP</li> <li>• Case studies to review</li> <li>• Quality control for clinical chemistry in laboratory</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |

|                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|--------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Recommended Texts</b> | <ol style="list-style-type: none"> <li>1. ThomasM.Devlin (2014) Textbook of Biochemistry with Clinical Correlations (7th ed). John Wiley &amp; Sons</li> <li>2. Montgomery R, Conway TW, Spector AA (1996),Biochemistry: A Case-Oriented Approach (6th ed), Mosby Publishers, USA.</li> <li>3. Tietz Fundamentals of Clinical Chemistry and Molecular Diagnostics (2018) (8th ed),Saunders</li> <li>4. Dinesh Puri, (2020) Text book of Biochemistry: A clinically oriented approach – 4th Edition, Elsevier.</li> <li>5. 5. M.N.Chatterjee and Rana Shinde (2012).Textbook of Medical Biochemistry (8th ed), Jaypee Brothers Medical Publishers.</li> <li>6. Clinical Case Discussion In Biochemistry A Book On Early Clinical Exposure (ECE), Poonam Agrawal , 2021, CBS Publishers &amp; distributors pvt. Ltd</li> </ol> |
|--------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

**Method of Evaluation:**

| Test I | Test II | Assignment | End Semester Examination | Total |
|--------|---------|------------|--------------------------|-------|
| 10     | 10      | 5          | 75                       | 100   |

**Methods of assessment:**

**Recall (K1)** - Simple definitions, MCQ, Recall steps, Concept definitions.

**Understand/ Comprehend (K2)** - MCQ, True/False, Short essays, Concept explanations, Short summary or overview.

**Application (K3)** - Suggest idea/concept with examples, Observe, Explain.

**Analyse (K4)**- Finish procedure in stepwise manner, Differentiation between various ideas, Map knowledge

**Evaluate (K5)** - Longer essay/ Evaluation essay, Critique or justify with pros and cons.

**Create (K6)**- Check knowledge in specific or offbeat situations, Discussion, Debating, Presentation

**Mapping with Programme Outcomes:**

|      | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 |
|------|------|------|------|------|------|------|------|------|------|-------|
| CO 1 | S    | S    | M    | S    | S    | S    | S    | M    | M    | S     |
| CO 2 | S    | M    | S    | M    | S    | S    | S    | M    | M    | M     |
| CO 3 | S    | S    | S    | S    | S    | M    | S    | S    | M    | M     |
| CO 4 | S    | M    | M    | M    | S    | M    | S    | S    | S    | M     |
| CO 5 | S    | M    | S    | M    | S    | S    | S    | S    | S    | S     |

**S-Strong M-Medium L-Low**

|                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|--------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Course</b>                  | <b>CORE PAPER VIII</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| <b>Title of the Course:</b>    | <b>INDUSTRIAL MICROBIOLOGY</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| <b>Credits:</b>                | <b>4 - - Hrs 5</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| <b>Pre-requisites, if any:</b> | Basic Knowledge of Microbiology and microbial techniques                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| <b>Course Objectives</b>       | <ol style="list-style-type: none"> <li>1. To gain knowledge of the structure, classification and use of microorganisms in various industries.</li> <li>2. To know various fermenter designs, culture systems and the application of fermentation process in industry.</li> <li>3. To understand the production and purification of fermented products and their industrial applications.</li> <li>4. Understand the basic concepts of food and agricultural microbiology.</li> </ol>                                                                                                                       |
| <b>Course Outcomes</b>         | <p><b>CO1.</b>Students will be able to understand the structure and classification of microorganisms (K2 , K4)</p> <p><b>CO2.</b>Gain knowledge of the uses of microorganisms in various industrial applications (K3 , K4)</p> <p><b>CO3.</b>Understand the concepts of fermentation process, harvest and recovery. (K1 , K5)</p> <p><b>CO4.</b>Students will know the types of microbial fermentation processes and their applications in pharmaceutical industry. (K2 , K3)</p> <p><b>CO5.</b>Students will learn about the use of microorganisms in beverages, diary and food industries. (K3 , K6)</p> |
| <b>Units</b>                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| <b>I</b>                       | Role of Microbes in (a) Food Industry (b) Chemical Industry (c) Pharmaceutical Industry                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| <b>II</b>                      | Fermentation – types, techniques, design and operation of fermenters including addition of medium. Types and characteristics of microorganisms, environmental conditions required for the growth and metabolism of industrially and pharmaceutically important microbes. Sterilization methods in fermentation techniques, air, gas, culture medium sterilization. Steam-filtration and chemicals. Types and constituents of fermentative culture medium and conditions of fermentations.                                                                                                                  |
| <b>III</b>                     | Recovery and estimation of products of fermentation- Production of ethanol, acetic acid, glycerol, acetone, butanol and citric acid by fermentation. Production of Enzymes- amylase, protease.                                                                                                                                                                                                                                                                                                                                                                                                             |
| <b>IV</b>                      | Microbes in pharmaceutical industry - Production of pharmaceuticals by fermentation–penicillin, streptomycin riboflavin, vitamin B12.Beverages- wine, beer and malt beverages.                                                                                                                                                                                                                                                                                                                                                                                                                             |

|                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |           |
|------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------|
| V                                  | Agricultural Microbiology: General Properties of soil, Biogeochemical cycles, nitrogen fixation, Production of bio fertilizers and its field applications – Rhizobium, azotobacter, blue green algae, mycorrhizae, azospirillum, Production of biofuels (biogas- methane), soil inoculants.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Method of |
| Self-Study                         | <ul style="list-style-type: none"> <li>• Micro-organisms in food processing and pharma industries</li> <li>• Upstream and Downstream processes in Biopharma</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |           |
| Reading List<br>(Print and Online) | Industrial biotechnology:<br><a href="https://nptel.ac.in/courses/102/105/102105058/">https://nptel.ac.in/courses/102/105/102105058/</a><br>Bioreactors:<br><a href="https://nptel.ac.in/courses/102/106/102106053/">https://nptel.ac.in/courses/102/106/102106053/</a><br>Food Microbiology:<br><a href="https://nptel.ac.in/courses/126/103/126103017/">https://nptel.ac.in/courses/126/103/126103017/</a><br>Agriculture Microbiology:<br><a href="https://www.youtube.com/watch?v=f7UXyVImZ_c">https://www.youtube.com/watch?v=f7UXyVImZ_c</a>                                                                                                                                                                                                                                                                                                                                              |           |
| Recommended Texts                  | <ol style="list-style-type: none"> <li>1. Food Microbiology: An Introduction: 4<sup>th</sup> edition, <b>Matthews KR, Kniel KE, Montville TJ</b>; American Society for Microbiology</li> <li>2. Food, Fermentation and Micro-Organisms, 2<sup>nd</sup> edition, <b>Charles, BW</b>; Blackwell Science Ltd</li> <li>3. Microbiology. 5th edition, <b>Pelczar MJ, Chan ECS and Krieg NR</b>; McGraw Hill Book Company.</li> <li>4. Text book of Microbiology: 11<sup>th</sup> edition, <b>Ananthanarayanan R and Paniker CKJ</b>; Universities Press (India) Pvt. Ltd.</li> <li>5. Food Microbiology, 3rd edition, <b>Frazier WC and Westhoff DC</b>; Tata McGrawHill Publishing Company Ltd, New Delhi</li> <li>6. New Methods of Food Preservation: 1<sup>st</sup> edition, <b>Gould GW</b>; Springer Manual of Industrial Microbiology and Biotechnology: 3rd edition, <b>Baltz</b></li> </ol> |           |

**Evaluation:**

| Test I | Test II | Assignment | End Semester Examination | Total | Grade |
|--------|---------|------------|--------------------------|-------|-------|
| 10     | 10      | 5          | 75                       | 100   |       |

**Methods of assessment:**

**Recall (K1)** - Simple definitions, MCQ, Recall steps, Concept definitions.

**Understand/ Comprehend (K2)** - MCQ, True/False, Short essays, Concept explanations, Short summary or overview.

**Application (K3)** - Suggest idea/concept with examples, Solve problems, Observe, Explain.

**Analyse (K4)**- Problem-solving questions, Finish a procedure in many steps, Differentiate between various ideas

**Evaluate (K5)** - Longer essay/ Evaluation essay, Critique or justify with pros and cons.

**Create (K6)**- Check knowledge in specific or offbeat situations, Discussion.

**Mapping with Programme Outcomes:**

|             | <b>PO 1</b> | <b>PO 2</b> | <b>PO 3</b> | <b>PO 4</b> | <b>PO 5</b> | <b>PO 6</b> | <b>PO 7</b> | <b>PO 8</b> | <b>PO 9</b> | <b>PO 10</b> |
|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|--------------|
| <b>CO 1</b> | S           | S           | M           | S           | S           | S           | M           | M           | S           | S            |
| <b>CO 2</b> | S           | M           | S           | S           | M           | S           | S           | M           | M           | M            |
| <b>CO 3</b> | S           | M           | L           | S           | M           | M           | S           | S           | M           | S            |
| <b>CO 4</b> | M           | S           | S           | S           | L           | M           | S           | M           | S           | M            |
| <b>CO 5</b> | S           | S           | M           | S           | S           | M           | M           | S           | S           | S            |

**S-Strong      M-Medium      L-Low**

|                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|-----------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Course</b>               | <b>CORE PAPER -IX P</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| <b>Title of the Course:</b> | <b>LAB COURSE IN ENZYMOLOGY , MICROBIOLOGY AND CELL BIOLOGY</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| <b>Credits:</b>             | <b>4 - - Hrs 5</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| <b>Pre-requisites</b>       | Knowledge on basic principles, Instrumentation of Biochemical techniques and metabolic reactions                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| <b>Course Objectives</b>    | <ol style="list-style-type: none"> <li>1. To inculcate skill in students enabling them to apprehend the wider knowledge about principles and techniques to be employed for the assay of enzymes under investigation.</li> <li>2. To inculcate the knowledge of isolation and purification techniques of enzymes using alkaline phosphatase as an example</li> <li>3. To perform experiments to study the factors affecting enzyme activity</li> <li>4. To achieve training in assay of enzymes</li> <li>5. To achieve training in basic microbiological techniques – preparation of culture, sterilization and staining methods.</li> <li>6. To perform the blood grouping test and to prepare blood smear to study different types of blood cells</li> <li>7. To learn molecular biology techniques like Gel electrophoresis and Blotting techniques</li> <li>8. To introduce industrial visit so that students may be aware of actual need of the industry and various opportunities available</li> </ol>                                                                                                                                                |
| <b>Course Outcomes</b>      | <p><b>On successful completion of this course, students should be able to:</b></p> <p>After completion of the course, the students should be able to:</p> <p><b>CO1.</b> The student will be able to employ the relevant techniques for isolation and purification of enzymes and gain skill in kinetic studies which is essential for research activity (K1, K2, K4)</p> <p><b>CO2.</b> Student will acquire ability in performing enzyme assay, and explicate the methods that form the basis of enzyme characterization. (K1, K2, K4)</p> <p><b>CO3.</b> Learn the Basic concepts in microbiology and cell biology which will be helpful for interdisciplinary research work. (K1, K3, K4)</p> <p><b>CO4.</b> Students will be trained in separation techniques used in molecular Biology which will be supportive in their future research (K1, K3, K4 &amp; K6)</p> <p><b>CO5.</b> Industrial visits will provide the students with an opportunity to learn practically through interaction, working methods and employment practices. Students will have an exposure to Industrial standard and current work practices (K1, K2, K3, K4 &amp; K6)</p> |
|                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |



| <b>Units</b>                               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|--------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>I</b>                                   | <p>Enzymology</p> <p>Alkaline Phosphatase</p> <ol style="list-style-type: none"> <li>a. Isolation of Alkaline Phosphatase from goat kidney.</li> <li>b. Purification of alkaline phosphatase</li> <li>c. Checking the purity using SDS-PAGE</li> <li>d. Determination of optimum pH and temperature of alkaline phosphatase.</li> <li>e. Determination of specific activity and Km of alkaline phosphatase.</li> <li>f. Effect of activators and inhibitors on the activity of alkaline phosphatase.</li> </ol> <p>Assay of enzymes</p> <ol style="list-style-type: none"> <li>a. Salivary Amylase</li> <li>b. Acid Phosphatase</li> </ol>                                                                                                                                                                                                                                                                                                                                 |
| <b>II</b>                                  | <p>Microbiology</p> <ol style="list-style-type: none"> <li>a. Safety measures and Good Laboratory Practices in microbiology laboratory</li> <li>b. Sterilization, Culture and inoculum preparation</li> <li>c. Staining of bacteria – Gram Staining</li> </ol>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| <b>III</b>                                 | <p>Physiology &amp; Cell Biology</p> <ol style="list-style-type: none"> <li>a. Test for blood grouping (Haemagglutination).</li> <li>b. Peripheral Blood smear – Staining and Interpretation</li> </ol>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| <b>IV</b>                                  | <p>Group Experiments</p> <ol style="list-style-type: none"> <li>a. Separation of proteins based on molecular weight by SDS PAGE</li> <li>b. Agarose gel electrophoresis of genomic DNA</li> </ol>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| <b>V</b>                                   | <p>Industrial visit can be organized to students through Academia – Industry collaborative Program</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| <b>Reading List<br/>(Print and Online)</b> | <ol style="list-style-type: none"> <li>1. <a href="https://www.researchgate.net/publication/337146254_Kinetic_studies_with_alkaline_phosphatase">https://www.researchgate.net/publication/337146254_Kinetic_studies_with_alkaline_phosphatase</a></li> <li>2. <a href="https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4846332/">https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4846332/</a></li> <li>3. <a href="https://www.ijsr.net/archive/v3i8/MDIwMTU0MDk=.pdf">https://www.ijsr.net/archive/v3i8/MDIwMTU0MDk=.pdf</a></li> <li>4. <a href="https://www.researchgate.net/publication/349318898_ABC_of_Peripheral_smear">https://www.researchgate.net/publication/349318898_ABC_of_Peripheral_smear</a></li> <li>5. <a href="https://ncdc.gov.in/WriteReadData/1892s/File608.pdf">https://ncdc.gov.in/WriteReadData/1892s/File608.pdf</a></li> <li>6. <a href="https://www.ncbi.nlm.nih.gov/books/NBK562156/">https://www.ncbi.nlm.nih.gov/books/NBK562156/</a></li> </ol> |
| <b>Self-Study</b>                          | <ol style="list-style-type: none"> <li>1. Preparation of Buffers and pH measurement</li> <li>2. Michaelis-Menten equation and Lineweaver Burk plot</li> </ol>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| <b>Books Recommended</b>                   | <ol style="list-style-type: none"> <li>1. David Plummer (2001) An Introduction to Practical Biochemistry (3rd ed) McGraw Hill Education (India) Private Ltd</li> <li>2. Jayaraman, J (2011), laboratory Manual in Biochemistry, New age publishers</li> </ol>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |

|  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
|--|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|  | <p>3. Fundamentals of Enzymology; 3rd Edn. Nicholas C. Price and Lewis Stevens, Oxford University Press (2012).</p> <p>4. Enzymes: A Practical Introduction to Structure, Mechanism, and Data Analysis; Robert A. Copeland, Wiley-VCH Publishers (2000).</p> <p>5. Cappuccino JG &amp; Sherman N (2005). Microbiology-A Laboratory Manual, Pearson Education Inc</p> <p>6. Practical Enzymology, Second Revised Edition: Hans Bisswanger, Wiley – Blackwell; 2 edition (2011)</p> |
|--|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

**Method of Evaluation:**

| Test I | Test II | Assignment | End Semester Examination | Total | Grade |
|--------|---------|------------|--------------------------|-------|-------|
| 10     | 10      | 5          | 75                       | 100   |       |

**Methods of assessment:**

**Recall (K1)** - Simple definitions, MCQ, Recall steps, Concept definitions.

**Understand/ Comprehend (K2)** - MCQ, True/False, Short essays, Concept explanations, Short summary or overview.

**Application (K3)** - Suggest idea/concept with examples, Solve problems, Observe, Explain.

**Analyse (K4)**- Problem-solving questions, Finish a procedure in many steps, Differentiate between various ideas

**Evaluate (K5)** - Longer essay/ Evaluation essay, Critique or justify with pros and cons.

**Create (K6)**- Check knowledge in specific or offbeat situations, Discussion.

**Mapping with Programme Outcomes:**

|      | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 |
|------|------|------|------|------|------|------|------|------|------|-------|
| CO 1 | S    | S    | S    | S    | M    | S    | L    | S    | M    | S     |
| CO 2 | S    | S    | S    | S    | M    | S    | L    | S    | M    | S     |
| CO 3 | S    | S    | S    | S    | M    | S    | M    | S    | M    | S     |
| CO 4 | S    | S    | S    | S    | S    | S    | S    | S    | S    | S     |
| CO 5 | S    | S    | S    | S    | S    | S    | S    | S    | S    | S     |

**S-Strong M-Medium L-Low**

| Course                  | CORE BASED ELECTIVE PAPER -I                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|-------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Title of the Course:    | MICROBIOLOGY & IMMUNOLOGY <sup>43</sup>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| Credits:                | 3 - - Hrs 5                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| Pre-requisites, if any: | The student should possess basic knowledge about microorganisms, types and their general characteristics. The students are also expected to possess basic understanding about the process of infection, immunological defence and pathological outcomes, if any.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| Course Objectives       | <ol style="list-style-type: none"> <li>1. To appreciate the classification of microorganisms based on their structure, size and shape with an insight into the ancient scriptures about microbes.</li> <li>2. To understand the role of microorganisms in environment and also to learn the culture conditions.</li> <li>3. To recognize the possible contamination of foods by microorganisms, to learn about counteracting preservative measures and to know about probiotic nature of microorganisms.</li> <li>4. To gain knowledge on pathogenic mediation by microorganisms and preventive measures as well.</li> <li>5. To comprehend the features of antimicrobial agents, their mechanism of action along with the side effects and also to explore natural remedial measures against microbes.</li> <li>6. To be able to exploit the various features of microorganisms for the beneficial industrial production.</li> </ol>                                                                                                                                                              |
| Course Outcomes         | <p>After completion of the course, the students should be able to:</p> <p><b>CO1.</b> To classify (by both ancient and modern modes) different types of microorganisms and explain life cycle of the microbes (K1, K2 &amp; K5)</p> <p><b>CO2.</b> To recognize the microorganisms involved in decay of foods and will be able to apply various counteracting measures. The students also will be able to relate the role of certain beneficial microbes in day-to- day's food consumption. (K1, K2 &amp; K4)</p> <p><b>CO3.</b> To understand the common pathogenic bacterial and fungi that cause toxic effects and also will be able to employ curative measures. (K1 &amp; K2)</p> <p><b>CO4.</b> To analyse various features of wide variety of antimicrobial agents along with their mode of action, in addition, being able to apprehend the valuable potentials of traditional and easily available herbs. (K2, K5 &amp; K6)</p> <p><b>CO5.</b> To apply knowledge gained in production of industrially important products as both pharmaceutical and nutraceutical. (K2, K4 &amp; K5)</p> |
| <b>Units</b>            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| <b>I</b>                | Structure and classification - bacteria, viruses (DNA, RNA), algae, fungi and protozoa. Distribution and role of microorganisms in soil, water and air. lytic cycle and lysogeny. Types of culture media, isolation of pure culture, growth curve and the measurement of microbial growth.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |

|                                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
|----------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| II                                     | Food Microbiology-Role of Microbes in Fermented food. Causative agent of food poisoning- <i>Salmonella</i> , <i>Staphylococcus aureus</i> , aflatoxin. Food infection – <i>Clostridium</i> , and <i>Staphylococcus</i> Pathogenic microorganisms, <i>E. coli</i> , <i>Pseudomonas</i> , <i>Klebsilla</i> & <i>Mycobacterium</i> , causes, control, prevention, cure and safety. Food microbiological screening- Real time PCR&ELISA.                                                                                                                                                                                                                                                                                 |
| III                                    | Antimicrobial chemotherapy, General characteristics of antimicrobial agents. Mechanism of action – sulfonamides, sulphones and PAS. Penicillin, streptomycin- spectra of activity, mode of administration, mode of action, adverse effects and sensitivity test., Antiviral and antiretroviral agents, Antiviral RNA interference.                                                                                                                                                                                                                                                                                                                                                                                   |
| IV                                     | Immune system- definition and properties. Cells of the immune system – neutrophils, eosinophils, basophils, mast cells, monocytes, macrophages, dendritic cells, natural killer cells, and lymphocytes (B cells and T cells). Lymphoid organs- Primary and Secondary; structure and functions. Natural defences of the body (Innate Immunity) - skin, mucous membrane, lysozyme and phagocytes - and acquired immunity.                                                                                                                                                                                                                                                                                              |
| V                                      | Antigens and Complement System: definition, properties- antigenicity and immunogenicity, antigenic determinants and haptens. Antigen - antibody interactions - molecular mechanism of binding. Affinity, avidity, valency, cross reactivity and multivalent binding. Immunoglobulins & Immune Response: Structure, classes and distribution of antibodies. Antibody diversity. Immune system in health & disease, Transplantation immunology-graft rejection , MHC and HLA antigens.                                                                                                                                                                                                                                 |
| <b>Reading List (Print and Online)</b> | <a href="https://www.ijam.co.in/index.php/ijam/article/view/1326">https://www.ijam.co.in/index.php/ijam/article/view/1326</a> (Krumi (Microorganisms) in Ayurveda- a critical review)<br>Virtual Lectures in Microbiology and Immunology, University of Rochester<br><a href="https://www.frontiersin.org/articles/10.3389/fphar.2020.578970/full#h9">https://www.frontiersin.org/articles/10.3389/fphar.2020.578970/full#h9</a><br><a href="https://www.frontiersin.org/articles/10.3389/fmicb.2018.02151/full">https://www.frontiersin.org/articles/10.3389/fmicb.2018.02151/full</a><br><a href="https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7559905/">https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7559905/</a> |
| <b>Self-Study</b>                      | <ol style="list-style-type: none"> <li>1. Microbial infections and gut microbiome with relevance to <i>tridoshas</i></li> <li>2. Microbial population and pH variations in different dairy products.</li> </ol>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| <b>Recommended Texts</b>               | <ol style="list-style-type: none"> <li>1. Michael J. Pelczar Jr. (2001) Microbiology (5th ed), McGraw Hill Education (India) Private Limited</li> <li>2. Frazier WC , Westhoff DC, Vanitha NM (2010) Food Microbiology (5<sup>th</sup> ed), McGraw Hill Education (India) Private Limited</li> <li>3. Willey J and Sherwood L (2011) , Prescott's Microbiology (8<sup>th</sup> ed) McGraw Hill Education (India)</li> <li>4. Ananthanarayanan , Paniker and Arti Kapil (2013) Textbook of</li> </ol>                                                                                                                                                                                                                 |

Microbiology (9<sup>th</sup> ed) Orient BlackSwan  
 5. Judy Owen, Jenni Punt Kuby (2013), Immunology (Kindt, Kuby Immunology) (7<sup>th</sup> ed) W. H. Freeman & Co  
 6. Brooks GF and Carroll KC (2013) Jawetz Melnick & Adelbergs Medical Microbiology, (26<sup>th</sup> ed) McGraw Hill Education  
 7. Greenwood D (2012), Medical Microbiology, Elsevier Health

**Method of Evaluation:**

| Test I | Test II | Assignment | End Semester Examination | Total | Grade |
|--------|---------|------------|--------------------------|-------|-------|
| 10     | 10      | 5          | 75                       | 100   |       |

**Methods of assessment:**

**Recall (K1)** - Simple definitions, MCQ, Recall steps, Concept definitions.

**Understand/ Comprehend (K2)** - MCQ, True/False, Short essays, Concept explanations, Short summary or overview.

**Application (K3)** - Suggest idea/concept with examples, Observe, Explain.

**Analyse (K4)**- Finish procedure in stepwise manner, Differentiation between various ideas, Map knowledge

**Evaluate (K5)** - Longer essay/ Evaluation essay, Critique or justify with pros and cons.

**Create (K6)**- Check knowledge in specific or offbeat situations, Discussion, Debating, Presentation

**Mapping with Programme Outcomes:**

|      | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 |
|------|------|------|------|------|------|------|------|------|------|-------|
| CO 1 | S    | L    | S    | S    | S    | S    | M    | S    | S    | S     |
| CO 2 | S    | S    | S    | S    | S    | M    | L    | M    | S    | S     |
| CO 3 | S    | M    | M    | S    | M    | M    | M    | M    | L    | M     |
| CO 4 | S    | M    | M    | M    | M    | M    | M    | S    | S    | S     |
| CO 5 | S    | L    | S    | S    | M    | L    | L    | S    | S    | S     |

**S-Strong M-Medium L-Low**

|                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|--------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Course</b>                  | <b>NON MAJOR ELECTIVE PAPER- IV</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| <b>Title of the Course:</b>    | <b>PRINCIPLES OF COMPUTER SCIENCE</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| <b>Credits:</b>                | <b>2 - - Hrs 3</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| <b>Pre-requisites, if any:</b> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| <b>Course Objectives</b>       | <ol style="list-style-type: none"> <li>1. To acquire knowledge in Computer Science, software, features and programming aids.</li> <li>2. To understand Binary number system.</li> <li>3. To understand the principles of Boolean Algebra</li> <li>4. To understand the concepts of database</li> <li>5.To gain knowledge computer hardware.</li> </ol>                                                                                                                                                                                         |
| <b>Course Outcomes</b>         | <p><b>On completion of this course the student will be able to understand</b></p> <p><b>CO1.</b> Computer Science basics and prerequisites for programming such as Algorithm.</p> <p><b>CO2.</b> Computer Science basics and prerequisites for programming such Procedure and Flowchart writings</p> <p><b>CO3.</b> Understand the Computer peripherals, software types,</p> <p><b>CO4.</b> A thorough knowledge of basic logics in digital computers</p> <p><b>CO5.</b> A thorough knowledge on the introduction to database are learned.</p> |
| Unit 1                         | Introduction to Computers: Definition - Classification of Computers: Analog, Digital and Hybrid Computers. Classification of Computer: Super, Mainframe, Maxi, Personal Computers and Terminals – Characteristics of Computers – Block diagram of a Digital Computer.                                                                                                                                                                                                                                                                          |
| Unit II                        | Input Devices: Keyboard, Mouse, and Joystick – Output Devices: Dot Matrix Printer, Laser Printer, Colour Inkjet Printer - Computer Software: Introduction – Operating System, Application software, Programming Languages, Query Languages - Examples.                                                                                                                                                                                                                                                                                         |

|                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Unit III         | Programming: Algorithms, Procedures, and Flow Charts: Symbols and concepts. Examples with Algorithm and Flowchart: Simple Interest, Degree, Radian and Gradient Conversion, Biggest of three numbers, Counting characters in a sequence                                                                                                                                                                                                                  |
| Unit IV          | Binary number system: Introduction, Decimal to Binary conversion - Boolean algebra: Introduction – Boolean Constants and Variables – 2 and 3 variables Logical Truth Tables: AND / OR / NOT / NAND / NOR / XOR - Basic Laws of Boolean algebra and De Morgan's laws                                                                                                                                                                                      |
| Unit V           | Introduction to database systems: Basic concepts and definitions – data dictionary – database – Database system – Database Administrator – Database Approach – Database system environment – advantages and disadvantages of DBMS                                                                                                                                                                                                                        |
| Text Books:      | <ol style="list-style-type: none"> <li>1. Fundamentals of Computers, Rajaraman, V, 2nd Edition, Prentice Hall India Limited.</li> <li>2. Fundamentals of Information Technology, Alexis Leon &amp; Mathews.</li> <li>3. Digital Electronics, G. K. Kharate, Oxford University Press, 2010. (For UNIT: 4).</li> <li>4. Database Systems Concepts, Designs and Application Second Edition, Shio Kumar Singh, Pearson Education. (For UNIT: 5).</li> </ol>  |
| Reference Books: | <ol style="list-style-type: none"> <li>1. Introduction to Information Technology, Turban, Rainer and Potter, Willey Student 2nd Edition, New Delhi, 2012.</li> <li>2. Using Information Technology – A Practical introduction to computers and communication, 3rd Ed., Stacey Sawyer, Brian K Williams, Sarah E Hutchinson, TMH, 1999.</li> <li>3. An Introduction to Database Systems, Seventh Edition, C. J. Date, Pearson Education, 2002.</li> </ol> |

### Method of Evaluation:

| Test I | Test II | Assignment | End Semester Examination | Total |
|--------|---------|------------|--------------------------|-------|
| 10     | 10      | 5          | 75                       | 100   |

### Methods of assessment:

**Recall (K1)** - Simple definitions, MCQ, Recall steps, Concept definitions

**Understand/ Comprehend (K2)** - MCQ, True/False, Short essays, Concept explanations, Short summary or overview

**Application (K3)** - Suggest idea/concept with examples, Suggest formulae, Solve problems, Observe, Explain

**Analyse (K4)** - Problem-solving questions, Finish a procedure in many steps, Differentiate between various ideas, Map knowledge

**Evaluate (K5)** - Longer essay/ Evaluation essay, Critique or justify with pros and cons

**Mapping with Programme Outcomes:**

|             | <b>PO 1</b> | <b>PO 2</b> | <b>PO 3</b> | <b>PO 4</b> | <b>PO 5</b> | <b>PO 6</b> | <b>PO 7</b> | <b>PO 8</b> | <b>PO 9</b> | <b>PO 10</b> |
|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|--------------|
| <b>CO 1</b> | <b>S</b>    | <b>S</b>    | <b>S</b>    | <b>M</b>    | <b>M</b>    | <b>S</b>    | <b>S</b>    | <b>S</b>    | <b>S</b>    | <b>S</b>     |
| <b>CO 2</b> | <b>S</b>    | <b>M</b>    | <b>S</b>    | <b>L</b>    | <b>M</b>    | <b>M</b>    | <b>M</b>    | <b>M</b>    | <b>M</b>    | <b>S</b>     |
| <b>CO 3</b> | <b>S</b>    | <b>S</b>    | <b>M</b>    | <b>L</b>    | <b>S</b>    | <b>S</b>    | <b>M</b>    | <b>M</b>    | <b>S</b>    | <b>M</b>     |
| <b>CO 4</b> | <b>S</b>    | <b>M</b>    | <b>M</b>    | <b>M</b>    | <b>M</b>    | <b>M</b>    | <b>S</b>    | <b>S</b>    | <b>M</b>    | <b>S</b>     |
| <b>CO 5</b> | <b>S</b>    | <b>S</b>    | <b>M</b>    | <b>M</b>    | <b>S</b>    | <b>M</b>    | <b>M</b>    | <b>M</b>    | <b>S</b>    | <b>S</b>     |

**S-Strong      M-Medium      L-Low**



|                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|--------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Course</b>                  | <b>SKILL ENHANCEMENT PAPER- II</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| <b>Title of the Course:</b>    | <b>MOLECULAR BASIS OF DISEASES AND THERAPEUTIC STRATEGIES</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| <b>Credits:</b>                | <b>2 - - Hrs 2</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| <b>Pre-requisites, if any:</b> | Knowledge of Human Physiology, Metabolism and Clinical Biochemistry                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| <b>Course Objectives</b>       | <p>1.To understand the concepts of the mechanisms involved in regulation of blood sugar and management of diabetes mellitus</p> <p>2.To gain in-depth knowledge of the mechanisms of cancer and of tumor metastasis</p> <p>3.The student will review the basic organization of the central and peripheral nervous system that coordinate the sensory and motor functions of the body. In addition, the student will explore impaired features underlying the major neuropathological complications.</p> <p>4.To gain knowledge in renal diseases</p> <p>5.To understand the mechanisms involved in cardiac disorders</p>                                                                                                                                                                                                                        |
| <b>Course Outcomes</b>         | <p><b>On completion of this course the student will be able to understand</b></p> <p><b>CO1.</b>Overall view about the complications of diabetes mellitus and its management.</p> <p><b>CO2.</b>Comprehensive understanding of the concepts of cancer biology and implicating the theoretical concepts for further research</p> <p><b>CO3.</b>Understand and appreciate the pathophysiology of conditions affecting the nervous system.</p> <p><b>CO4.</b>A thorough knowledge of renal and cardiac diseases with emphasis related to mechanistic aspects and therapeutic interventions.</p> <p><b>CO5.</b> A thorough knowledge on the experimental models of non-communicable diseases that will be applied for future research or project dissertation. An in-depth knowledge on development of drugs against non-communicable diseases.</p> |
| <b>Units</b>                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| <b>I</b>                       | Pathophysiology of Type I and II diabetes, Diabetes – investigation methods for the diagnosis of diabetes. Nutritional care. Complications related to diabetes – Diabetic cardiovascular disease, retinopathy,                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |

|                                            |                                                                                                                                                                                                                                                                                                                                                                        |
|--------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                            | neuropathy and nephropathy. Cellular and molecular mechanism of development of diabetes- Management of Type I and Type II diabetes, drugs for the treatment of diabetes.                                                                                                                                                                                               |
| <b>II</b>                                  | Biology of cancer: Overview of hallmarks of cancer. Tumorigenesis, Tumor progression and mechanism of Metastasis. Diagnosis- Non-invasive imaging techniques, Tumor diagnosis, Molecular techniques in cancer diagnosis.- treatment of cancer- surgery, radiotherapy, chemotherapy, hormonal treatment, and biological therapy. Introduction to personalized medicine. |
| <b>III</b>                                 | Brain- neuronal network- memory- Neurodegenerative diseases- Parkinson and Alzheimer Disease- molecular understanding of the neurodegenerative diseases- treatment modalities.                                                                                                                                                                                         |
| <b>IV</b>                                  | Acute and chronic renal failure, glomerular diseases– glomerulonephritis, nephritic syndrome, diabetes insipidus, diagnosis of kidney disease. Normal ranges of Biochemical parameters in Blood, Normal and Abnormal Constituents of urine.                                                                                                                            |
| <b>V</b>                                   | Introduction to cardiovascular diseases, Lipids and lipoproteins in coronary heart disease-Atherosclerosis, Fatty Liver, cardiac enzymes, Molecular changes during cardiac remodeling – hypertrophy of hearts – heart failure- treatment modalities.                                                                                                                   |
| <b>Reading List<br/>(Print and Online)</b> | The Biochemical basis of disease:2018, <b>Barr AJ</b> ; Portland Press<br>1. Biochemical Basis of Diseases<br>2. <a href="https://www.biologydiscussion.com/diseases-2/biochemical-basis-of-diseases/44276">https://www.biologydiscussion.com/diseases-2/biochemical-basis-of-diseases/44276</a>                                                                       |
| <b>Recommended<br/>Texts</b>               | 1. Wills' Biochemical Basis of Medicine: 2 <sup>nd</sup> edition, Thomas H, Gillham B;Elsevier<br>2. Molecular Biochemistry of Human Diseases,2021, Feuer G ,de la Iglesia F; CRC Press                                                                                                                                                                                |

**Method of Evaluation:**

| Test I | Test II | Assignment | End Semester Examination | Total |
|--------|---------|------------|--------------------------|-------|
| 10     | 10      | 5          | 75                       | 100   |

**Methods of assessment:**

**Recall (K1)** - Simple definitions, MCQ, Recall steps, Concept definitions

**Understand/ Comprehend (K2)** - MCQ, True/False, Short essays, Concept explanations, Short summary or overview

**Application (K3)** - Suggest idea/concept with examples, Suggest formulae, Solve problems, Observe, Explain

**Analyse (K4)** - Problem-solving questions, Finish a procedure in many steps, Differentiate between various ideas, Map knowledge

**Evaluate (K5)** - Longer essay/ Evaluation essay, Critique or justify with pros and cons

**Mapping with Programme Outcomes:**

|      | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 |
|------|------|------|------|------|------|------|------|------|------|-------|
| CO 1 | S    | S    | S    | M    | M    | S    | S    | S    | S    | S     |
| CO 2 | S    | M    | S    | L    | M    | M    | M    | M    | M    | S     |
| CO 3 | S    | S    | M    | L    | S    | S    | M    | M    | S    | M     |
| CO 4 | S    | M    | M    | M    | M    | M    | S    | S    | M    | S     |
| CO 5 | S    | S    | M    | M    | S    | M    | M    | M    | S    | S     |

**S-Strong      M-Medium      L-Low**

|                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
|--------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Course</b>                  | <b>CORE PAPER –X</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| <b>Title of the Course:</b>    | <b>MOLECULAR BIOLOGY</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| <b>Credits:</b>                | <b>5 - - Hrs 6</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| <b>Pre-requisites, if any:</b> | Knowledge of the basics of genetics, cell biology and molecular biology.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| <b>Course Objectives</b>       | <ol style="list-style-type: none"> <li>1. To introduce the students to the process of inheritance, concepts of genes, genome, chromatin and chromosomes.</li> <li>2. To impart a thorough understanding of the key events of molecular biology, including the mechanisms of DNA replication, transcription and translation along with DNA repair mechanisms.</li> <li>3. To provide a detailed understanding of post transcriptional and posttranslational modifications and processing of eukaryotic RNA and proteins</li> <li>4. To give a detailed explanation of transcriptional regulation with lac operon and tryptophan operon as examples</li> <li>5. To impart adequate information of the types of regulatory RNAs along with key concepts of gene silencing</li> </ol>                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| <b>Course Outcomes</b>         | <p>After completion of the course, the students should be able to:</p> <p><b>CO1:</b> Comprehend the organization of genomes, the molecular basis of DNA replication, recombination and transposition, the significance of these processes, the various ways in which the DNA can be damaged leading to mutations and lesions and the different ways in which they are repaired.(K1,K2,K3,K5)</p> <p><b>CO2:</b> Gain knowledge about how genes are transcribed and translated in prokaryotes and eukaryotes and how these processes are regulated, recognize the nature of the genetic code and the various experimental approaches used to crack the code (K1,K2,K3,K4,K5)</p> <p><b>CO3:</b> Acquire knowledge of the molecular basis of RNA processing and RNA splicing and the various human pathologies that can result from defects of RNA modification. (K1,K2,K4,K5)</p> <p><b>CO4:</b> Comprehend the techniques of gene silencing and its applications.(K1,K2,K3,K4,K5,K6)</p> <p><b>CO5:</b> Apply the knowledge they have gained in understanding the above vital life processes to enhancing their analytical and problem-solving skills and develop an interest to pursue high quality research. (K2,K3,K4,K5,K6)</p> |

| <b>Units</b> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|--------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>I</b>     | Mendel's laws of inheritance-dominance-complete, incomplete and co-dominance, multiple alleles-gene mapping in haploids and diploids, recombination mapping- restriction mapping- modes of gene information transfer in bacterial- conjugation, transformation and transduction. The bacterial chromosome, the eukaryotic genome- chromosome structure – Histones, Nucleosome, chromatin- heterochromatin, euchromatin, chromatin remodeling, DNAase hypersensitive sites, genome organization – the C-value paradox, reassociation kinetics, repetitive sequences, gene amplification, telomeres, pseudogenes, split genes, organelle genomes – mitochondrial and chloroplast genome.                                                                                                                                                                 |
| <b>II</b>    | DNA replication and repair: Enzymes of replication, prokaryotic replication mechanisms, primosome & replisomes, eukaryotic DNA replication, the role of topoisomerases and telomerase, regulation of replication, difference between prokaryotic and eukaryotic replication. Mutations -Types of mutations, mechanisms of mutations, mutagenic agents. DNA repair mechanisms – Direct repair, excision repair, mismatch repair, recombination repair, SOS response, eukaryotic repair systems. Recombination and mobile genetic elements- the Holliday model, the general recombination in <i>E.coli</i> , site specific recombination, transposons and retroposons.                                                                                                                                                                                   |
| <b>III</b>   | Transcription – Prokaryotic transcription-subunits of RNA polymerase, <i>E. coli</i> promoters, sigma factor and promoter recognition, alternative sigma factors, initiation, elongation, Rho-dependent and independent termination of transcription. Eukaryotic transcription- Initiation, promoter elements, RNA polymerases, transcription factors, regulatory sequences in eukaryotic protein – coding genes, CpG islands, enhancers.<br><br>Post transcriptional modifications in eukaryotes- RNA processing- mRNA 5' capping and 3' poly-adenylation, introns and exons, RNA splicing,- spliceosome assembly, alternative splicing, processing of tRNA and rRNA, self-splicing, ribozymes, RNA editing- substitution and insertion/deletion editing, Genome editing-CRISPR- Cas technology                                                       |
| <b>IV</b>    | Translation – organization of the ribosome, the genetic code, evidence for a triplet code, deciphering the genetic code, wobble hypothesis, deviation in the genetic code, unusual codons. activation, initiation, elongation and termination of translation in <i>E. coli</i> . The role of tRNA and rRNA, suppressor tRNAs and inhibitors of protein synthesis., Comparison of prokaryotic translation with eukaryotic translation.<br><br>Post translational modification of proteins- Proteolytic cleavage, covalent modifications, glycosylation of proteins, disulfide bond formation, Protein sorting – signal peptides, transport of secretory proteins, Golgi and post-golgi sorting, coated vesicles, targeting of mitochondrial, lysosomal and nuclear proteins, Protein degradation-Ubiquitination of proteins, Protein folding-chaperones |

|                                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
|----------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| V                                      | Regulation of gene expression in prokaryotes-- Positive and negative control, the lac operon, identification of operator and regulator sequences by mutations, induction and repression, Foot-printing and gel-shift assays for identification of protein-DNA interactions. Catabolite repression. <i>Trp</i> operon – Attenuation, alternative secondary structures of <i>trp</i> mRNA. Regulation of gene expression in eukaryotes- Response elements, DNA-binding motifs, steroid receptors, association of methylation and histone acetylation with gene expression.                                                                                                                                                                                                                                                                                         |
| <b>Reading List (Print and Online)</b> | <ol style="list-style-type: none"> <li>1. Molecular Biology Free Online Course by MIT Part 3: RNA Uploaded by edX</li> <li>2. <a href="https://mooc.es/course/molecular-biology/">https://mooc.es/course/molecular-biology/</a></li> <li>3. <a href="https://onlinecourses.swayam2.ac.in/cec20_ma13/preview">https://onlinecourses.swayam2.ac.in/cec20_ma13/preview</a></li> <li>4. <a href="https://learn.genetics.utah.edu/">https://learn.genetics.utah.edu/</a></li> <li>5. <a href="https://www.cellbio.com/education.html">https://www.cellbio.com/education.html</a></li> <li>6. <a href="https://lifescienceinteractive.com/category/molecular-biology/">https://lifescienceinteractive.com/category/molecular-biology/</a></li> </ol>                                                                                                                   |
| <b>Self-Study</b>                      | <ol style="list-style-type: none"> <li>1. Multiple roles of noncoding RNAs (long ncRNA ,siRNA, miRNA ) in development and differentiation; implication of ncRNAs in pathologies.</li> <li>2. mRNA degradation- nonsense-mediated decay.</li> </ol>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| <b>Recommended Texts</b>               | <ol style="list-style-type: none"> <li>1. Lewin’s Genes XII : 12th edition, Krebs JE, Goldstein ES, Kilpatrick ST ;Prentice Hall, Delhi</li> <li>2. Molecular Biology of the Gene : 6th edition, Watson JD , Baker TA, Bell S, Gann A, Levine M, Losick R; Cold Spring Harbor Laboratory Press, New York</li> <li>3. Essential Cell Biology :3rd edition, Alberts B, Bray D, Hopkin K, Johnson A, Lewis J, Raff M, Roberts K, Walter P ; Garland Science, New York</li> <li>4. Molecular Cell Biology : 8th edition , Lodish H, Arnold Berk; W.H.Freeman &amp; Co, New York</li> <li>5. Karp's Cell and Molecular Biology: Concepts and Experiments, 8th Edition; Wiley, India</li> <li>6. An Introduction to Genetic Analysis 12th edition,, Griffith A. F, Doebley J, Peichel C, David A, Wassarman DA; Albion Press.W.H.Freeman &amp; Co ,New York</li> </ol> |

**Method of Evaluation:**

| Test I | Test II | Assignment | End Semester Examination | Total | Grade |
|--------|---------|------------|--------------------------|-------|-------|
| 10     | 10      | 5          | 75                       | 100   |       |

**Methods of assessment:**

**Recall (K1)** - Simple definitions, MCQ, Recall steps, Concept definitions.

**Understand/ Comprehend (K2)** - MCQ, True/False, Short essays, Concept explanations, Short summary or overview.

**Application (K3)** - Suggest idea/concept with examples, Solve problems, Observe, Explain.

**Analyse (K4)**- Problem-solving questions, Finish a procedure in many steps, Differentiate between various ideas

**Evaluate (K5)** - Longer essay/ Evaluation essay, Critique or justify with pros and cons.

**Create (K6)**- Check knowledge in specific or offbeat situations, Discussion.

**Mapping with Programme Outcomes:**

|      | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 |
|------|------|------|------|------|------|------|------|------|------|-------|
| CO 1 | S    | S    | S    | L    | M    | L    | S    | S    | S    | S     |
| CO 2 | S    | S    | S    | M    | M    | L    | M    | S    | S    | S     |
| CO 3 | S    | S    | S    | L    | M    | L    | M    | S    | S    | S     |
| CO 4 | S    | S    | S    | M    | M    | L    | S    | S    | S    | S     |
| CO 5 | S    | S    | S    | S    | S    | M    | M    | S    | S    | S     |

**S-Strong      M-Medium      L-Low**

|                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
|--------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Course</b>                  | <b>CORE PAPER – XI</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| <b>Title of the Course:</b>    | <b>GENE EDITING, CELL AND GENE THERAPY</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| <b>Credits:</b>                | <b>4 - - Hrs 5</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| <b>Pre-requisites, if any:</b> | To introduce students molecular basis of cell gene therapy; viral and nonviral gene transfer techniques and gene therapy applications in hereditary and acquired diseases.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| <b>Course Objectives</b>       | <p>1.To train the student in techniques related to the molecular basis of genetic diseases and to incorporate skills essential for various types of sequencing.</p> <p>2.To inculcate practical knowledge on comparing the animal models used to model genetic diseases</p> <p>3.To introduce and also elaborate knowledge about wide varieties of vectors and their features in addition to their applications and to identify the viral and nonviral gene transfer techniques</p> <p>4.To educate about the characteristics of cell culture, therapeutic strategies in gene therapy with relevant safety/ethics involved and patents as well.</p>                                                                                                                                                                                                                                                                                                                                                |
| <b>Course Outcomes</b>         | <p>After completion of the course, the students should be able to:</p> <p><b>CO1.</b> Ability to read, and evaluate scientific articles within the subjects of immune therapy, gene therapy and cell therapy. (K1, &amp; K2)</p> <p><b>CO2.</b> To clone gene of their interest for several downstream purposes with a robust comprehension about wide variety of applicable gene delivery vectors. (K1, K2 &amp; K5)</p> <p><b>CO3.</b> Be able to provide examples of diseases that can be treated with immune therapy, gene therapy and cell therapy. (K2, K3 &amp; K4)</p> <p><b>CO4.</b> To identify knowledge gaps and need for further research within their chosen topic of immune therapy, gene therapy or cell therapy. (K2, K4 &amp; K5)</p> <p><b>CO5.</b> To critically discuss and reflect on ethical and social aspects of using immune, gene or cell therapy. The student will be persuaded to contemplate on upcoming technologies for futuristic benefits. (K2, K5 &amp; K6)</p> |
| <b>Units</b>                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| <b>I</b>                       | Gene Editing: Basis of gene editing, DNA repair mechanisms, Double strand DNA breaks, Non homologous 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, drawbacks and major challenges to present gene editing techniques, gene editing for human disease therapy                                                                                                                                                                                                                         |
| <b>II</b>                                      | 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, ethical and legal issues, concerns about gene and cell therapy                                                             |
| <b>III</b>                                     | 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, Herpes Simplex virus, vaccinia, baculoviral vectors for gene delivery, choice of viral vector and oncolytic virus. Gene therapy applications, Gene therapy for cancer, suicide and oncolytic gene therapy. |
| <b>IV</b>                                      | 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 progenitors 'cells, Organoids, three dimensional (3D) bioprinting.                                                                                                                                                           |
| <b>V</b>                                       | 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 development of pluripotent stem cell-based cell replacement therapies.                                                                                                                        |
| <b>Reading List<br/>(Print and<br/>Online)</b> | <ol style="list-style-type: none"> <li>1. Stem Cell Biology, Daniel Marshak, Richard L. Gardener and David Gottlieb, Cold Spring Harbour Laboratory Press</li> <li>2. Stem cell biology and gene therapy, Booth C., Cell Biology International, Academic Press</li> <li>3. Stem Cell and Gene-Based Therapy: Frontiers in Regenerative Medicine, Alexander Battler,</li> </ol>                                                                                       |
| <b>Self-Study</b>                              | <ol style="list-style-type: none"> <li>1. Applications of gene editing strategies</li> <li>2. CART therapy for Cancer</li> </ol>                                                                                                                                                                                                                                                                                                                                     |
| <b>Recommended<br/>Texts</b>                   | <ol style="list-style-type: none"> <li>1. An Introduction to Human Molecular Genetics (2nd Edition), J.J. Pasternak, 2005</li> <li>2. An Introduction to Molecular Medicine and Gene Therapy 1st Edition by Thomas F. Kresina Upadhyay, S. K. (Ed.). (2021).</li> <li>3. Human Molecular Genetics (4th Edition), Tom Strachan &amp; Andrew Read, 2010.</li> <li>4. Stem Cells Handbook: Stewart Sell, Humana Press; Totowa NJ, USA; Oct. 2003,</li> </ol>            |

**Method of Evaluation:**

| Test I | Test II | Assignment | End Semester Examination | Total | Grade |
|--------|---------|------------|--------------------------|-------|-------|
| 10     | 10      | 5          | 75                       | 100   |       |

**Methods of assessment:**

**Recall (K1)** - Simple definitions, MCQ, Recall steps, Concept definitions.

**Understand/ Comprehend (K2)** - MCQ, True/False, Short essays, Concept explanations, Short summary or overview.

**Application (K3)** - Suggest idea/concept with examples, Observe, Explain.

**Analyse (K4)**- Finish procedure in stepwise manner, Differentiation between various ideas, Map knowledge

**Evaluate (K5)** - Longer essay/ Evaluation essay, Critique or justify with pros and cons.

**Create (K6)**- Check knowledge in specific or offbeat situations, Discussion, Debating, Presentation

**Mapping with Programme Outcomes:**

|      | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 |
|------|------|------|------|------|------|------|------|------|------|-------|
| CO 1 | S    | L    | M    | S    | M    | M    | M    | M    | M    | M     |
| CO 2 | S    | S    | S    | S    | M    | M    | M    | M    | M    | S     |
| CO 3 | S    | M    | S    | S    | M    | S    | S    | S    | S    | S     |
| CO 4 | S    | L    | M    | M    | M    | M    | S    | M    | M    | S     |
| CO 5 | S    | S    | S    | S    | S    | S    | S    | S    | S    | S     |

**S-Strong M-Medium L-Low**

|                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|--------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Course</b>                  | <b>CORE PAPER – XII P</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| <b>Title of the Course:</b>    | <b>LABORATORY COURSE ON CLINICAL BIOCHEMISTRY</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| <b>Credits:</b>                | <b>4 - - Hrs 5</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| <b>Pre-requisites, if any:</b> | Knowledge on basic principles, Instrumentation of Biochemical techniques and metabolic reactions                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| <b>Course Objectives</b>       | <ol style="list-style-type: none"> <li>1. To instill skill in students enabling them to apprehend the wider knowledge about principles and techniques to be employed for the investigation of biological samples, clinical approach, normal values of biochemical constituents and clinical interpretations.</li> <li>2. To inculcate the knowledge of collection, preservation of blood sample and learning various hematological parameters and their significance.</li> <li>3. To perform experiments to assess liver functions. And also to study the marker enzymes of liver</li> <li>4. To evaluate lipid profile and assess their relation to cardiac function.</li> <li>5. To perform experiments to estimate blood glucose and glycosylated hemoglobin.</li> <li>6. To perform urine analysis, estimate BUN and clearance test to assess renal function .</li> <li>7. To learn basic immuno techniques antigen –antibody reactions.</li> <li>8. To perform data analysis in using MS Excel</li> <li>9. To introduce visit to hospital so that students may be aware of Phlebotomy ,Collection and storage of specimen, Good laboratory practices, Automation and current methods adopted in the diagnostic labs</li> </ol> |
| <b>Course Outcomes</b>         | <p>After completion of the course, the students should be able to:</p> <p><b>CO1.</b>The student will be able to acquire knowledge and skill in hematology techniques. They will get familiar with methods and knowledge to interpret the electrolyte concentration in serum (K1,K2,K3,K4,K5)</p> <p><b>CO2.</b> The student will be able to assess the Liver Function and interpret the biochemical investigation in a given clinical situation (K1,K2,K3,K4,K5)</p> <p><b>CO3.</b>Skill to perform the Renal function test to assess the function of Kidney and report the abnormal parameters with reference range will be achieved by the student (K1,K2,K3,K4,K5)</p> <p><b>CO4.</b> To estimate the blood glucose content and lipid profile , to evaluate the alterations and record the observation in accordance to reference range will be acquired by the student (K1,K2,K3,K4,K5,K6)</p>                                                                                                                                                                                                                                                                                                                                 |

|                                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
|----------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                        | <b>CO5:</b> The Group Experiments will support them to acquire practical skills to work in health care sector and assist them to understand the automation process in clinical labs (K1,K2,K3,K4,K5,K6)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| <b>Units</b>                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| <b>I</b>                               | Haematology:<br>RBC count, WBC count – total and differential count, ESR, PCV, MCV. Bleeding Time, Clotting Time and Estimation of hemoglobin.<br>Determination of Electrolytes :Sodium, Potasium and Calcium                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| <b>II</b>                              | Liver function test:<br>Estimation of bilirubin – direct and indirect. Estimation of plasma protein, A/G ratio, Thymol turbidity test, Prothrombin Time (PT), Assay of serum glutamate oxaloacetate transaminase, alkaline phosphatase, Gamma-glutamyltransferase (GGT), isoenzyme separation of LDH by electrophoresis.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| <b>III</b>                             | Renal function test:<br>Collection and Preservation of Urine sample<br>Qualitative tests for normal and pathological components of urine.<br>BUN: Estimation of blood Urea, creatinine, and uric acid.<br>Urea Clearance test                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| <b>IV</b>                              | Estimation of blood glucose by orthotoluidine and glucose oxidase method. Determination of glycosylated Hb. Glucose tolerance test. Kit method<br>Lipid profile:<br>Estimation of cholesterol by Zak's method, lipoprotein profile, estimation of ketone bodies, estimation of triglycerides, free fatty acids and phospholipids.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| <b>V</b>                               | Group Experiments<br>a. Antigen – Antibody Reaction - HCG kit method , RA kit method<br>b. Phlebotomy –Venipuncture , Different techniques of venipuncture<br>c. Collection of blood ,Serum or Plasma separation and Storage<br>d. Automation in Clinical Biochemistry -Autoanalyser ,Semiautoanalyser                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| <b>Reading List (Print and Online)</b> | <ol style="list-style-type: none"> <li><a href="https://www.researchgate.net/publication/260182512_Practical_Manual_in_Biochemistry_and_Clinical_Biochemistry">https://www.researchgate.net/publication/260182512_Practical_Manual_in_Biochemistry_and_Clinical_Biochemistry</a></li> <li><a href="https://main.icmr.nic.in/sites/default/files/upload_documents/GCLP_Guidelines_2020_Final.pdf">https://main.icmr.nic.in/sites/default/files/upload_documents/GCLP_Guidelines_2020_Final.pdf</a><a href="https://www.westgard.com/cli.html">https://www.westgard.com/cli.html</a></li> <li><a href="https://www.researchgate.net/publication/263929434_Biochemistry">https://www.researchgate.net/publication/263929434_Biochemistry</a></li> <li><a href="https://ucms.ac.in/Lectures-C-2020/Renal%20function%20Tests%20-%20PPT.pdf">https://ucms.ac.in/Lectures-C-2020/Renal%20function%20Tests%20-%20PPT.pdf</a></li> <li><a href="https://youtu.be/i2PfjEks4GQ">https://youtu.be/i2PfjEks4GQ</a></li> <li><a href="https://www.euro.who.int/__data/assets/pdf_file/0005/268790/WHO-guidelines-on-drawing-blood-best-practices-in-phlebotomy-Eng.pdf">https://www.euro.who.int/__data/assets/pdf_file/0005/268790/WHO-guidelines-on-drawing-blood-best-practices-in-phlebotomy-Eng.pdf</a></li> </ol> |

|                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
|--------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Self-Study</b>        | 1. Laboratory handling of human biological specimen<br>2. Automation in Clinical Biochemistry                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| <b>Recommended Texts</b> | 1. Practical Clinical Biochemistry- Varley's by Alan H Gowenlock, published by CBS Publishers and distributors, India Sixth Edition, 1988.<br>2. Manipal Manual of Clinical Biochemistry (For Med.Lab.And Msc Stud.) 2013 (4 Edition )<br>3. Case Oriented Approach in Biochemistry-Dr. Rajesh Kawaduji Jambhulkar, Dr. Abhijit D. Ninghot: 2019 First Edition<br>4. Medical Lab Technology Vol I& II, Kanai L Mukerjee New Delhi: Tata Mcgraw Hill Publishing Company, 1996.<br>5. Practical Biochemistry – Plummer, New Delhi: Tata Mcgraw Hill Publishing Company, 2000.<br>6. Introductory practical Biochemistry – S.K. Sawhney, Randhir Singh, 2nd ed, 2005. |

**Method of Evaluation:**

| Test I | Test II | Assignment | End Semester Examination | Total | Grade |
|--------|---------|------------|--------------------------|-------|-------|
| 10     | 10      | 5          | 75                       | 100   |       |

**Methods of assessment:**

**Recall (K1)** - Simple definitions, MCQ, Recall steps, Concept definitions.

**Understand/ Comprehend (K2)** - MCQ, True/False, Short essays, Concept explanations, Short summary or overview.

**Application (K3)** - Suggest idea/concept with examples, Solve problems, Observe, Explain.

**Analyse (K4)** – Problem-solving questions, Finish a procedure in many steps, Differentiate between various ideas.

**Evaluate (K5)** - Longer essay/ Evaluation essay, Critique or justify with pros and cons

**Create(K6)** – Check knowledge in specific or offbeat situations. Discussion.

**Mapping with Programme Outcomes:**

|      | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 |
|------|------|------|------|------|------|------|------|------|------|-------|
| CO 1 | S    | S    | S    | S    | M    | S    | L    | S    | M    | S     |
| CO 2 | S    | S    | S    | S    | M    | S    | L    | S    | M    | S     |
| CO 3 | S    | S    | S    | S    | M    | S    | M    | S    | M    | S     |
| CO 4 | S    | S    | S    | S    | M    | S    | M    | S    | S    | S     |
| CO 5 | S    | S    | S    | S    | S    | S    | S    | S    | S    | S     |

**S-Strong M-Medium L-Low**

|                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
|-----------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Course</b>               | <b>CORE BASED ELECTIVE PAPER II</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| <b>Title of the Course:</b> | <b>ENERGY AND DRUG METABOLISM</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| <b>Credits:</b>             | <b>3 - - Hrs 4</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| <b>Pre-requisites</b>       | Basic knowledge on biochemical reactions such as addition, deletion, rearrangement, transfer and breaking of bonds                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| <b>Course Objectives</b>    | <ol style="list-style-type: none"> <li>1. Familiarize on concepts of enthalpy, entropy, free energy, redox system, biological oxidation and high energy compounds</li> <li>2. Provide an insight into the relationship between electron flow and phosphorylation</li> <li>3. Inculcate knowledge on processes involved in converting light energy to chemical energy and associated food production by autotrophs</li> <li>4. Provide a platform to understand the versatile role of Krebs cycle, transport of NADH across mitochondrial membrane and energetics</li> <li>5. Educate on the various phases xenobiotic metabolism</li> </ol>                                                                                                                                                                                                                                                       |
| <b>Course Outcomes</b>      | <p><b>On successful completion of this course, students should be able to:</b></p> <p>After completion of the course, the students should be able to:</p> <p><b>CO1.</b> Appreciate the relationship between free energy and redox potential and will be able to justify the role of biological oxidation and energy rich compounds in maintaining the energy level of the system <b>(K1,K2,K3,K4)</b></p> <p><b>CO2.</b> Gain knowledge on role of mitochondria in the production of energy currency of the cell <b>(K1, K2, K5, K6)</b></p> <p><b>CO3.</b> Acquaint with the process of photosynthesis <b>(K1,K2,K5)</b></p> <p><b>CO4.</b> Comprehend on the diverse role of TCA cycle and the energy obtained on complete oxidation of glucose and fatty acid <b>(K1,K2,K4,K5)</b></p> <p><b>CO5.</b> Correlate the avenues available to metabolize the xenobiotics <b>(K1, K2,K4,K5)</b></p> |
| <b>Units</b>                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| <b>I</b>                    | Thermodynamic- principles in biology- Concept of entropy, enthalpy and free energy change. Redox systems. Redox potential and calculation of free energy. Biological oxidation – Oxidases, dehydrogenases, hydroperoxidases, oxygenases. Energy rich compounds – phosphorylated and non-phosphorylated. High energy linkages.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |

|                                            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
|--------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>II</b>                                  | Electron transport chain-various complexes of ETC, Q-cycle. Inhibitors of ETC. Oxidative phosphorylation-P/O ratio, chemiosmotic theory. Mechanism of ATP synthesis - role of F <sub>0</sub> -F <sub>1</sub> ATPase, ATP-ADP cycle. Inhibitors of oxidative phosphorylation ionophores, protonophores. Regulation of oxidative phosphorylation                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| <b>III</b>                                 | Light reaction-Hills reaction, absorption of light, photochemical event. Photo ETC-cyclic and non-cyclic electron flow. Photophosphorylation-role of CF <sub>0</sub> -CF <sub>1</sub> ATPase. Dark reaction- Calvin cycle, control of C <sub>3</sub> pathway, and Hatch-Slack pathway (C <sub>4</sub> pathway), Photorespiration. Synthesis and degradation of starch                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| <b>IV</b>                                  | Interconversion of major food stuffs. Energy sources of brain, muscle, liver, kidney and adipose tissue. Amphibolic nature of Citric acid cycle. Anaplerotic reaction. Krebs cycle, Inhibitors and regulation of TCA cycle. Transport of extra mitochondrial NADH – Glycerophosphate shuttle, malate aspartate shuttle. Energetics of metabolic pathways – glycolysis, (aerobic and anaerobic) ,citric acid cycle, beta oxidation                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| <b>V</b>                                   | Activation of sulphate ions – PAPS, APS, SAM and their biological role. Metabolism of xenobiotics – Phase I reactions – hydroxylation, oxidation and reduction. Phase II reactions – glucuronidation, sulphation, glutathione conjugation, acetylation and methylation. Mode of action and factors affecting the activities of xenobiotic enzymes.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| <b>Reading List<br/>(Print and Online)</b> | <ol style="list-style-type: none"> <li>1. <a href="https://chemed.chem.purdue.edu/genchem/topicreview/bp/ch21/gibbs.php">https://chemed.chem.purdue.edu/genchem/topicreview/bp/ch21/gibbs.php</a></li> <li>2. <a href="https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7767752/#:~:text=The%20mitochondrial%20electron%20transport%20chain,cellular%20ATP%20through%20oxidative%20phosphorylation.">https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7767752/#:~:text=The%20mitochondrial%20electron%20transport%20chain,cellular%20ATP%20through%20oxidative%20phosphorylation.</a></li> <li>3. <a href="https://www.researchgate.net/figure/Oxidative-phosphorylation-in-mitochondrial-electron-transport-chain-ETC-and-proton_fig1_230798915">https://www.researchgate.net/figure/Oxidative-phosphorylation-in-mitochondrial-electron-transport-chain-ETC-and-proton_fig1_230798915</a></li> <li>4. <a href="https://www.lyndhurstschools.net/userfiles/84/Classes/851/photosynthesis%20light%20&amp;%20dark%20reactions%20ppt.pdf?id=560837">https://www.lyndhurstschools.net/userfiles/84/Classes/851/photosynthesis%20light%20&amp;%20dark%20reactions%20ppt.pdf?id=560837</a></li> <li>5. <a href="https://bajan.files.wordpress.com/2010/05/amphibolic-nature-of-krebs-cycle.pdf">https://bajan.files.wordpress.com/2010/05/amphibolic-nature-of-krebs-cycle.pdf</a></li> <li>6. <a href="https://www.sciencedirect.com/topics/medicine-and-dentistry/xenobiotic-metabolism#:~:text=Xenobiotic%20metabolism%20can%20be%20defined,more%20readily%20excreted%20hydrophilic%20metabolites">https://www.sciencedirect.com/topics/medicine-and-dentistry/xenobiotic-metabolism#:~:text=Xenobiotic%20metabolism%20can%20be%20defined,more%20readily%20excreted%20hydrophilic%20metabolites</a></li> </ol> |
| <b>Self-Study</b>                          | <ol style="list-style-type: none"> <li>1. Calculation of Keq and <math>\Delta G</math></li> <li>2. Interrelationship of carbohydrate, protein, and fat metabolism-role of acetyl CoA</li> </ol>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |

|                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
|--------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Recommended Texts</b> | <ol style="list-style-type: none"> <li>1. David L. Nelson and Michael M. Cox (2012) Lehninger Principles of Biochemistry (6th ed), W.H. Freeman</li> <li>2. Robert K. Murray, Darryl K. Granner, Peter A. Mayes, and Victor W. Rodwell (2012), Harper's Illustrated Biochemistry, (29th ed), McGraw-Hill Medical</li> <li>3. Metzler D.E (2003). The chemical reactions of living cells (2nd ed), Academic Press.</li> <li>4. Zubay G.L (1999) Biochemistry , (4th ed), Mc Graw-Hill.</li> <li>5. Devlin RM (1983) Plant Physiology (4th ed), PWS publishers</li> <li>6. Taiz L , Zeiger E (2010), Plant Physiology (5th ed), Sinauer Associates, Inc</li> </ol> |
|--------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

**Method of Evaluation:**

| Test I | Test II | Assignment | End Semester Examination | Total | Grade |
|--------|---------|------------|--------------------------|-------|-------|
| 10     | 10      | 5          | 75                       | 100   |       |

**Methods of assessment:**

**Recall (K1)** - Simple definitions, MCQ, Recall steps, Concept definitions.

**Understand/ Comprehend (K2)** - MCQ, True/False, Short essays, Concept explanations, Short summary or overview.

**Application (K3)** - Suggest idea/concept with examples, Solve problems, Observe, Explain.

**Analyse (K4)**- Problem-solving questions, Finish a procedure in many steps, Differentiate between various ideas

**Evaluate (K5)** - Longer essay/ Evaluation essay, Critique or justify with pros and cons.

**Create (K6)**- Check knowledge in specific or offbeat situations, Discussion.

**Mapping with Programme Outcomes:**

|      | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 |
|------|------|------|------|------|------|------|------|------|------|-------|
| CO 1 | S    | S    | S    | M    | S    | M    | S    | S    | S    | M     |
| CO 2 | S    | S    | S    | S    | S    | S    | S    | S    | S    | S     |
| CO 3 | S    | S    | S    | S    | S    | S    | S    | S    | S    | S     |
| CO 4 | S    | M    | S    | M    | S    | M    | S    | S    | S    | L     |
| CO 5 | S    | M    | S    | S    | S    | M    | S    | S    | S    | S     |

**S-Strong M-Medium L-Low**



|                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|--------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Course</b>                  | <b>CORE BASED ELECTIVE PAPER III</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| <b>Title of the Course:</b>    | <b>BIOSAFETY, LAB SAFETY AND FIRST AID</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| <b>Credits:</b>                | <b>3 - - Hrs 4</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| <b>Pre-requisites, if any:</b> | The student should have a basic knowledge of hazards associated with the handling of biological agents and importance of intellectual property from scientific research.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| <b>Course Objectives</b>       | <ol style="list-style-type: none"> <li>1. To assimilate the hazards associated with the handling of biological and chemical agents.</li> <li>2. To understand how to protect from the hazards by the implementation of various safety measures in biochemical laboratories.</li> <li>3. To implicate the importance of protecting the scientific intellect by filing patent and understand the various offices for filing and maintaining patents</li> <li>4. To understand the scope of patenting in biological research.</li> <li>5. To create an awareness of ethics associated with used of genetically modified organisms/cells and its rationale for use in living organisms.</li> </ol>                                                                                                                                           |
| <b>Course Outcomes</b>         | <p>After completion of the course, the students should be able to:</p> <p><b>CO1.</b> To understand and implement various aspects of biosafety and carry out risk assessment of products in biological research</p> <p><b>CO2.</b> Understand the basic concepts of ethics and safety that are essential for different disciplines of science and procedures involved and protection of intellectual property and related rights.</p> <p><b>CO3.</b> To appreciate the intellectual property rights and its implementation of on the invention related to biological research.</p> <p><b>CO4.</b> To understand the statutory bodies that regulates the property rights and its validity in various countries.</p> <p><b>CO5.</b> Critique the ethical concerns associated with modern biotechnology processes and plan accordingly.</p> |

| <b>Units</b>                               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
|--------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>I</b>                                   | Biosafety: Historical background; introduction to biological safety cabinets; primary containment for biohazards; biosafety levels; recommended biosafety levels for infectious agents and infected animals;                                                                                                                                                                                                                                                                                              |
| <b>II</b>                                  | biosafety guidelines - government of India, roles of IBSC, RCGM, GEAC etc. for GMO applications in food and agriculture; environmental release of GMOs; risk assessment; risk management and communication; national regulations and international agreements.                                                                                                                                                                                                                                            |
| <b>III</b>                                 | Laboratory safety - Chemical, electrical and fire hazards; handling and manipulating human or animal cells and tissues, toxic, corrosive or mutagenic solvents and reagents; mouth pipetting, and inhalation exposures to infectious aerosols, Safe handling of syringe needles or other contaminated sharps, spills and splashes onto skin and mucous membranes. Health aspects; toxicology, allergenicity, antibiotic resistance.                                                                       |
| <b>IV</b>                                  | History of biosafety microbiology and molecular biology, Risk assessment, Personal protective equipment, Laboratory facilities and safety equipment, Disinfection, decontamination, and sterilization, Regulatory compliance, Laboratory security and emergency response and administrative controls.                                                                                                                                                                                                     |
| <b>V</b>                                   | <b>Essentials Methods of First Aid</b><br>First aid tips for burns, cuts and scalds- First aid tips for Eyes- First aid tips for head injury- First aid tips for poisons- priorities for First Aid – First Aid needs and assessment                                                                                                                                                                                                                                                                       |
| <b>Self-Study</b>                          | 1. Review of drug patent documents<br>2. Safety in biological research laboratories                                                                                                                                                                                                                                                                                                                                                                                                                       |
| <b>Reading List<br/>(Print and Online)</b> | 1. V. Shree Krishna, (2007). Bioethics and Biosafety in Biotechnology, New Age International Pvt. Ltd. Publishers. (Unit III, Unit IV and Unit V)<br>2. Deepa Goel, Shomini Parashar, (2013). IPR, Biosafety and Bioethics, Pearson. (Unit II)<br>3. R. Ian Freshney, 2016. Culture of Animal Cells: A Manual of Basic Technique and Specialized Applications, 6th Ed, John Wiley & Blackwell.<br>4. BAREACT, Indian Patent Act 1970 Acts & Rules, Universal Law Publishing Co. Pvt. Ltd., 2007. (Unit I) |

**Recommended Texts**

1. Biosafety in Microbiological and Biomedical Laboratories, (2020) 6th Ed. ([https://www.cdc.gov/labs/pdf/SF\\_\\_19\\_308133-A\\_BMBL6\\_00-BOOK-WEB-final3.pdf](https://www.cdc.gov/labs/pdf/SF__19_308133-A_BMBL6_00-BOOK-WEB-final3.pdf))
2. Kankanala C., (2007), Genetic Patent Law & Strategy, 1st Edition, Manupatra Information Solution Pvt. Ltd.,

**Method of Evaluation:**

| Test I | Test II | Assignment | End Semester Examination | Total | Grade |
|--------|---------|------------|--------------------------|-------|-------|
| 10     | 10      | 5          | 75                       | 100   |       |

**Methods of assessment:**

**Recall (K1)** - Simple definitions, MCQ, Recall steps, Concept definitions.

**Understand/ Comprehend (K2)** - MCQ, True/False, Short essays, Concept explanations, Shortsummary or overview.

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**Analyse (K4)** – Problem-solving questions, Finish a procedure in many steps, Differentiate between various ideas.

**Evaluate (K5)** - Longer essay/ Evaluation essay, Critique or justify with pros and cons

**Create(K6)** – Check knowledge in specific or offbeat situations. Discussion.

**Mapping with Programme Outcomes:**

|      | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 |
|------|------|------|------|------|------|------|------|------|------|-------|
| CO 1 | S    | S    | S    | M    | S    | M    | S    | S    | S    | S     |
| CO 2 | S    | S    | S    | L    | M    | M    | S    | S    | S    | S     |
| CO 3 | S    | M    | M    | M    | S    | M    | S    | S    | S    | M     |
| CO 4 | S    | M    | M    | L    | S    | L    | S    | S    | S    | M     |
| CO 5 | S    | S    | S    | L    | S    | M    | S    | S    | S    | S     |

**S-Strong M-Medium L-Low**

|                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|--------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Course</b>                  | <b>NON MAJOR ELECTIVE PAPER –II</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| <b>Title of the Course:</b>    | <b>BIostatistics &amp; Data Science</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| <b>Credits:</b>                | <b>2 - - Hrs 3</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| <b>Pre-requisites, if any:</b> | Basic knowledge of Statistics and Data Sciences                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| <b>Course Objectives</b>       | <ol style="list-style-type: none"> <li>1. To summarize the data and to obtain its salient features from the vast mass of original data.</li> <li>2. To understand the concept of various measures of dispersion.</li> <li>3. To understand the concepts of sampling and learning test of significance.</li> <li>4. To understand the concept of various attributes and relate to biological studies.</li> <li>5. To gain knowledge in SPSS, a software package which gives a perfect graphical representation and appropriate result for the data that has been entered</li> </ol>                                                                                                                                                                                                                                                                                                    |
| <b>Course Outcomes</b>         | <p>After completion of the course, the students should be able to:</p> <p><b>CO1:</b> Concepts of statistical population and sample, variables and attributes. Tabular and graphical representation of data based on variables.(K1,K2,K3)</p> <p><b>CO2:</b>Conditions for the consistency' and criteria for the independence of data based on attributes. Measures of central tendency, Dispersion, Skewness and Kurtosis.(K1,K2,K3)</p> <p><b>CO3:</b>Learning different sampling methods and analysing statistical significance.(K1,K2,K3,K4)</p> <p><b>CO4:</b> Understanding students t test , ANOVA , Chi square test to analyse the significance of various research. (K1,K2,K3,K4)</p> <p><b>CO5:</b> Learning on data science, algorithm for machine learning, artificial intelligence and big data, their applications in clinical and pharma domain . (K1,K2,K3,K4.K6)</p> |
| <b>Units</b>                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |

|                                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|----------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| I                                      | Nature of biological and clinical experiments – Collection of data in experiment- Primary and secondary data. Methods of data collection. Classification and tabulation. Different forms of diagrams and graphs related to biological studies. Measures of Averages- Mean, Median, and mode. Use of these measures in biological studies.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| II                                     | Measures of Dispersion for biological characters – Mean deviation, Standard deviation and coefficient of variation. Correlation and regression – Rank correlation – Regression equation. Simple problems based on biochemical data.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| III                                    | Basic concepts of sampling- Simple random sample and systemic sampling. Sampling distribution and standard error. Test of significance based on large samples. Test for mean, difference of means, proportions and equality of proportions.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| IV                                     | Small sample tests – Students't' test for mean, difference of two way means, tests for correlation and regression coefficients. Chi-square test for goodness of a non independence of attributes. F test for equality of variances. ANOVA- one way and two way. Basic concept related to biological studies,SPSS.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| V                                      | Introduction to Data Science, Definition of data science, importance, and basic applications, Machine Learning Algorithms, Deep Learning, Artificial Neural Networks and their Application, Reinforcement Learning, Natural Language Processing Artificial Intelligence (AI), Data Visualization, Data Analysis, Optimization Techniques, Big Data, Predictive Analysis. Application of AI in medical, health and pharma industries.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| <b>Reading List (Print and Online)</b> | <ol style="list-style-type: none"> <li>1. <a href="https://www.ibm.com/docs/en/SSLVMB_28.0.0/pdf/Accessibility.pdf">https://www.ibm.com/docs/en/SSLVMB_28.0.0/pdf/Accessibility.pdf</a></li> <li>2. <a href="https://pure.tue.nl/ws/portalfiles/portal/19478370/20160419_CO_Mzolo.pdf">https://pure.tue.nl/ws/portalfiles/portal/19478370/20160419_CO_Mzolo.pdf</a></li> <li>3. <a href="https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5453888/">https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5453888/</a></li> <li>4. <a href="https://home.ubalt.edu/ntsbarsh/excel/excel.htm">https://home.ubalt.edu/ntsbarsh/excel/excel.htm</a></li> <li>5. <a href="https://students.shu.ac.uk/lits/it/documents/pdf/analysing_data_using_spss.pdf">https://students.shu.ac.uk/lits/it/documents/pdf/analysing_data_using_spss.pdf</a></li> <li>6. <a href="https://www.ibm.com/support/pages/ibm-spss-statistics-28-documentation">https://www.ibm.com/support/pages/ibm-spss-statistics-28-documentation</a></li> </ol> |
| <b>Self-Study</b>                      | <ol style="list-style-type: none"> <li>1.Simple problems on probability, theoretical distributions, hypothesis testing</li> <li>2. Relationship between mean, median and mode pros and cons of the measures of central tendency and deviation</li> </ol>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| <b>Recommended Texts</b>               | <ol style="list-style-type: none"> <li>1. Zar, J.H. (1984) "Bio Statistical Methods", Prentice Hall, International Edition</li> <li>2. Sundar Rao P. S.S., Jesudian G. &amp; Richard J. (1987), "An Introduction to Biostatistics", 2nd edition,. Prestographik, Vellore, India,.</li> <li>3. Warren,J; Gregory,E; Grant,R (2004), "Statistical Methods in Bioinformatics",1st edition,Springer</li> </ol>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |

|  |                                                                                                                                                                                                                                                                                |
|--|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|  | <p>4. Milton,J.S.(1992),. "Statistical methods in the Biological and Health Sciences", 2nd edition ,Mc Graw Hill,</p> <p>5. Rosner,B (2005), "Fundamentals of Biostatistics", Duxbury Press</p> <p>6. Introducing Data Science, Davy Cielen, Anro DB Meysman, Mohamed Ali.</p> |
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**Method of Evaluation:**

| Test I | Test II | Assignment | End Semester Examination | Total | Grade |
|--------|---------|------------|--------------------------|-------|-------|
| 10     | 10      | 5          | 75                       | 100   |       |

**Methods of assessment:**

**Recall (K1)** - Simple definitions, MCQ, Recall steps, Concept definitions.

**Understand/ Comprehend (K2)** - MCQ, True/False, Short essays, Concept explanations, Short summary or overview.

**Application (K3)** - Suggest idea/concept with examples, Solve problems, Observe, Explain

**Analyse (K4)** - Problem-solving questions, Finish a procedure in many steps, Differentiate between various ideas

**Evaluate (K5)** - Longer essay/ Evaluation essay, Critique or justify with pros and cons

**Create (K6)** - Check knowledge in specific or off beat situations, Discussion, Presentations

**Mapping with Programme Outcomes:**

|      | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 |
|------|------|------|------|------|------|------|------|------|------|-------|
| CO 1 | S    | S    | S    | S    | M    | S    | L    | S    | S    | S     |
| CO 2 | S    | S    | S    | S    | M    | S    | L    | S    | S    | S     |
| CO 3 | S    | S    | S    | S    | S    | S    | M    | S    | S    | S     |
| CO 4 | S    | S    | S    | S    | S    | S    | M    | S    | S    | S     |
| CO 5 | S    | S    | S    | S    | S    | S    | M    | S    | S    | S     |

**S-Strong      M-Medium      L-Low**

|                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|--------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Course</b>                  | <b>SKILL ENHANCEMENT PAPER- III</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| <b>Title of the Course:</b>    | <b>INDUSTRIAL VISIT – BIOTECH INDUSTRY</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| <b>Credits:</b>                | <b>2- - Hrs 2</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| <b>Pre-requisites, if any:</b> | Knowledge of Human Physiology, Metabolism and Clinical Biochemistry                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| <b>Course Objectives</b>       | <p>1.To understand the concepts of the mechanisms involved in regulation of blood sugar and management of diabetes mellitus</p> <p>2.To gain in-depth knowledge of the mechanisms of cancer and of tumor metastasis</p> <p>3.The student will review the basic organization of the central and peripheral nervous system that coordinate the sensory and motor functions of the body. In addition, the student will explore impaired features underlying the major neuropathological complications.</p> <p>4.To gain knowledge in renal diseases</p> <p>5.To understand the mechanisms involved in cardiac disorders</p>                                                                                                                                                                                                                        |
| <b>Course Outcomes</b>         | <p><b>On completion of this course the student will be able to understand</b></p> <p><b>CO1.</b>Overall view about the complications of diabetes mellitus and its management.</p> <p><b>CO2.</b>Comprehensive understanding of the concepts of cancer biology and implicating the theoretical concepts for further research</p> <p><b>CO3.</b>Understand and appreciate the pathophysiology of conditions affecting the nervous system.</p> <p><b>CO4.</b>A thorough knowledge of renal and cardiac diseases with emphasis related to mechanistic aspects and therapeutic interventions.</p> <p><b>CO5.</b> A thorough knowledge on the experimental models of non-communicable diseases that will be applied for future research or project dissertation. An in-depth knowledge on development of drugs against non-communicable diseases.</p> |

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|--------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Course I</b>                | <b>CORE PAPER – XIII</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| <b>Title of the Course:</b>    | <b>PHARMACEUTICAL BIOCHEMISTRY</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| <b>Credits:</b>                | <b>4 - - Hrs 6</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| <b>Pre-requisites, if any:</b> | The student should have a basic knowledge of drug discovery and development. Student should possess basic knowledge bioinformatics to understand and correlate the drug development process.                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| <b>Course Objectives</b>       | <ol style="list-style-type: none"> <li>1. To understand the different types of bioinformatic tools for drug discovery.</li> <li>2. To get an overview of how different bioinformatic tools aid in the process of target identification, drug screening and quantitative structure activity relationship.</li> <li>3. To assimilate the involvement of different metabolic pathways involved in drug metabolism and correlate their involvement in elimination process</li> <li>4. To understand the biochemical basis of drug action at the target tissue.</li> <li>5. To understand different phases in drug clinical trials and its assessment.</li> </ol> |
| <b>Course Outcomes</b>         | <p>After completion of the course, the students should be able to:</p> <p><b>CO1.</b> To understand and explain the basic concepts of drug discovery and drug development process.</p> <p><b>CO2.</b> To review the different software and computational tools which aid in the design of drugs and its rationalization.</p> <p><b>CO3.</b> To analyze the different stages of the drug discovery process with the target &amp; hit identification, assays for drug screening and preclinical studies.</p> <p><b>CO4.</b> To understand the various phases of the clinical trails and the method of conduct of clinical trails.</p>                          |
| <b>Units</b>                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| <b>I</b>                       | Special emphasis on cell-based assay, biochemical assay, radiological binding assay, Pharmacological assay, In vitro, In vivo & Ex-vivo experiments, lead optimization, preclinical studies.                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| <b>II</b>                      | Bioinformatics approaches for drug development:<br>Identification of potential molecules, chemical compound library preparation, Identification of target in pathogen, Ligand & protein preparation, Molecular docking, High throughput virtual screening, Docking protocol validation and enrichment analysis, Pharmacokinetics                                                                                                                                                                                                                                                                                                                             |



|                                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|----------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                        | and Pharmacodynamics, ADME & toxicity prediction, Rule of three and five, Lipinsky rule, Pharmacophore development, 3D-QSAR, Techniques of developing a pharmacophore map covering both ligand based and receptor based approaches.                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| <b>III</b>                             | Drug metabolism & interactions:<br>Drug-receptor interactions, receptor theories and drug action, Xenobiotics, xenobiotics phases (Phase-I, Phase-II and Phase-III), role of cytochrome P450 oxidases and glutathione S-transferases in drug metabolism, factors affecting drug metabolism, Enzymes as a drug target, Kinase inhibitors, ATPase inhibitors, drug protein interaction, Drug DNA interaction. Basic ligand concepts-agonist, antagonist, partial agonist, inverse agonist, efficiency and potency. Forces involved in drug-receptor complexes. Receptor classification – the four super families. Receptor binding assays-measurement of K <sub>d</sub> , B <sub>max</sub> and IC <sub>50</sub> . |
| <b>IV</b>                              | Biochemical mode of action of antibiotics- penicillin and chloramphenicol, actions of alkaloids, antiviral and antimalarial substances. Biochemical mechanism of drug resistance- sulphonamides. Drug potency and drug efficacy. General principles of chemotherapy. Introduction to immunomodulators and chemotherapy of cancer.                                                                                                                                                                                                                                                                                                                                                                               |
| <b>V</b>                               | Clinical trials (Phase-I, Phase-II, Phase-III and Phase-IV clinical trial). Main features of clinical trials, including methodological and organizational considerations and the principles of trial conduct and reporting. Key designs surrounding design, sample size, delivery and assessment of clinical trials.                                                                                                                                                                                                                                                                                                                                                                                            |
| <b>Self-Study</b>                      | <ol style="list-style-type: none"> <li>1. Examples of pharmaceutical development of a drug</li> <li>2. Basic pharmacology of drug action and kinetics</li> </ol>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| <b>Reading List (Print and Online)</b> | <ol style="list-style-type: none"> <li>1. Textbook of Drug Design. Krogsgaard-Larsen, Liljefors and Madsen (Editors), Taylor and Francis, London UK, 2002.</li> <li>2. Drug Discovery Handbook S.C. Gad (Editor) Wiley-Interscience Hoboken USA, 2005</li> </ol>                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| <b>Recommended Texts</b>               | <ol style="list-style-type: none"> <li>1. Practical Application of Computer-Aided Drug Design, Ed. Charifson P., Marcel Dekker Inc.</li> <li>2. 3D QSAR in Drug Design: Theory, Methods and Applications, Ed. Kubinyi H., Ledien</li> <li>3. Pharmaceutical Profiling in Drug Discovery for Lead Selection, Borchardt RT, Kerns, EH, Lipinski CA, Thakker DR and Wang B, AAPS Press, 2004</li> <li>4. Drug Discovery and Development; Technology in Transition. HP Rang. Elsevier Ltd 1st edition 2006.</li> <li>5. Pharmacology in Drug Discovery. T. P. Kenakin. Elsevier, 1st Edition</li> </ol>                                                                                                             |

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**Method of Evaluation:**

| Test I | Test II | Assignment | End Semester Examination | Total | Grade |
|--------|---------|------------|--------------------------|-------|-------|
| 10     | 10      | 5          | 75                       | 100   |       |

**Methods of assessment:**

**Recall (K1)** - Simple definitions, MCQ, Recall steps, Concept definitions.

**Understand/ Comprehend (K2)** - MCQ, True/False, Short essays, Concept explanations, Shortsummary or overview.

**Application (K3)** - Suggest idea/concept with examples, Solve problems, Observe, Explain.

**Analyse (K4)** – Problem-solving questions, Finish a procedure in many steps, Differentiate between various ideas.

**Evaluate (K5)** - Longer essay/ Evaluation essay, Critique or justify with pros and cons

**Create(K6)** – Check knowledge in specific or offbeat situations. Discussion.

**Mapping with Programme Outcomes:**

|      | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 |
|------|------|------|------|------|------|------|------|------|------|-------|
| CO 1 | S    | M    | S    | M    | S    | M    | M    | S    | S    | S     |
| CO 2 | S    | S    | S    | M    | M    | S    | S    | S    | S    | S     |
| CO 3 | S    | S    | S    | L    | S    | M    | M    | S    | S    | M     |
| CO 4 | S    | M    | S    | L    | S    | L    | M    | S    | S    | M     |
| CO 5 | S    | S    | S    | L    | S    | M    | M    | S    | S    | S     |

**S-Strong      M-Medium      L-Low**

|                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|--------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Course I</b>                | <b>CORE PAPER – XIV</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| <b>Title of the Course:</b>    | <b>BIOCHEMICAL TOXICOLOGY</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| <b>Credits:</b>                | <b>4 - - Hrs 5</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| <b>Pre-requisites, if any:</b> | The student should have a basic knowledge of pharmacology of drug action and understanding on their biochemical pathways.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| <b>Course Objectives</b>       | <ol style="list-style-type: none"> <li>1. To understand the detailed study of biochemical basis of drugs and its toxicity, particularly their actions on living systems.</li> <li>2. To understand the relevance and methods to identify the chemotherapeutic value of drug.</li> <li>3. To understand the fundamentals of toxicology and dose- response relationships.</li> <li>4. To understand the toxicological drug testing procedures based on in vitro and animal studies</li> <li>5. To understand biochemical pathways of drug toxicity and its manifestation on vital organs.</li> </ol>                                                                                                                                                      |
| <b>Course Outcomes</b>         | <p>On completion of this course, the student will be able</p> <p><b>CO1:</b> To appreciate and understand the role of toxicological biomarkers to assess drug toxicities.</p> <p><b>CO2:</b> To conceive the role of disposition of drug in human system and their metabolism and methodologies pertaining to toxicological studies.</p> <p><b>CO3:</b> To understand and evaluate the functions of different organs on drug disposition and associated drug toxicities.</p> <p><b>CO4 :</b> To understand the toxicological response to foreign compounds and their pharmacological, physiological and biochemical effects.</p> <p><b>CO5:</b> To link the mechanism of toxicity and clinical symptoms with underlying physiological disturbances.</p> |
| <b>Units</b>                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| <b>I</b>                       | <p>Fundamentals of Toxicology and dose-Response Relationships: Introduction Biomarkers Criteria of Toxicity New Technologies ,Dose Response; Measurement of Dose-Response; Relationships Linear Dose Response Hormesis; Hazard and Risk Assessment Duration and Frequency of Exposure and Effect</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                    |

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|--------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>II</b>                                  | Factors Affecting Toxic Responses: Disposition: Absorption ,Sites of absorption, distribution, Excretion; Metabolism: types of Metabolic change phase I reactions; Phase 2 reactions; control of Metabolism, Toxication vs. Detoxication                                                                                                                                                                   |
| <b>III</b>                                 | Toxicity testing; Test protocol, Genetic toxicity testing & Mutagenesis assay: In vitro test systems: Bacterial mutation tests-Ames test and Eukaryotic mutation test. In vivo test system Mammalian mutation test-Host mediated assay and Dominant Lethal test. Biochemical basis of toxicity: Mechanism of toxicity: Disturbance of excitable membrane function, genotoxicity, Tissue specific toxicity. |
| <b>IV</b>                                  | Toxic Responses to Foreign Compounds: Direct Toxic Action: Tissue Lesions; Mechanism and response in cellular toxicity, pharmacological, physiological and Biochemical effects; Developmental Toxicology-Teratogenesis; Immunotoxicity Genetic Toxicity; Chemical Carcinogenesis                                                                                                                           |
| <b>V</b>                                   | Biochemical Mechanisms of Toxicity: Tissue Lesions: Liver Necrosis; Liver damage, kidney Damage; Lung Damage, Cardiac damage; Neurotoxicity; Exaggerated and Unwanted pharmacological effects; Physiological effects; Biochemical Effects: Lethal Synthesis and Incorporation, Immunotoxicity; multi-Organ Toxicity                                                                                        |
| <b>Self-Study</b>                          | • Case studies to review                                                                                                                                                                                                                                                                                                                                                                                   |
| <b>Reading List<br/>(Print and Online)</b> | 1. Preclinical Safety Evaluation of Biopharmaceuticals: A Science-Based Approach to Facilitating Clinical Trials by Joy A. Cavagnaro<br>2. A Comprehensive Guide to Toxicology in Nonclinical Drug Development 2nd Edition by Ali S. Faqi                                                                                                                                                                  |
| <b>Recommended<br/>Texts</b>               | 1. Principles Of Toxicology by: Karen E Stine, Thomas M Brown 2006 Publisher. Crc Press<br>2. Principles of Biochemical Toxicology by John A. Timbrell Publisher: Informa Healthcare<br>3. Environmental Toxicology by Sigmund F. Zakrzewski, (2002) Publisher: Oxford University Press, USA                                                                                                               |

**Method of Evaluation:**

| Test I | Test II | Assignment | End Semester Examination | Total | Grade |
|--------|---------|------------|--------------------------|-------|-------|
| 10     | 10      | 5          | 75                       | 100   |       |

**Methods of assessment:**

**Recall (K1)** - Simple definitions, MCQ, Recall steps, Concept definitions.

**Understand/ Comprehend (K2)** - MCQ, True/False, Short essays, Concept explanations, Shortsummary or overview.

**Application (K3)** - Suggest idea/concept with examples, Solve problems, Observe, Explain.

**Analyse (K4)** – Problem-solving questions, Finish a procedure in many steps, Differentiate between various ideas.

**Evaluate (K5)** - Longer essay/ Evaluation essay, Critique or justify with pros and cons

**Create(K6)** – Check knowledge in specific or offbeat situations. Discussion.

**Mapping with Programme Outcomes:**

|      | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 |
|------|------|------|------|------|------|------|------|------|------|-------|
| CO 1 | S    | S    | S    | L    | S    | L    | M    | M    | M    | M     |
| CO 2 | M    | M    | S    | M    | M    | L    | M    | S    | S    | S     |
| CO 3 | S    | S    | S    | M    | M    | L    | S    | S    | M    | M     |
| CO 4 | S    | M    | S    | M    | M    | M    | S    | S    | M    | M     |
| CO 5 | M    | S    | S    | S    | S    | M    | M    | M    | S    | S     |

**S-Strong      M-Medium      L-Low**

|                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|--------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Course I</b>                | <b>CORE BASED ELECTIVE PAPER IV</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| <b>Title of the Course:</b>    | <b>DEVELOPMENTAL BIOLOGY</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| <b>Credits:</b>                | <b>3 - - Hrs 5</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| <b>Pre-requisites, if any:</b> | Comprehensive Knowledge of Cell Biology                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| <b>Course Objectives</b>       | <p>The candidates undertaking this course will understand the concepts of developmental biology.</p> <ol style="list-style-type: none"> <li>1. To understand the background of developmental biology</li> <li>2. To gain in-depth knowledge of various model organisms</li> <li>3. To gain insight into aspects of stem cell technology</li> <li>4. To gain insights into morphogenesis and organogenesis</li> <li>5. To acquire in-depth understanding of cell death mechanisms and cell fate decision</li> </ol>                                                    |
| <b>Course Outcomes</b>         | <p><b>CO1.</b>Grasp knowledge about the background of developmental biology</p> <p><b>CO2.</b>Gain abundant knowledge about model organisms and gametogenesis</p> <p><b>CO3.</b>Gain knowledge about stem cells and their applications in regenerative therapy</p> <p><b>CO4.</b>Good knowledge about organogenesis</p> <p><b>CO5.</b>Learn the basics of cell death mechanisms and cell fate decision .</p>                                                                                                                                                          |
| <b>Units</b>                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| <b>I</b>                       | Overview of Developmental biology: Background of Developmental biology - Principles of developmental biology –Potency, commitment, specification, induction, competence, determination and differentiation; morphogenetic gradients; cell fate and cell lineages; stem cells; genomic equivalence and the cytoplasmic determinants; imprinting; mutants and transgenics in analysis of development.                                                                                                                                                                   |
| <b>II</b>                      | <p>Model organisms</p> <p>Gametogenesis – production of gametes, Formation of zygote, fertilization and early development: molecules in sperm-egg recognition in animals; embryo sac development and double fertilization in plants; cleavage, blastula formation, embryonic fields, gastrulation and formation of germ layers in animals; embryogenesis, establishment of symmetry in plants; seed formation and germination. <i>Drosophila</i> Developmental biology- Axis formation, Genes &amp; mutation. <i>C.elegans</i> – Vulva formation, Axis formation.</p> |

|                                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
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| <b>III</b>                             | Regeneration Developmental Biology<br>Stem cells – Definition, Classification, Embryonic and adult stem cells, properties, identification, Culture of stem cells, Differentiation and dedifferentiation, Stem cell markers, techniques and their applications in modern clinical sciences. Three- dimensional culture and transplantation of engineered cells. Tissue engineering – skin and neuronal tissues.                                           |
| <b>IV</b>                              | Morphogenesis & Organogenesis: Cell aggregation and differentiation in Dictyostelium; axes and pattern formation in Drosophila, amphibia and chick; organogenesis – vulva formation in <i>Caenorhabditis elegans</i> , eye lens formation, limb development and regeneration in vertebrates; differentiation of neurons, post embryonic development- larval formation, metamorphosis; environmental regulation of normal development; sex determination. |
| <b>V</b>                               | Cellular senescence and Cell fate decision<br>Cellular senescence – concepts & Frizzled receptor in Development and disease. Diabetes and developmental biology, Cell death pathways in developments. Markers of important diseases.                                                                                                                                                                                                                     |
| <b>Reading List (Print and Online)</b> | Developmental Biology – Gilbert Scott<br><a href="http://bgc.org.in/pdf/study-material/developmental-biology-7th-ed-sf-gilbert.pdf">http://bgc.org.in/pdf/study-material/developmental-biology-7th-ed-sf-gilbert.pdf</a>                                                                                                                                                                                                                                 |
| <b>Recommended Texts</b>               | Developmental biology: VIII edition, Gilbert, SF; Sinauer Associates, Inc                                                                                                                                                                                                                                                                                                                                                                                |

**Method of Evaluation:**

| Test I | Test II | Assignment | End Semester Examination | Total | Grade |
|--------|---------|------------|--------------------------|-------|-------|
| 10     | 10      | 5          | 75                       | 100   |       |

**Methods of assessment:**

**Recall (K1)** - Simple definitions, MCQ, Recall steps, Concept definitions.

**Understand/ Comprehend (K2)** - MCQ, True/False, Short essays, Concept explanations, Short summary or overview.

**Application (K3)** - Suggest idea/concept with examples, Solve problems, Observe, Explain.

**Analyse (K4)** – Problem-solving questions, Finish a procedure in many steps, Differentiate between various ideas.

**Evaluate (K5)** - Longer essay/ Evaluation essay, Critique or justify with pros and cons

**Create(K6)** – Check knowledge in specific or offbeat situations. Discussion.

**Mapping with Programme Outcomes:**

|      | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 |
|------|------|------|------|------|------|------|------|------|------|-------|
| CO 1 | S    | M    | M    | S    | S    | M    | L    | S    | S    | M     |
| CO 2 | M    | M    | M    | M    | M    | S    | M    | S    | M    | M     |
| CO 3 | M    | M    | L    | M    | M    | S    | L    | S    | L    | L     |
| CO 4 | S    | M    | L    | S    | S    | M    | S    | S    | M    | M     |
| CO 5 | S    | S    | M    | S    | L    | M    | M    | S    | M    | M     |

**S-Strong      M-Medium      L-Low**



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| <b>Course</b>                  | <b>SKILL ENHANCEMENT PAPER- IV</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| <b>Title of the Course:</b>    | <b>INDUSTRIAL VISIT – PHARMA AND FOOD PROCESSING INDUSTRY</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| <b>Credits:</b>                | <b>2 - - Hrs 2</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| <b>Pre-requisites, if any:</b> | Knowledge of Human Physiology, Metabolism and Clinical Biochemistry                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| <b>Course Objectives</b>       | <p>1.To understand the concepts of the mechanisms involved in regulation of blood sugar and management of diabetes mellitus</p> <p>2.To gain in-depth knowledge of the mechanisms of cancer and of tumor metastasis</p> <p>3.The student will review the basic organization of the central and peripheral nervous system that coordinate the sensory and motor functions of the body. In addition, the student will explore impaired features underlying the major neuropathological complications.</p> <p>4.To gain knowledge in renal diseases</p> <p>5.To understand the mechanisms involved in cardiac disorders</p>                                                                                                                                                                                                                        |
| <b>Course Outcomes</b>         | <p><b>On completion of this course the student will be able to understand</b></p> <p><b>CO1.</b>Overall view about the complications of diabetes mellitus and its management.</p> <p><b>CO2.</b>Comprehensive understanding of the concepts of cancer biology and implicating the theoretical concepts for further research</p> <p><b>CO3.</b>Understand and appreciate the pathophysiology of conditions affecting the nervous system.</p> <p><b>CO4.</b>A thorough knowledge of renal and cardiac diseases with emphasis related to mechanistic aspects and therapeutic interventions.</p> <p><b>CO5.</b> A thorough knowledge on the experimental models of non-communicable diseases that will be applied for future research or project dissertation. An in-depth knowledge on development of drugs against non-communicable diseases.</p> |

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| <b>Course</b>                  | <b>EXTENSION ACTIVITY</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| <b>Title of the Course:</b>    | <b>INDUSTRIAL VISIT – PHARMA AND FOOD PROCESSING INDUSTRY</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| <b>Credits:</b>                | <b>1</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| <b>Pre-requisites, if any:</b> | Knowledge of Human Physiology, Metabolism and Clinical Biochemistry                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| <b>Course Objectives</b>       | <p>1.To understand the concepts of the mechanisms involved in regulation of blood sugar and management of diabetes mellitus</p> <p>2.To gain in-depth knowledge of the mechanisms of cancer and of tumor metastasis</p> <p>3.The student will review the basic organization of the central and peripheral nervous system that coordinate the sensory and motor functions of the body. In addition, the student will explore impaired features underlying the major neuropathological complications.</p> <p>4.To gain knowledge in renal diseases</p> <p>5.To understand the mechanisms involved in cardiac disorders</p>                                                                                                                                                                                                                        |
| <b>Course Outcomes</b>         | <p><b>On completion of this course the student will be able to understand</b></p> <p><b>CO1.</b>Overall view about the complications of diabetes mellitus and its management.</p> <p><b>CO2.</b>Comprehensive understanding of the concepts of cancer biology and implicating the theoretical concepts for further research</p> <p><b>CO3.</b>Understand and appreciate the pathophysiology of conditions affecting the nervous system.</p> <p><b>CO4.</b>A thorough knowledge of renal and cardiac diseases with emphasis related to mechanistic aspects and therapeutic interventions.</p> <p><b>CO5.</b> A thorough knowledge on the experimental models of non-communicable diseases that will be applied for future research or project dissertation. An in-depth knowledge on development of drugs against non-communicable diseases.</p> |

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| <b>Course</b>                  | <b>PROJECT</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| <b>Title of the Course:</b>    | <b>PROJECT VIVA VOCE</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| <b>Credits:</b>                | <b>4- - Hrs 12</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| <b>Pre-requisites, if any:</b> | Knowledge of Human Physiology, Metabolism and Clinical Biochemistry                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| <b>Course Objectives</b>       | <p>1.To understand the concepts of the mechanisms involved in regulation of blood sugar and management of diabetes mellitus</p> <p>2.To gain in-depth knowledge of the mechanisms of cancer and of tumor metastasis</p> <p>3.The student will review the basic organization of the central and peripheral nervous system that coordinate the sensory and motor functions of the body. In addition, the student will explore impaired features underlying the major neuropathological complications.</p> <p>4.To gain knowledge in renal diseases</p> <p>5.To understand the mechanisms involved in cardiac disorders</p>                                                                                                                                                                                                                        |
| <b>Course Outcomes</b>         | <p><b>On completion of this course the student will be able to understand</b></p> <p><b>CO1.</b>Overall view about the complications of diabetes mellitus and its management.</p> <p><b>CO2.</b>Comprehensive understanding of the concepts of cancer biology and implicating the theoretical concepts for further research</p> <p><b>CO3.</b>Understand and appreciate the pathophysiology of conditions affecting the nervous system.</p> <p><b>CO4.</b>A thorough knowledge of renal and cardiac diseases with emphasis related to mechanistic aspects and therapeutic interventions.</p> <p><b>CO5.</b> A thorough knowledge on the experimental models of non-communicable diseases that will be applied for future research or project dissertation. An in-depth knowledge on development of drugs against non-communicable diseases.</p> |

**NON MAJOR ELCTIVE PAPER FOR OFFERING TO STATISTICS**  
**DEPARTMENT**

**NME-I- MEDICAL LABORATORY TECHNOLOGY**

**Course objectives:**

1. To understand the laboratory principles of the modern laboratory set up.
2. To analyze the various laboratory equipment's and handling.
3. To understand the preparation of reagents.
4. To understand how to maintenance of laboratory records.
5. To Understand and apply biochemical investigations to develop a clinical diagnosis.

**Course outcomes:**

1. Discuss the laboratory principles and modern laboratory set up
2. Describe and identify the uses of various laboratory equipment's
3. Analyze the type of blood specimens and the criteria for specimen collection and storage
4. Apply the preparation of laboratory chemicals and the importance of record maintenance
5. Critically evaluate the role of clinical biochemistry in diagnosis, monitoring and treatment.

**UNIT-I**

**5Hrs**

**Basic laboratory principles-** Importance's of clinical laboratory - Safety measures - Chemical, fire & Electrical - Lab Technician Duties and Responsibilities – Professional Ethics in laboratory workers, Set up of Instruments in the Modern Laboratory

**UNIT-II**

**5Hrs**

**Basic Laboratory Equipment's-** Microscopy – Light and Contrast Microscopy-types, Incubator, Hot Air Oven, Colorimeter - Laminar Air flow Chamber, Water Bath, Centrifuge, Autoclave, Hemocytometer, Cell counter – Microtip pipette - Microtome – autoanalyzer – ELIZA reader

**UNIT-III**

**5Hrs**

**Preparation of Reagents** -Buffer and pH - Normal, Percent and Molar solutions -Normal saline, Standard solutions – Working and Stock standards, Clinical Laboratory records and

maintenance -Quality control: Accuracy, Precision, and Reference values, use of chemicals and their interactions, disposal methods.

#### **UNIT-IV**

**5Hrs**

**Basic Clinical Chemistry-** Types of blood specimens for chemical analyses- Serum and Plasma, Collections and storage of specimens, Blood and Urine, Specimen transport, and processing - Diagnosis of different diseases- Acute and Chronic diseases -

#### **UNIT-V**

**5Hrs**

**Biochemistry, Pathology and Microbiology** – Carbohydrates, lipids, proteins, and their qualitative analysis – Cell morphological changes during injuries and infectious diseases and neoplastic changes in cells - Microbes – Important parasites ( Malarian) , Intestinal protozoa (E. histolytica, and Amoebic), viuses (Hepatitis) – Laboratory diagnosis-

#### **TEXTBOOKS:**

1. Godkar P.B (2020), Textbook of Medical Laboratory Technology Vol 1 & 2, 3<sup>rd</sup> Edition, Bhalani Publishing House.
2. SANT M (2020). Textbook of Medical Laboratory Technology.CBS Publishers.
3. Monica Cheesbrough (1987), Medical Laboratory Manual for Tropical Countries, 2<sup>nd</sup> Edition, Butterworth-Heinemann Publications

#### **BOOKS FOR REFERENCE:**

1. Fischbach, 2005. Manual of lab and diagnostic tests, Lippincott Williams Wilkins, New York.
2. Gradwohls, 2000. Clinical laboratory methods and diagnosis. (ed) Ales C. Sonnenwirth and leonardjarret, M.D.B.I., New Delhi.
3. J Ochei and Kolhatkar, 2002. Medical laboratory science theory and practice, Tata McGraw-Hill, New Delhi.
4. Kanai L. Mukherjee, 2007, Medical laboratory technology Vol.1.Tata McGraw Hill *Diploma in Clinical Lab. Tech. – Colleges – 2015-16 onwards Annexure No.26C*

**NON MAJOR ELCTIVE PAPER FOR OFFERING TO CHEMISTRY**  
**DEPARTMENT**

**NME-II- FIRST AID MANAGEMENT**

**Course Objectives:**

1. To understand their role as an emergency first aider.
2. To understand the use of risk assessments for health and safety purposes and apply it the daily life.
3. To understand how to respond to accidents and sudden illnesses and analyse the different treatment methodologies.
4. To understand the ways of minimizing risks to themselves and others
5. To evaluate the various first aid strategies that can be applied at different occasions

**Course Outcomes:**

1. Understand the knowledge about the most important action you can take in a life-threatening emergency.
2. Explain the principles of First aid in emergency conditions.
3. Apply and demonstrate rescue treatment.
4. Analyze first aid parameters during various illness
5. Evaluate the first aid strategies used in day to day life.

**Unit-I**

**Principles and objectives of First Aid**

Principles and definition of First Aid, First Aid methods for Patients, Guidelines for First Aid providers and care. – SOP on First Aid - Emergency care, Resuscitation – CPR

**Unit -II**

**Essentials Methods of First Aid**

First aid tips for burns, cuts and scalds- First aid tips for Eyes- First aid tips for head injury- First aid tips for poisons- priorities for First Aid – First Aid needs and assessment

**Unit- III**

**First Aid Equipments and facilities**

Instruments needed for First Aid –Storage of first aid kits- Maintenance of first aid kits- First Aid Importances of hydrocortisone cream – Tweezers – hand sanitizer and gloves – pain relievers – gauze and tape

**Unit-IV****First Aid Methods for Accident Emergencies**

Safety measures and importances of first aid – First Aid for emergency situations- Life saving procedures – First aid, emergency and complications of road accidents – cardiac emergencies

**Unit -V****First Aid Kits**

Content and Types – Quick kit- Home kit – Small kit – Travel kit – Emergencies survival kits- Industrial First aid kits – Disaster supplies kits - Usage and storage

**TEXT BOOK:**

1. John A Eastman, (2007). First Aid to the Injured – Authorized manual of St. John's.
2. [Shirley A. Jones](#) First Aid, Survival, and CPR: Home and Field Pocket Guide 1st Edition
3. [Paolo Jose de Luna](#) Basic First Aid Management: A Book on First Aid and Responding to Emergencies

**BOOK OF REFERENCE:**

1. Subramanian. R. (2006) First aid Home nursing, 1<sup>st</sup>edn, Bharat printers Trichy.
2. [Shirley A. Jones](#) First Aid, Survival, and CPR: Home and Field Pocket Guide 1st Edition
3. [Paolo Jose de Luna](#) Basic First Aid Management: A Book on First Aid and Responding to Emergencies