ALAGAPPA UNIVERSITY

(A State University Established by the Government of Tamil Nadu in 1985
Accredited with 'A++" Grade by NAAC (CGPA : 3.59) in the Fourth Cycle under Dual Mode Category MHRD-NIRF 2024 Rank-47, THE-WUR 202: 601-800, THE ASIA 2024: 251-300, QS ASIA 2024: 271-280)
KARAIKUDI -630 003, Tamil Nadu, India

FACULTY OF SCIENCE

DEPARTMENT OF BIOINFORMATICS

M.Sc. BIOCHEMISTRY

REGULATIONS AND SYLLABUS

(For the candidates admitted from the Academic Year 2025 - 2026)

DEPARTMENT OF BIOINFORMATICS
M.Sc., Biochemistry

REGULATIONS AND SYLLABUS

[For the candidates admitted from the Academic Year 2025 – 2026 onwards]

ALAGAPPA UNIVERSITY

(A State University | A++ by NAAC (CGPA: 3.59) Dual Mode in the 4th Cycle | Category - I University by UGC)

Karaikudi -630003, Tamil Nadu.

The panel of Members-Broad Based Board of Studies

Chairperson: Name: **Dr. J. Jeyakanthan**, Designation: **Senior Professor and Head,** Department: **Bioinformatics,Alagappa University, Karaikudi**, Teaching Experience: **15 years**, Research Experience: **31 years**, Area of Research: **Structural Biology, Computer-Aided Drug Design, and Bio-Computing.**	
Subject Expert: Name **Dr. Suresh Kumar Rayala**, Designation: **Professor** Department: **Biotechnology, Indian Institute of Madras**. Teaching Experience: **27 years**, Research Experience: **27 years**, Area of Research: **Cancer Biology - Small molecules/peptides targeting novel oncogenes, mechanism of action of new drugs, Mechanisms of therapy resistance, and developing pre-clinical models of tumor progression.**	
Subject Expert: Name **Dr. S. Suja** Designation: **Professor** Department: **Biochemistry, Bharathiar University, Coimbatore**. Teaching Experience: **11 years**, Research Experience: **11 years**, Area of Research: **Bioengineering, Nanomedicines for cancer therapeutics, Bio-residues for cancer prognosis and diagnosis.**	
Members Name: **Dr. Sanjeev Kumar Singh**, Designation: **Professor** Department: **Bioinformatics, Alagappa University, Karaikudi**. Teaching Experience: **20 years**, Research Experience: **25 years**, Area of Research: **Structural bioinformatics and computer aided drug designing.**	
Name: **Dr. M. Kathikeyan**, Designation: **Associate Professor** Department: **Bioinformatics, Alagappa University, Karaikudi**, Teaching Experience: **20 years**, Research Experience: **25years**, Area of Research: **Pharmacogenomics and Computational Biology. Hypertension, diabetes, cardiovascular diseases, renal failure, cancer, Neurological Disorders.**	
Name: **Dr. RM. Vidhyavathi,** Designation: **Assistant Professor** Department: **Bioinformatics, Alagappa University, Karaikudi**, Teaching Experience: **12 years**, Research Experience: **09 years**, Area of Research: **Datamining and Data Warehousing, Database Security, Bioinformatics, Networking Database Management System, Cloud Computing, Machine Learning and Artificial Intelligent, Block Chain Technology.**	
Name: **Dr. J. Joseph Sahayarayan**, Designation: **Assistant Professor** Department: **Bioinformatics, Alagappa University, Karaikudi**, Teaching Experience: **11 years**, Research Experience: **14 years**, Area of Research: **Plant Bioinformatics - Network Pharmacology, Computer Aided Drug Designing and Next Generation Sequencing in plant system.**	
Name: **Dr. P. Boomi**, Designation: **Assistant Professor** Department: **Bioinformatics, Alagappa University, Karaikudi**, Teaching Experience: **10 years**, Research Experience: **14 years**, Area of Research: **Cheminformatics, Synthesis of self-Assembly Nanoparticles, Nano Drug Delivery and Computer Aided Drug Designing.**	
Name: **Dr. N. Suganthy** Designation: **Assistant Professor** Department: **Department of Nanoscience and Technology, Alagappa University, Karaikudi**, Teaching Experience: **10 years**, Research Experience: **14 years**, Area of Research: **Fabricating Nanotheranostic agents for Alzheimer's disease and Cancer therapy, Elucidating the toxicity profile of nanomaterials through *in vitro* and *in vivo* approach.**	
Name: **Dr. P. Kumar** Designation: **Assistant Professor** Department: **Department of Animal Health and Management, Alagappa University, Karaikudi**, Teaching Experience: **10 years**, Research Experience: **14 years**, Area of Research: **Nanomedicine, Molecular Cancer Biology, Systems Toxicology and Toxicogenomics.**	

Name of the Department	:	**Bioinformatics**
Name of the Subject Discipline	:	**Biochemistry**
Programme of Level	:	**M.Sc**
Duration for the Course	:	**Full Time (Two Years)**

1. Choice-Based Credit System

A choice-Based Credit System is a flexible system of learning. This system allows students to gain knowledge at their own tempo. Students shall decide on electives from a wide range of elective courses offered by the University Departments in consultation with the Department committee. Students undergo additional courses and acquire more than the required number of credits. They can also adopt an inter-disciplinary and intra-disciplinary approach to learning, and make the best use of the expertise of available faculty.

2. Programme

"Programme" means a course of study leading to the award of a degree in a discipline.

3. Courses

'Course' is a component (a paper) of a programme. Each course offered by the Department is identified by a unique course code. A course contains lectures/ tutorials/laboratory work/seminar/project work / practical training/report writing /Viva-voce, etc. or a combination of these, to meet effectively the teaching and learning needs.

4. Credits

The Term "Credit" refers to the weightage given to a course, usually in relation to the instructional hours assigned to it. Normally in each of the courses credits will be assigned on the basis of the number of lectures/tutorials/laboratory and other forms of learning required completing the course contents in a 15-week schedule. One credit is equal to one hour of lecture per week. For laboratory/field work one credit is equal to two hours.

5. Semesters

An Academic year is divided into two **Semesters.** In each semester, courses are offered in 15 teaching weeks and the remaining 5 weeks are to be utilized for conduct of examination and evaluation purposes. Each week has 30 working hours spread over 5 days a week.

6. Departmental committee

The Departmental Committee consists of the faculty of the Department. The Departmental Committee shall be responsible for admission to all the programmes offered by the Department

including the conduct of entrance tests, verification of records, admission, and evaluation. The Departmental Committee determine the deliberation of courses and specifies the allocation of credits semester-wise and course-wise. For each course, it will also identify the number of credits for lectures, tutorials, practical's, seminars etc. The courses (Core/Discipline Specific Elective/Non-Major Elective) are designed by teachers and approved by the Departmental Committees. Courses approved by the Departmental Committees shall be approved by the Board of Studies. A teacher offering a course will also be responsible for maintaining attendance and performance sheets (CIA -I, CIA-II, assignments and seminar) of all the students registered for the course. The Non-major elective programme and MOOCs coordinator are responsible for submitting the performance sheet to the Head of the department. The Head of the Department consolidates all such performance sheets of courses pertaining to the programmes offered by the department. Then forward the same to be Controller of Examinations.

7. Programme Objectives- (POB)

POB-1	Provide a comprehensive understanding of biochemical concepts, focusing on the principles and mechanisms underlying chemical processes in biological systems.
POB-2	Equip students with essential and advanced laboratory methodologies necessary for experimental, diagnostic, and research-based biochemistry.
POB-3	Promote the application of biochemical knowledge to real-world problems in healthcare, agriculture, industry, and environmental sustainability.
POB-4	Introduce students to modern computational and bioinformatics techniques for analyzing biological data and modeling biochemical systems.
POB-5	Develop scientific reasoning, critical thinking, and problem-solving skills necessary for designing experiments, analyzing data, and interpreting scientific outcomes.
POB6	Encourage independent research aptitude, creative thinking, and innovation through guided research projects, internships, and practical experiences.
POB7	Promote ethical conduct, scientific integrity, and responsibility in research, data management, and communication of scientific information.
POB8	Enable interdisciplinary integration by applying knowledge from related fields such as molecular biology, biotechnology, and environmental science.
POB9	Strengthen scientific communication skills and foster teamwork and leadership abilities through collaborative learning and professional development activities.
POB10	Prepare students for diverse career paths in academia, research, healthcare, and industry while fostering adaptability and a commitment to lifelong learning.

8. Programme Outcome-(POs)

Knowledge:	
PO1	Understand core concepts in biochemistry, molecular biology, and metabolism.
PO2	Apply biochemical principles to health, disease, and therapeutic contexts.
PO3	Interpret scientific literature and recent research trends.
PO4	Integrate knowledge across disciplines for problem-solving.

Skills:	
PO5	Perform advanced biochemical and molecular techniques.
PO6	Analyze data using statistical and bioinformatics tools.
PO7	Communicate scientific information effectively.
PO8	Design and execute independent research projects.
Attitude:	
PO9	Uphold ethical standards in research and professional practice.
PO10	Demonstrate lifelong learning and collaborative spirit.

9. Course Objectives- (COB)

COB-1	Understand core biochemical concepts and molecular mechanisms.
COB-2	Apply biochemical knowledge in clinical, pharmaceutical, and biotech contexts.
COB-3	Analyze data using laboratory techniques and computational tools.
COB-4	Evaluate scientific literature and design research strategies.
COB-5	Innovate ethically in research and demonstrate lifelong learning.

10. Course Outcome-(COs)

Knowledge:	
CO1	Explain core biochemical and molecular processes.
CO2	Apply biochemical principles in clinical and research contexts.
CO3	Analyze experimental data and biomolecular interactions.
Attitude:	
CO4	Demonstrate ethical conduct in scientific research.
CO5	Engage in lifelong learning and collaborative research.

11. Eligibility for admission

Candidates for admission to Master of Science in Biochemistry shall be required to have passed B.Sc Life Science/ Biochemistry/ Biotechnology/ Microbiology/ Molecular Biology/ Food Science and Nutrition Dietetics/ Bioinformatics/ Botany/ Zoology/ Chemistry/B.Tech.,(Biotech/Biochemistry) or any other course equivalent thereto and must have obtained 55% marks for others and 50% for SC/ST at graduation level in Part III.

12. Medium of instruction

The medium of instruction is English only.

13. Minimum Duration of programme

The programme is for a period of two years. Each year shall consist of two semesters viz. Odd and Even semesters. Odd semesters shall be from June / July to October / November and even semesters shall be from November / December to April / May. Each semester there shall be 90 working days consisting of 6 teaching hours per working day (5 days/week).

14. Components

A PG programme consists of a number of courses. The term "course" is applied to indicate a logical part of the subject matter of the programme and is invariably equivalent to the subject matter of a "paper" in the conventional sense. The following are the various categories of the courses suggested for the PG programmes:

A. Core courses (CC)- "Core Papers" means "the core courses" related to the programme concerned including practicals and project work offered under the programme and shall cover Core competency, critical thinking, analytical reasoning, and research skill.

B. Discipline-specific electives (DSE) means the courses offered under the programme related to the major but are to be selected by the students, and shall cover additional academic knowledge, critical thinking, and analytical reasoning.

C. Non-Major Electives (NME)- Exposure beyond the discipline

- Students have to undergo a total of Non-Major Elective courses with 2 credits offered by other departments (one in II Semester and another in III Semester)
- A uniform time frame of 3 hours on a common day (Tuesday) shall be allocated for the Non-Major Electives.
- Non-Major Elective courses offered by the departments pertaining to a semester should be announced before the end of the previous semester.
- Registration process: Students have to register for the Non-Major Elective course within 15 days from the commencement of the semester either in the department or NME portal (University website).

D. Self-Learning Courses from MOOCs platforms.

- MOOCs shall be voluntary for the students.
- Students have to undergo a total of 2 Self Learning Courses (MOOCs) one in II semester and another in III semesters.
- The actual credits earned through MOOCs shall be transferred to the credit plan of programmes as extra credits. Otherwise, 2 credits/course be given if the self Learning Course (MOOCs) is without credit.
- While selecting the MOOCs, preference shall be given to the course related to employability skills.

E. Projects / Dissertation /Internships (Maximum Marks: 200**)**

The student shall undertake the Project/Dissertation/internship during the fourth semester.

- **Plan of work**

Project/Dissertation

The candidate shall undergo Project/Dissertation Work during the final semester. The candidate should prepare a scheme of work for the dissertation/project and should get approval from the guide. The candidate, after completing the dissertation /project work, shall be allowed to submit it

to the university departments at the end of the final semester. If the candidate is desirous of availing the facility from other departments/ universities/laboratories/organizations they will be permitted only after getting approval from the guide and HOD. In such a case, the candidate shall acknowledge the same in their dissertation/project work.

Format to be followed for dissertation/project report

The format /certificate for thesis to be followed by the student are given below

- Title page
- Certificate
- Acknowledgment

Content as follows:

Chapter No	Title	Page number
1	Introduction	
2	Aim and objectives	
3	Review of literature	
4	Materials and methods	
5	Result	
6	Discussion	
7	Summary	
8	References	

Format of the title page

Title of Dissertation/Project work

Dissertation submitted in partial fulfilment of the requirement for the degree of Master of Science in Biochemistry to the Alagappa University, Karaikudi -630003.

By

(Student Name)

(Register Number)

Department of Bioinformatics

ALAGAPPA UNIVERSITY

(A State University Established by the Government of Tamil Nadu in 1985,Accredited with 'A++' Grade by NAAC (CGPA 3.59) under Dual Mode Category in the Fourth Cycle, Graded as Category- I University and Granted Autonomy by MHRD-UGC, 2023 : NIRF : 30, THE – Asia : 111, THE – World Young Universities : 101-150, 2024 : QS India : 32, QS South Asia : 59, QS Asia : 271-280)

Karaikudi - 630003

(Year)

Format of certificates-

Certificate -Guide

This is to certify that the thesis entitled "----------" submitted to Alagappa University, Karaikudi-630 003 in partial fulfilment for the degree of Master of Science in Biochemisty by Mr/Miss ----------(Reg No:----------) under my supervision. This is based on the results of studies carried out by him/her in the Department of Bioinformatics, Alagappa University, Karaikudi-630 003. This dissertation/Project or any part of this work has not been submitted elsewhere for any other degree, diploma, fellowship, or any other similar titles or record of any University or Institution.

Place: Karaikudi
Date:_____

Research Supervisor

Certificate - (HOD)

This is to certify that the thesis entitled **"----------"** submitted by Mr/**Miss ----------(Reg No: ----------)** to the Alagappa University, in partial fulfilment for the award of the degree of **Master of Science** in Biochemistry is a Bonafide record of research work done under the supervision of **Dr.----------,** Assistant Professor, Department of Bioinformatics, Alagappa University. This is to further certify that the thesis or any part thereof has not formed the basis of the award to the student of any degree, diploma, fellowship, or any other similar title of any University or Institution.

Place: Karaikudi
Date:_____

Head of the Department

Declaration (student)

I hereby declare that the dissertation entitled **"----------"** submitted to Alagappa University for the award of the degree of Master of Science in Biochemistry has been carried out by me under the guidance of **Dr. ----------**, Assistant Professor, Department of Bioinformatics, Alagappa University, Karaikudi – 630 003. This is my original and independent work and has not previously formed the basis of the award of any degree, diploma, associateship, fellowship, or any other similar title of any University or Institution.

Place: Karaikudi
Date:_____

(----------)

Internship

The students shall undergo Internship / industrial training in the reputed organizations for minimum of two weeks to acquire industrial knowledge during the summer vacation of second semester. The students have to find industry related to their discipline (Public limited/Private Limited/owner/NGOs etc.,) in consultation with the faculty in charge/Mentor and get approval from the Head of the Department and Departmental Committee before going for an internship / industrial training.

Format to be followed for Internship report

The format for internship report to be followed by the student are given below

Format of the title page

Title of internship report

Internship report submitted in partial fulfillment of the requirement for the Master of Science in Biochemistry to the Alagappa University, Karaikudi - 630003.

By

(Student Name)
(Register Number)

Department of Bioinformatics

Alagappa University

ALAGAPPA UNIVERSITY
(A State University Established by the Government of Tamil Nadu in 1985,Accredited wit
Grade by NAAC (CGPA 3.59) under Dual Mode Category in the Fourth Cycle, Graded as C
University and Granted Autonomy by MHRD-UGC, 2023 : NIRF : 30, THE – Asia : 111,
World Young Universities : 101-150, 2024 : QS India : 32, QS South Asia : 59, QS Asia : 2
Karaikudi - 630003
(Year)

Format of certificate

(Faculty in-charge)

This is to certify that the internship report entitled "----------" submitted to Alagappa University, Karaikudi-630 003 in partial fulfilment for the Master of Science in Biochemistry by Mr/Miss ---------- (Reg. No.:----------) under my supervision. This is based on the work carried out by him/her in the organization M/S ----------. This Internship report or any part of this work has not been submitted elsewhere for any other degree, diploma, fellowship, or any other similar record of any University or Institution.

Place: Research Supervisor
Date:_____

Certificate - (HOD)

This is to certify that the Internship report entitled "----------" submitted by Mr./Miss.---------- (Reg No:----------) to the Alagappa University, in partial fulfilment for the award of the Master of Science in Biochemistry is a Bonafide record of Internship report done under the supervision of ----------, Assistant Professor, Department of Bioinformatics, Alagappa University and the work carried out by him/her in the organization M/S ----------. This is to further certify that the thesis or any part thereof has not formed the basis of the award to the student of any degree, diploma, fellowship, or any other similar title of any University or Institution.

Place: Karaikudi
Head of the Department
Date:_____

(Company supervisor or Head of the Organization)

This is to certify that the Internship report entitled "----------" submitted to Alagappa University, Karaikudi-630 003 in partial fulfilment for the Master of Science in Biochemistry by Mr./Miss ---------- (Reg No:----------) under my supervision. This is based on the work carried out by him/her in our organization M/S ---------- for the period of ------. This Internship report or any part of this work has not been submitted elsewhere for any other degree, diploma, fellowship, or any other similar record of any University or Institution.

Place: Supervisor or In charge
Date:_____

Declaration (student)

I hereby declare that the Internship Report entitled "----------" submitted to the Alagappa University for the award of the Master of Science in Biochemistry has been carried out by me under the supervision of----------, Assistant Professor, Department of Bioinformatics, Alagappa University, Karaikudi – 630 003. This is my original and independent work carried out by me in the organization M/S ---------- for the period of ------ and has not previously formed the basis of the award of any degree, diploma, associateship, fellowship, or any other similar title of any University or Institution.

Place: Karaikudi (----------)
Date:_____

- Acknowledgment
- Content as follows:

Field study

The students shall undergo field to various aquaculture farms, fish landing centers, sea food processing industries, Research Institutes, ship building industries etc. to acquire industrial and practical knowledge during the first semester.

Format to be followed for Field Visit report

The format for Field Visit report to be followed by the student are given below

Format of the title page

Field Visit report

submitted in partial fulfilment of the requirement for the Master of Science in Biochemistry to the Alagappa University, Karaikudi -630003.

By

(Student Name)

(Register Number)

Department of Bioinformatics

Alagappa University

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(Year)

Format of certificate

Certificate - (HOD)

This is to certify that the Field Visit report submitted by Mr./Miss ---------- (Reg No:----------) to the Alagappa University, in partial fulfilment for the award of the Master of Science in Biochemistry is a Bonafide record of Field Visit reports carried out by him/her during ----------. This is to further certify that the report or any part thereof has not formed the basis of the award to the student of any degree, diploma, fellowship, or any other similar title of any University or Institution.

Place: Karaikudi Head of the Department

Date:_____

Declaration (student)

I hereby declare that the Field Visit Report submitted to the Alagappa University for the award of the Master of Science in Biochemistry has been carried out by me. This is my original and independent work carried out by me during ------ and has not previously formed the basis of the award of any degree, diploma, associateship, fellowship, or any other similar title of any University or Institution.

Place: Karaikudi (----------)

Date:_____

- Acknowledgment
- Content as follows:

S. No.	Date	Field Visit	Page No.	Signature
1				
2				
3				
4				
5				

No. of copies of the dissertation/internship report

The candidate should prepare three copies of the dissertation report and submit the same for the evaluation of examiners. After evaluation, one copy will be retained in the department library, one copy will be retained by the guide and the student shall hold one copy. The

candidate should prepare one copy of the field visit/internship report and submit the same for the evaluation of examiners

15. Teaching methods

The mode of teaching is based on the following learning activities:

- Lectures covering the theoretical part will be delivered using PowerPoint presentations.
- Delivering the lectures in the form of presentation using advanced technologiesdevices such as smart board.
- Video-conferencing for lectures that will be sought from experts belonging tooverseas reputed institutions
- A set of laboratory exercises to analyze biological problems using softwares andtools to develop student's interests in scientific discovery.
- Case studies and Review questions.

16. Attendance

Students must have earned 75% of attendance in each course for appearing for the examination. Students who have earned 74% to 70% of attendance need to apply for condonation in the prescribed form with the prescribed fee. Students who have earned 69% to 60% of attendance need to apply for condonation in the prescribed form with the prescribed fee along with the Medical Certificate. Students who have below 60% of attendance are not eligible to appear for the End Semester Examination (ESE). They shall re-do the semester(s) after completion of the programme

17. Examination

The examinations shall be conducted separately for theory and practical's to assess (remembering, understanding, applying, analyzing, evaluating, and creating) the knowledge required during the study. There shall be two systems of examinations viz., internal and external examinations. The internal examinations shall be conducted as Continuous Internal Assessment tests I and II (CIA Test I & II).

A. Internal Assessment

The internal assessment shall comprise a maximum of 25 marks for each subject. The following procedure shall be followed for awarding internal marks.

Theory -25 marks

Sr.No	Content	Marks
1	Average marks of two CIA test	15
2	Seminar/group discussion/quiz	5
3	Assignment/field trip report/case study report	5
	Total	25

Practical -25 Marks

1	Average marks of two CIA test	15 marks
2	Observation note book	10 marks
	Total	25 Marks

Internship- 25 Marks (assess by Guide/incharge/HOD/Supervisor)

1	Presentations	15 Marks
2	Progress report	10 Marks
	Total	25 Marks

Project/Dissertation -50 Marks (assess by Guide /incharge /HOD/ Supervisor)

1	Two presentations (mid-term)	15 /30 Marks
2	Progress report	10 /20Marks
	Total	25/50 Marks

B. External Examination

- There shall be examinations at the end of each semester, for odd semesters in the month of October / November; for even semesters in April / May.
- A candidate who does not pass the examination in any course(s) may be permitted to appear in such failed course(s) in the subsequent examinations to be held in October / November or April / May. However, candidates who have arrears in Practical shall be permitted to take their arrear Practical examination only along with Regular Practical examination in the respective semester.
- A candidate should get registered for the first-semester examination. If registration is not possible owing to a shortage of attendance beyond condonation limit/regulation prescribed OR belated joining OR on medical grounds, the candidates are permitted to move to the next semester. Such candidates shall re-do the missed semester after completion of the programme.
- For the Project Report/ Dissertation Work the maximum marks will be 50/100 marks for project report evaluation and for the Viva-Voce it is 25/50 marks
- For the Internship the maximum marks will be 50 marks for project report evaluation and for the Viva –Voce it is 25 marks.
- Viva-Voce: Each candidate shall be required to appear for the Viva-Voce Examination (in defense of the Dissertation Work / Internship).

C. Scheme of External Examination (Question Paper Pattern)

Theory - Maximum 75 Marks

Section A	10 questions. All questions carry equal marks. (Objective-type questions)	10 x 1 = 10	10 questions – 2 each from every unit
Section B	5 questions Either / or type like 1.a (or) b. All questions carry equal marks and each answer should not exceed one page or 250 words.	5 x 5 = 25	5 questions – 1 each from every unit
Section C	Essay type questions 5 out of 8 questions. All questions carry equal marks and each answer should not exceed two page	5 x8 = 40	5 question –Should cover all units

Practical (Science) –Maximum 75 Marks

Section A	Major experiment	15 Marks
Section B	Minor experiment	10 Marks
Section C	Experimental setup	5 Marks
Section D	Spotters (5 spotters x5 marks)	25 Marks
Section E	Record note	10 Marks
Section F	Vivo voce	10 Marks

Dissertation /Project report Maximum 75/150 Marks

Dissertation /Project report	50/100 Marks
Vivo voce	25/50 Marks

Internship report Maximum 75 Marks

Internship report	50 Marks
Vivo voce	25 Marks

18. Results

The results of all the examinations will be published through the Department where the student underwent the course as well as through University Website

19. Passing minimum

- A candidate shall be declared to have passed in each course if he/she secures not less than 40% marks in the End Semester Examinations and 40% marks in the Internal Assessment and not less than 50% in the aggregate, taking Continuous assessment and End Semester Examinations marks together.

- The candidates not obtained 50% in the Internal Assessment are permitted to improve their Internal Assessment marks in the subsequent semesters (2 chances will be given) by writing the CIA tests and by submitting assignments.
- Candidates, who have secured the pass marks in the End-Semester Examination and in the CIA but failed to secure the aggregate minimum pass mark (E.S.E + C I.A), are permitted to improve their Internal Assessment mark in the following semester and/or in University examinations.
- A candidate shall be declared to have passed in the Project / Dissertation / Internship if he /she gets not less than 40% in each of the Project / Dissertation / Internship and Viva-Voce and not less than 50% in the aggregate of both the marks for Project / Dissertation / Internship Report and Viva-Voce.
- A candidate who gets less than 50% in the Project Report must resubmit the Project Report. Such candidates need to take again the Viva-Voce on the resubmitted Project.

20. Grading of the Courses

The following table gives the marks, Grade points, Letter Grades and classifications meant to indicate the overall academic performance of the candidate.

Conversion of Marks to Grade Points and Letter Grade (Performance in Paper / Course)

RANGE OF MARKS	GRADE POINTS	LETTER GRADE	DESCRIPTION
90 - 100	**9.0 – 10.0**	**O**	**Outstanding**
80 - 89	**8.0 – 8.9**	**D+**	**Excellent**
75 - 79	**7.5 – 7.9**	**D**	**Distinction**
70 - 74	**7.0 – 7.4**	**A+**	**Very Good**
60 - 69	**6.0 – 6.9**	**A**	**Good**
50 - 59	**5.0 – 5.9**	**B**	**Average**
00 - 49	**0.0**	**U**	**Re-appear**
ABSENT	**0.0**	**AAA**	**ABSENT**

a) Successful candidates passing the examinations and earning GPA between 9.0 and 10.0 and marks from 90 – 100 shall be declared to have Outstanding (O).
b) Successful candidates passing the examinations and earning GPA between 8.0 and 8.9 and marks from 80 - 89 shall be declared to have Excellent (D+).
c) Successful candidates passing the examinations and earning GPA between 7.5 – 7.9 and marks from 75 - 79 shall be declared to have Distinction (D).
d) Successful candidates passing the examinations and earning GPA between 7.0 – 7.4 and marks from 70 - 74 shall be declared to have Very Good (A+).
e) Successful candidates passing the examinations and earning GPA between 6.0 – 6.9 and marks from 60 - 69 shall be declared to have Good (A).
f) Successful candidates passing the examinations and earning GPA between 5.0 – 5.9 and

marks from 50 - 59 shall be declared to have Average (B).

g) Candidates earning GPA between 0.0 and marks from 00 - 49 shall be declared to have Re-appear (U).

h) Absence from an examination shall not be taken as an attempt.

From the second semester onwards the total performance within a semester and continuous performance starting from the first semester are indicated respectively **by Grade Point Average (GPA) and Cumulative Grade Point Average (CGPA).** These two are calculated by the following formulate

$$\text{GRADE POINT AVERAGE (GPA)} = \Sigma_i C_i \; G_i / \Sigma_i C_i$$

$$\text{GPA} = \frac{\text{Sum of the multiplication of Grade Points by the credits of the courses}}{\text{Sum of the credits of the courses in a Semester}}$$

21. Classification of the final result

CGPA	Grade	Classification of Final Result
9.5 – 10.0 9.0 and above but below 9.5	**O+** **O**	First Class – Exemplary*
8.5 and above but below 9.0 8.0 and above but below 8.5 7.5 and above but below 8.0	**D++** **D+** **D**	First Class with Distinction*
7.0 and above but below 7.5 6.5 and above but below 7.0 6.0 and above but below 6.5	**A++** **A+** **A**	First Class
5.5 and above but below 6.0 5.0 and above but below 5.5	**B+** **B**	Second Class
0.0 and above but below 5.0	**U**	Re-appear

The final result of the candidate shall be based only on the CGPA earned by the candidate.

a) Successful candidates passing the examinations and earning CGPA between 9.5 and 10.0 shall be given Letter Grade (O+), those who earned CGPA between 9.0 and 9.4 shall be given Letter Grade (O) and declared to have First Class –Exemplary*.

b) Successful candidates passing the examinations and earning CGPA between 7.5 and 7.9 shall be given Letter Grade (D), those who earned CGPA between 8.0 and 8.4 shall be given Letter Grade (D+), those who earned CGPA between 8.5 and 8.9 shall be given Letter Grade (D++) and declared to have First Class with Distinction*.

c) Successful candidates passing the examinations and earning CGPA between 6.0 and 6.4 shall be given Letter Grade (A), those who earned CGPA between 6.5 and 6.9 shall be given Letter Grade (A+), those who earned CGPA between 7.0 and 7.4 shall be given Letter Grade (A++) and declared to have First Class.

d) Successful candidates passing the examinations and earning CGPA between 5.0 and 5.4 shall be given Letter Grade (B), those who earned CGPA between 5.5 and 5.9 shall be given Letter Grade (B+) and declared to have passed in Second Class.

i) Candidates those who earned CGPA between 0.0 and 4.9 shall be given Letter Grade (U) and declared to have Re-appear.

e) Absence from an examination shall not be taken as an attempt.

$$\text{CUMULATIVE GRADE POINT AVERAGE (CGPA)} = \Sigma_n \; \Sigma_i C_{ni} \;\; G_{ni} / \Sigma_n \; \Sigma_i C_{ni}$$

$$\text{CGPA} = \frac{\text{Sum of the multiplication of Grade Points by the credits of the entire Programme}}{\text{Sum of the credits of the courses for the entire Programme}}$$

Where '**Ci**' is the Credit earned for Course i in any semester; '**Gi**' is the Grade Point obtained by the student for Course i and 'n' refers to the semester in which such courses were credited.

CGPA (Cumulative Grade Point Average) = Average Grade Point of all the Courses passed starting from the first semester to the current semester.

Note: * The candidates who have passed in the first appearance and within the prescribed Semesters of the PG Programme are alone eligible for this classification.

22. Maximum duration of the completion of the programme

A student who is not able to complete the programs within the normal period (N) or the minimum duration prescribed for the programme, may be allowed two years period beyond the normal period to clear the backlog to be qualified for the degree. (Time Span = N+2 years for the completion of programme.) In exceptional cases like major accidents and child birth an extension of one year be considered beyond maximum Span of time (Time Span = N+2+1 years for the completion of programme).A student who has obtained the minimum required credits in core, elective, soft skills, and internship will be considered to have passed the Master Programme.

23. Conferment of the Master's Degree

A candidate shall be eligible for the conferment of the Degree only after he/ she has earned the minimum required credits for the Programme prescribed therefor (i.e. 90 credits).

24. **Ranking**

The first ranks for all academic programmes offered in the University Departments will be determined based on the CGPA of core course and elective courses passed on the first attempt. Candidates with arrears in any semester are not eligible for ranking. Students who qualify during the extended period shall also not be eligible for ranking. Further, absence from an examination shall be considered as an attempt.

25. Village Extension Programme

The Sivaganga and Ramnad districts are very backward districts where a majority of people Lives in poverty. The rural mass is economically and educationally backward. Thus, the aim of the introduction of this Village Extension Programme is to extend out to reach environmental awareness, social activities, hygiene, and health to the rural people of this region. The students in their third semester have to visit any one of the adopted villages within the jurisdiction of Alagappa University and can arrange various programs to educate the rural mass in the following areas for three day based on the theme.1. Environmental awareness 2. Hygiene and Health. A minimum of two faculty members can accompany the students and guide them.

What to do after M.Sc.,

Job and Career option for

Employment Areas

M.Sc Biochemistry

Choice Based Credit System (CBCS) for the Academic Year 2025 – 2026 onwards

S.No.	Course Code	Title of the Paper		T/P	Credit	Hrs/ Week	Marks		
							I	E	Total
SEMESTER-I									
1	25MBC1C1	**Core-I**	Introduction to Biomolecules	T	4	5	25	75	100
2	25MBC1C2	**Core-II**	Cell and Molecular Biology	T	4	5	25	75	100
3	25MBC1C3	**Core-III**	Enzymology	T	4	5	25	75	100
4	25MBC1P1	**Core-IV**	**Lab – I:** Biomolecules, Cellular, and Enzymology Lab	P	4	8	25	75	100
5	25MBC1E1	DSE-1	**Major Elective-I** Microbial Biochemistry	T	3	3	25	75	100
6	25MBC1S1	SEC-1	Introduction to Bioinformatics	T	2	2	25	75	100
7	Library/ Yoga/ Journal Club/Career Guidance			-	-	2	-	-	-
Total					**21**	**30**	**150**	**450**	**600**
SEMESTER-II									
8	25MBC2C1	**Core-V**	Intermediary Metabolism and Regulation	T	4	4	25	75	100
9	25MBC2C2	**Core-VI**	Molecular Basis of Development	T	4	4	25	75	100
10	25MBC2C3	**Core-VII**	Immunology and Immunotechnology	T	4	4	25	75	100
11	25MBC2C4	**Core-VIII**	Clinical and Medical Biochemistry	T	4	4	25	75	100
12	25MBC2P1	**Core-IX**	**Lab – II:** Metabolism, Developmental, Immunology & Clinical Biochemistry Lab.	P	4	8	25	75	100
13	25MBC2N1	Non Major Elective (NME) – I		T	2	3	25	75	100
14	25MBC2S1	SEC-2	Molecular Modelling and Drug Design	T	2	2	25	75	100
15	Library/Yoga/ Journal Club/Career Guidance			-	-	1	-	-	-
16	Self Learning Course (SLC) - I MOOC's			Extra Credit					
Total					**24**	**30**	**175**	**525**	**700**
SEMESTER-III									
17	25MBC3C1	**Core-X**	Genetics	T	5	5	25	75	100
18	25MBC3C2	**Core-XI**	rDNA Technology	T	5	5	25	75	100
19	25MBC3C3	**Core-XII**	Analytical and Instrumentation Techniques	T	5	5	25	75	100
20	25MBC3P1	**Core-XIII**	**Lab – III :** Genetics, rDNA Technology and Advanced Biochemistry Lab	P	4	8	25	75	100
21	25MBC3E1	DSE-2	**Major Elective-2** Food and Nutritional Biochemistry	T	3	3	25	75	100
22	25MBC3N1	Non Major Elective (NME) – II		T	2	3	25	75	100
23	25MBC3IN	Summer Internship		-	2	-	25	75	100
24	Library/ Yoga/ Journal Club/Career Guidance			-	-	1	-	-	-
25	Self Learning Course (SLC) – II MOOC's			Extra Credit					
Total					**26**	**30**	**175**	**525**	**700**

SEMESTER-IV									
26	25MBC4C1	**Core-XIV**	Computational and Structural Biology	T	4	4	25	75	100
27	25MBC4C2	**Core-XV**	Industrial and Environmental Biochemistry	T	4	4	25	75	100
28	25MBC4P1	**Core-XVI**	**Lab – IV:** Industrial, Environmental, and Structural Biology Lab	P	4	8	25	75	100
29	25MBC4PR	**Core-XVII**	Project Work & Viva-Voce	-	6	10	50	150	200
30	25MBC4E1	DSE-3	**Major Elective-3** Pharmaceutical Biochemistry	T	3	3	25	75	100
31	Library/ Yoga/ Journal Club/Career Guidance			-	-	1	-	-	-
Total					**21**	**30**	**150**	**450**	**600**
Grand Total (Semester I + II + III + IV)					**92+EC**	**120**	**650**	**1950**	**2600**

*DSE – Student Choice and it may be conducted by parallel sections.

*SEC-Skill Enhancement Course

**SLC- Voluntary basis

*** Dissertation / internship report –Marks -Vivo-voce (50) + thesis (100) + internal (50) = 200

T-Theory P-Practical, P-Practical 1 cr = 2 hrs for Practical paper

Semester wise credit details:

I	Semester	21 Credits	Core Credits: 16; Major Elective Credits: 3; Skill Enhancement course Credits: 2
II	Semester	24 Credits+ EC	Core Credits: 20; Non-Major Elective Credits: 2; Skill Enhancement course Credits: 2; Self Learning course credits– EC
III	Semester	26 credits+ EC	Core Credits: 19; Major Elective Credits: 3; Non-Major Elective Credits: 2; Summer Internship Credits: 2; Self Learning course credits – EC
IV	Semester	21 credits	Core Credits: 12; Major Elective Credits: 3; Project Work& Viva-Voce: 6
Total credits		**92+ EC**	**Core Credits: 67; Major Elective Credits: 9; Non-Major Elective Credits: 4; Project Work & Viva-Voce: 6, Summer Internship Credits: 2, Skill Enhancement course Credits: 4 + Self Learning course credits - extra credits**

Major Elective for the Department of Biochemistry (DSE)

S. No	Subject Code	Subject Name
1.	25MBC1E1	Microbial Biochemistry
2.	25MBC1E2	General Chemistry
3.	25MBC3E1	Food and Nutritional Biochemistry
4.	25MBC3E2	Plant Biochemistry
5.	25MBC3E3	Medical Biochemistry
6	25MBC3E4	Nanotechnology and Advanced Drug Delivery System
7	25MBC4E1	Pharmaceutical Biochemistry
8	25MBC4E2	Genomics and Proteomics
9	25MBC4E3	Cell communication and cell signaling
10	25MBC4E4	IPR, Biosafety and Bioethics

Non Major Electives for the other Departments

S. No	Subject Code	Subject Name
1.	25MBC2N1	Introduction to Biomolecules
2.	25MBC2N2	Cell and Molecular Biology
3.	25MBC2N3	Immunology and Immunotechnology
4.	25MBC2N4	Clinical and Medical Biochemistry
5.	25MBC3N1	rDNA Technology
6.	25MBC3N2	Analytical and Instrumentation Techniques
7	25MBC3N3	Computational and Structural Biology
8	25MBC3N4	Industrial and Environmental Biochemistry

SEMESTER-I

Course Depiction

Introduction to Biomolecules

Program: M.Sc.,	Semester : I (2025-2026 Onwards)
Course Title**: Introduction to Biomolecules** Subject Code: 25MBC1C1	Class Time: As per the time table
Name of Course Teachers	Dr. P. Boomi
Mobile:+91 - 9486031423	E-mail: boomip@alagappauniversity.ac.in

Course Overview:

This course offers a comprehensive introduction to the foundational biomolecules essential for life, including carbohydrates, lipids, proteins, nucleic acids, and vitamins. Students will explore the structure, classification, and functional roles of these molecules in biological systems. Emphasis is placed on chemical principles, water chemistry, acid-base balance, and buffer systems to build a robust biochemical framework. The course develops analytical and application-level understanding necessary for advanced studies in biochemistry and molecular biology.

Teaching methods: The teaching includes lectures, discussions, demonstrations, concept maps and models, self-study and question times and an integrating project work. The project work is in-depth studies in groups with an emphasis on own work and literature studies. The course is completed with a written final examination.

Attendance: Having good attendance record marks the student's sincerity and has an overall positive impact on his/her personality trait development. The students are asked to attend the classes on a regular note and those having a minimum scale of 70-75% attendance are eligible to take up the end-semester examinations as per the University norms.

Punctuality: It is the most important attribute to be followed and maintained by the student throughout his/her life which for sure will lead to the path of success. Students who arrive late by 10mins after the attendance has been taken will be marked absent unless there is a valid reason (medical/ personal emergency) at the discretion of the Head of the Department.

Class Participation: A student's overall growth and personality development is based on his/her involvement in the class not just by mere presence but rather being interactive through questioning that will lead to propagation of ideas, initiation of thought-provoking process and much more that will provide a wholesome enriched classroom experience. Therefore, students are advised to be more attentive so that they

learn from one another and develop quality-based knowledge.

Submission of Assignment: Assignments are given to students with just one motive to get more quantitative and qualitative knowledge insights into the assigned topic/chapter that will lead to preparation and completion of the assignment in a constructive manner here just the knowledge provided is not merely counted but also completion prior to proposed deadline will also have a check on the student's serious consideration of the assignments.

Presentation of Seminar: Apart from the assignments the concerned instructors also allocate the students with a topic or based on their interests to present seminar that will aid them built their confidence levels, command over English language to communicate with precision and fluently. In addition, the fellow students are encouraged to pose questions that will instigate interest and provide update in that particular topic besides the information presented helping them to prepare for their examinations that can be taken as added advantage for the students.

Preparedness: At the end of every class, the concerned instructor tells the students what will be taken in the next class using these details the students should be aware of the topics that will be covered in the upcoming lectures which actually enhance the student's capability to grasp the knowledge and concepts provided much efficiently.

Academic Dishonesty: This is an important aspect that every student should be aware of. Thus, the respective faculty members educate the students of possible means of academic malpractices (plagiarism, violation of copyrights and stealing the patented knowledge) and the following consequences that will make them more vigilant in their academic career.

Subject to change clause: Based on the requirement of student's feasibility and meeting the competitive demands of the discipline the syllabus courses will be re-structured and updated accordingly at the discretion of the Professor(s) and Board of studies chairman.

Important dates: Please note down the important dates and stick to the schedule.

CIA Test I	CIA Test II	Assignment	Seminar
As per Academic Calendar		After CIA Test-I	

Course Outline:

- Structure of atoms and molecules, water chemistry, pH, acids and bases, Henderson-Hasselbalch equation, and biological buffer systems.
- Explains the classification, chemical properties, and biological roles of carbohydrates, including glycoproteins and polysaccharides.

- Describes various classes of lipids, their structures, physicochemical properties, and functions in biological membranes and signaling.
- Discusses the classification, structure, and functional significance of amino acids, proteins, and protein folding levels.
- Covers nucleic acid types, structures, genetic processes (replication, transcription, translation), and an overview of vitamins and their biochemical roles.

I - Semester					
Core-I	**Course Code : 25MBC1C1**	**Introduction to Biomolecules (K1-K5)**	**T**	**Credits: 4**	**Hours: 5**
UNIT-I					
Objective -1	To understand the fundamental chemical principles governing biomolecules, water chemistry, acid-base balance, and buffering systems essential for biological processes.				
Introduction to Biochemistry, structure of atoms, molecules and chemical bonds; structure of water, physio-chemical and significance of water, weak interactions in aqueous systems, ionization of water, pH, pKa, Henderson–Hasselbalch equation; Bronsted-Lowry Concept of Acids and Bases; Introduction to buffer, buffer systems- The phosphate buffer system, The bicarbonate buffer system, The protein buffer system, The amino acid buffer. system, The hemoglobin buffer system					
Outcome – 1	Students will understand water chemistry, acid-base balance, and key biological buffers.				
UNIT-II					
Objective - 2	To provide an in-depth understanding of the classification, structure, stereochemistry, and biological roles of carbohydrates and their derivatives.				
Carbohydrates: Introduction, Classification, Physicochemical properties; Chemistry, Biological roles of carbohydrates, structure and functions of monosaccharides, disaccharides, oligosaccharides and polysaccharides; structure and conformation of sugars; monosaccharides: stereoisomerism and optical isomerism; chemical reactions of the functional groups; sugar derivatives; Glycoproteins; peptidoglycan, proteoglycan, N-linked and O-linked glycoproteins bacterial cell wall polysaccharides; blood group polysaccharides;					
Outcome – 2	Students will be able to analyze carbohydrate types, interpret their functional properties, and explain the structural role of glycoproteins and polysaccharides in biological systems.				
UNIT-III					
Objective - 3	To understand the classification, structure, and biological significance of lipids including fatty acids, complex lipids, and lipid-derived molecules.				
Lipids: Classifications of lipids, Structure, Properties and Biological roles of fatty acids, Fatty acids and their physicochemical properties; Classifications of Triacylglycerols, Phospholipids, glycolipids, Sphingolipids, Lipoproteins, chylomicrons, LDL, HDL and VLDL, steroids, prostaglandins and bile acids ; Introduction to Amphipathic lipids.					
Outcome – 3	Students will be able to describe lipid classes, analyze their physicochemical properties, and explain the roles of lipids in membranes, signaling, and transport.				
UNIT-IV					

Objective - 4	To explore the classification, structure, and physicochemical properties of amino acids and proteins, including their hierarchical structural organization.

Amino acids and Proteins: Classification, Structure and Physicochemical properties, Essential and non-essential amino acids; Proteins - classification based on, chemical composition, Properties and functions; Structural classification - Primary, secondary, tertiary and quaternary structure of proteins. Physiochemical properties of proteins; denaturation

Outcome – 4	Students will be able to classify amino acids and proteins, understand protein structural levels, and explain how protein properties relate to function and denaturation.

UNIT-V

Objective - 5	To understand the structure, types, and functions of nucleic acids and vitamins, and their roles in genetic information flow and metabolism.

Nucleic acids and vitamins: Introduction, Structure and properties of nucleotides, nucleosides, purine (Adenine, Guanine) and pyrimidine (Cytosine, Thiamine, Uracil) bases; Types of Nucleic acids –DNA and RNA; DNA – types-A, B, Z, double helical structure, properties and functions; Denaturation and renaturation; RNA – types-mRNA, tRNA, rRNA; structure and functions. difference between DNA and RNA; genetic code, biological roles of DNA and RNA: replication, transcription and translation; **Vitamins:** Structure and Classification, water soluble and fat soluble vitamins.

Outcome – 5	Students will be able to distinguish between DNA and RNA structures, explain gene expression processes, and classify vitamins based on solubility and biological functions.

Suggested Readings

Reference Books

Voet, D., Voet, J. G., & Pratt, C. W. (2016). Fundamentals of Biochemistry: Life at the Molecular Level (5th ed.). Wiley.

Nelson, D. L., & Cox, M. M. (2021). Lehninger Principles of Biochemistry (8th ed.). W. H. Freeman.

Branden, C., & Tooze, J. (1999). Introduction to Protein Structure (2nd ed.). Garland Science.

Creighton, T. E. (2010). Proteins: Structures and Molecular Properties (2nd ed.). W. H. Freeman.

Alberts, B., Johnson, A., Lewis, J., et al. (2014). Molecular Biology of the Cell (6th ed.). Garland Science.

Satyanarayana, U., & Chakrapani, U. (2021). Biochemistry (6th ed.). Elsevier.

Textbooks

Berg, J. M., Tymoczko, J. L., Gatto, G. J., &Stryer, L. (2022). Biochemistry (9th ed.). W. H. Freeman.

Course Outcome	**K1**	**K2**	**K3**	**K4**	**K5**	**K6**
CO1	✓	✓	✓	✓	✓	-
CO2	✓	✓	✓	✓	✓	-
CO3	✓	✓	✓	✓	✓	-
CO4	✓	✓	✓	✓	✓	-
CO5	✓	✓	✓	✓	✓	-

K1-Remember	***K2-Understand***	***K3- Apply***	***K4-Analyze***	***K5-Evaluate***	***K6-Create***

Course designed by: **Dr. P. Boomi**

Course outcome Vs Programme outcome

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	3	3	3	3	2	3	2	2	1
CO2	3	3	3	3	3	2	2	2	3	3
CO3	3	3	3	3	3	2	2	2	2	3
CO4	3	3	3	3	3	2	2	3	2	3
CO5	3	3	3	3	3	2	2	2	2	3
W. AV	3	3	3	3	3	2	2.2	2.2	2.2	2.6

S-Strong (3) M-Medium (2) L-Low (1)

POs vs COs Interpretation

PO	Weighted Average	Interpretation
PO1	3.0	Strongly aligned with all COs
PO2	3.0	Strongly aligned with all COs
PO3	3.0	Strongly aligned with all COs
PO4	3.0	Strongly aligned with all COs
PO5	3.0	Strongly aligned with all COs
PO6	2.0	Moderately aligned.
PO7	2.2	Moderately supported
PO8	2.2	Moderately supported
PO9	2.2	Moderately supported
PO10	2.6	Moderately supported

Assignment Topics:

- Explain the role of water in biochemical reactions and the significance of its physico-chemical properties.
- Using the Henderson–Hasselbalch equation, calculate the pH of buffer systems under various conditions.
- Compare and contrast the phosphate, bicarbonate, and hemoglobin buffer systems.
- Prepare a comparative chart on structural and functional differences between monosaccharides, disaccharides, and polysaccharides.
- Illustrate the stereoisomerism in glucose and its impact on biological activity.

- Classify lipids and explain the role of phospholipids and sphingolipids in membrane structure.
- Discuss the structure-function relationship of proteins with examples for each structural level.
- Analyze the importance of essential amino acids in human nutrition with examples.
- Compare the structure, function, and biological significance of DNA and RNA.
- Classify vitamins based on solubility and provide their biochemical roles and associated deficiency disorders.

SEMESTER-I

Course Depiction

Cell and Molecular Biology

Program: M.Sc.,	Semester : I (2025-2026 Onwards)
Course Title**: Cell and Molecular Biology** Subject Code: 25MBC1C2	Class Time: As per the time table
Name of Course Teachers	Dr. M. Jeyakumar
Mobile: +91 96559 07058	E-mail: biotechjeya@gmail.com

Course Brief:

This course offers an in-depth exploration of the structural and functional organization of cells, focusing on membranes, organelles, and molecular mechanisms governing cellular life. Students will understand the intricacies of membrane dynamics, signal transduction, intercellular communication, and the role of cytoskeletons in cell structure and motility. Emphasis is placed on the molecular control of the cell cycle, mitosis, and meiosis, along with a detailed study of DNA replication, recombination, and repair processes in both prokaryotic and eukaryotic systems. The course also covers gene expression mechanisms including transcription, translation, and their regulation. By integrating cellular architecture with molecular function, this course prepares students for advanced studies in molecular genetics, biotechnology, and biomedical research.

Teaching methods:

The course will be based on the following teaching and learning activities:

- Lectures covering the theoretical part using PowerPoint presentations
- Case studies
- Review questions

Attendance: A student's academic performance and opportunity to gain knowledge largely depend on regular class attendance. According to university norms, maintaining at least 70–75% attendance is essential

to be eligible to appear for the end-semester examinations.

Punctuality: Punctuality is one of the essential qualities that students must follow and maintain to achieve greater success. Students are required to arrive in class on time without any delay. Only important reasons such as personal or medical emergencies will be accepted as valid excuses. Otherwise, the student will be marked absent.

Class Participation: Classroom participation is important because learning is not just between the student and the teacher, but part of the whole classroom experience which involves questioning, inquiring and exchanging ideas. When students participate, they learn from each other and internalize the knowledge better.

Submission of Assignment: Assignments are an important part of the learning process, designed to help students apply the concepts and knowledge acquired during the course. Each student will receive two assignments that together cover the full syllabus. The course instructor will assign specific topics for each. Completing these assignments with proper effort and understanding will greatly benefit students in preparing for their final examinations.

Presentation of Seminar: Students are supposed to give an oral presentation during the class seminar hours in their assigned topic. Students will discuss on recent research finding related to the topic and participants are encouraged to ask valid questions. Seminars help the students to be updated in their course. In addition students will be able to learn their mistakes and can improve their communication skills during seminar presentation.

Preparedness: Students are expected to have read and be able to discuss the assigned chapter before attending the lecture. In addition, students should be prepared to discuss homework problems.

Academic Dishonesty: Academic dishonesty includes giving, receiving, or using unconstitutional support on any academic work. This includes a person who has taken a test discussing what was on a test with a person who has not taken the test. A clear indication of academic dishonesty will result in a grade of "F" being assigned to that particular piece of work.

Subject to change clause: This syllabus, the course schedule and reading assignments are subject to change at the discretion of the Professor to accommodate instructional and/or student needs.

Important dates: Please note down the important dates and stick to the schedule.

CIA Test I	CIA Test II	Assignment	Seminar
As per Academic Calendar		After CIA Test-I	

Course outline:

- Covers the structure, composition, and transport functions of membranes, cytoskeletal organization, and roles of organelles in cellular processes.
- Explores hormone-receptor interactions, second messengers, G-protein pathways, adhesion molecules, and mechanisms of intercellular communication.
- Describes phases of mitosis and meiosis, regulatory checkpoints, and the biological significance of cell division in growth and reproduction.
- Details the central dogma, DNA replication in prokaryotes and eukaryotes, types of recombination, and DNA damage repair systems.
- Explains the synthesis of RNA and proteins, post-transcriptional/post-translational modifications, genetic code, and inhibitors of gene expression.

I – Semester					
Core-II	**Course Code : 25MBC1C2**	**Cell and Molecular Biology (K1-K5)**	**T**	**Credits: 4**	**Hours: 5**
UNIT-I					
Objective -1	To study the structural organization of cellular membranes and organelles, and understand their dynamic roles in transport, signaling, and motility.				
Cellular Organization and Membrane Dynamics: Structure and function of plasma membrane and membrane transport mechanisms. Membrane models, lipid rafts, and membrane fluidity. Endocytosis, exocytosis, and vesicular trafficking. Cell wall, nucleus, mitochondria, Golgi bodies, lysosomes, endoplasmic reticulum, peroxisomes, plastids, vacuoles, chloroplast, structure & function of cytoskeleton and its role in motility; Cytoskeletal organization: microtubules, microfilaments, and intermediate filaments.					
Outcome - 1	Students will be able to explain membrane structure, transport mechanisms, organelle functions, and the cytoskeleton's role in maintaining cell shape and movement.				
UNIT-II					
Objective - 2	To understand the mechanisms of cell signaling and communication, including receptor types, signal transduction pathways, and intercellular interactions.				
Cell signaling and Communication: Introduction of cell signaling, Hormones and their receptors, cell surface receptor, signaling through G-protein coupled receptors, signal transduction pathways, second messengers, regulation of signaling pathways. **Cellular communication:** Regulation of hematopoiesis, general principles of cell communication, cell adhesion and roles of different adhesion molecules, gap junctions, extracellular matrix, integrins, neurotransmission and its regulation.					
Outcome - 2	Students will be able to explain hormone-receptor signaling, second messengers and the molecular basis of cell adhesion and neurotransmission.				
UNIT-III					

Objective - 3	To provide a comprehensive understanding of the cell cycle, and the mechanisms and significance of mitosis and meiosis.
Cell cycle and Cell division: Cell cycle; Mitosis – Introduction, Phases involved in mitosis, significance of mitosis; Meiosis - Introduction, Phases involved in meiosis, significance of meiosis; Comparison of mitosis and meiosis.	
Outcome - 3	Students will be able to describe the phases of mitosis and meiosis, compare their processes, and explain their roles in growth, repair, and reproduction.
UNIT-IV	
Objective - 4	To study the mechanisms of DNA replication, recombination, and repair in prokaryotes and eukaryotes.
Replication, Recombinant and Repair: Central Dogma, Replication of DNA, Process of Replication in Prokaryotes and Eukaryotes; Enzymes involved in replication and Inhibitors of replication; Homologues and Non-Homologues recombination; DNA damage and repair mechanism.	
Outcome - 4	Students will be able to understand replication processes, distinguish types of recombination, and evaluate DNA repair mechanisms.
UNIT-V	
Objective - 5	To understand the processes of transcription, translation, and their regulation in prokaryotic and eukaryotic systems.
Transcription and Translation: RNA synthesis, Transcription in Prokaryotes and Eukaryotes, post-transcription modification; Reverse transcription; Protein synthesis – genetic code, wobble hypothesis, translation – Initiation, elongation, termination; Inhibitors of translation; Post-translational modification; Gene regulation –lac and trp operon.	
Outcome - 5	Students will be able to describe RNA and protein synthesis, interpret the genetic code, and explain post-transcriptional and post-translational modifications

Suggested Readings

Reference Books

Alberts, B., Johnson, A., Lewis, J., Raff, M., Roberts, K., & Walter, P. (2014). Molecular Biology of the Cell (6th ed.). Garland Science.

Cooper, G. M., & Hausman, R. E. (2018). The Cell: A Molecular Approach (8th ed.). Oxford University Press.

Lodish, H., Berk, A., Kaiser, C. A., Krieger, M., Scott, M. P., Bretscher, A., Ploegh, H., & Matsudaira, P. (2021). Molecular Cell Biology (9th ed.). W.H. Freeman.

Karp, G. (2018). Cell and Molecular Biology: Concepts and Experiments (8th ed.). Wiley.

Hall, J. E. (2020). Guyton and Hall Textbook of Medical Physiology (14th ed.). Elsevier.

P.S. Verma & V.K. Agarwal. (2005). Cell Biology, Genetics, Molecular Biology, Evolution and Ecology. S. Chand & Company Ltd. ISBN : 81-219-2442-1

Satyanarayana, B. D. *Biotechnology*. 2nd ed., Books and Allied (P) Ltd., 2013.

Online Resources

Molecular Biology of the Cell - NCBI Bookshelf https://www.ncbi.nlm.nih.gov/books/NBK21054/

HHMI BioInteractive – Cell Biology and Physiology – https://www.biointeractive.org/.

Nature Reviews Molecular Cell Biology – https://www.nature.com/nrm/.

Physiology Online – American Physiological Society – https://www.physiology.org/.

Course Outcome	K1	K2	K3	K4	K5	K6
CO1	✓	✓	✓	✓	✓	-

CO2	✓	✓	✓	✓	✓	-
CO3	✓	✓	✓	✓	✓	-
CO4	✓	✓	✓	✓	✓	-
CO5	✓	✓	✓	✓	✓	-
K1-Remember	***K2-Understand***	***K3- Apply***	***K4-Analyze***	***K5-Evaluate***	***K6-Create***	
Course designed by: Dr. M. Jeyakumar						

Course outcome Vs Programme outcome

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	3	3	3	2	2	2	1	2	2
CO2	3	3	3	3	2	3	2	2	2	3
CO3	3	3	3	3	3	2	2	2	2	2
CO4	3	3	3	3	3	2	3	3	2	2
CO5	3	3	3	3	3	2	3	3	3	2
W. AV	3	3	3	3	2.6	2.2	2.4	2.2	2.2	2.2

S-Strong (3) M-Medium (2) L-Low (1)

POs vs COs Interpretation

PO	Weighted Average	Interpretation
PO1	3.0	Strongly aligned with all COs
PO2	3.0	Strongly aligned with all COs
PO3	3.0	Strongly aligned with all COs
PO4	3.0	Strongly aligned with all COs
PO5	2.6	Moderately supported
PO6	2.2	Moderately supported
PO7	2.4	Moderately supported
PO8	2.2	Moderately supported
PO9	2.2	Moderately supported
PO10	2.2	Moderately supported

Assignment Topics:

- Structural Models of Plasma Membranes: Evolution from Fluid Mosaic Model to Lipid Rafts
- Cytoskeletal Elements and Their Role in Cell Shape, Intracellular Transport, and Motility.
- G-Protein Coupled Receptors (GPCRs) in Cell Signaling: Structure, Function, and Clinical Relevance.

- Mechanisms and Regulation of Cell Cycle: Comparison between Mitosis and Meiosis.
- Signal Transduction Pathways in Hormone Action: cAMP and Calcium as Second Messengers.
- DNA Replication in Prokaryotes vs. Eukaryotes: Key Enzymes, Origins, and Fidelity Mechanisms.

SEMESTER-I

Course Depiction

Enzymology

Program: M.Sc.,	Semester : I (2025-2026 Onwards)
Course Title**: Enzymology** Subject Code: 25MBC1C3	Class Time: As per the time table
Name of Course Teachers	Dr. M. Mamutha
Mobile:+91 91761 63179	E-mail: mamudha2014@gmail.com

Course Brief:

This course provides a comprehensive overview of enzymes—their structure, mechanisms, kinetics, regulation, and diverse applications. Students will explore the molecular basis of enzyme catalysis, inhibition, and regulation; derive and apply enzyme kinetic models; and understand how enzymes are used and modified for industrial, diagnostic, and therapeutic purposes. Emphasis is placed on modern enzymology including enzyme engineering, immobilization techniques, and emerging biotechnological uses of extremozymes and biosensors.

Teaching methods:

The course will be based on the following teaching and learning activities:

- Lectures covering the theoretical part using PowerPoint presentations
- Case studies
- Review questions

Attendance: A student's academic performance and opportunity to gain knowledge largely depend on regular class attendance. According to university norms, maintaining at least 70–75% attendance is essential to be eligible to appear for the end-semester examinations.

Punctuality: Punctuality is one of the essential qualities that students must follow and maintain to achieve greater success. Students are required to arrive in class on time without any delay. Only important reasons such as personal or medical emergencies will be accepted as valid excuses. Otherwise, the student will be

marked absent.

Class Participation: Classroom participation is important because learning is not just between the student and the teacher, but part of the whole classroom experience which involves questioning, inquiring and exchanging ideas. When students participate, they learn from each other and internalize the knowledge better.

Submission of Assignment: Assignments are an important part of the learning process, designed to help students apply the concepts and knowledge acquired during the course. Each student will receive two assignments that together cover the full syllabus. The course instructor will assign specific topics for each. Completing these assignments with proper effort and understanding will greatly benefit students in preparing for their final examinations.

Presentation of Seminar: Students are supposed to give an oral presentation during the class seminar hours in their assigned topic. Students will discuss on recent research finding related to the topic and participants are encouraged to ask valid questions. Seminars help the students to be updated in their course. In addition students will be able to learn their mistakes and can improve their communication skills during seminar presentation.

Preparedness: Students are expected to have read and be able to discuss the assigned chapter before attending the lecture. In addition, students should be prepared to discuss homework problems.

Academic Dishonesty: Academic dishonesty includes giving, receiving, or using unconstitutional support on any academic work. This includes a person who has taken a test discussing what was on a test with a person who has not taken the test. A clear indication of academic dishonesty will result in a grade of "F" being assigned to that particular piece of work.

Subject to change clause: This syllabus, the course schedule and reading assignments are subject to change at the discretion of the Professor to accommodate instructional and/or student needs.

Important dates: Please note down the important dates and stick to the schedule.

CIA Test I	**CIA Test II**	**Assignment**	**Seminar**
As per Academic Calendar		After CIA Test-I	

Course outline:

- Understand the IUBMB classification of enzymes, active site structure, coenzymes and cofactors, and catalytic mechanisms including acid-base, covalent, and metal ion catalysis involved in enzyme-substrate interactions.
- Study steady-state enzyme kinetics and derive the Michaelis-Menten equation. Analyze kinetic

plots (Lineweaver-Burk, Eadie-Hofstee, Hanes) and understand single and double displacement mechanisms in bi-substrate reactions.

- Explore types of enzyme inhibition (competitive, non-competitive, uncompetitive, mixed) and models of allosteric regulation. Examine zymogen activation, covalent modifications, and multi-enzyme complexes like pyruvate dehydrogenase.
- Learn strategies such as site-directed mutagenesis and directed evolution. Understand enzyme immobilization methods (adsorption, covalent bonding, entrapment) and their applications in biosensors and industrial biocatalysis.
- Examine the roles of enzymes in food, pharmaceutical, and textile industries. Understand the use of enzymes in diagnostics and therapy (e.g., streptokinase, asparaginase), enzymatic biosensors, and the biotechnological relevance of extremozymes.

<table>
<tr><td colspan="6">I – Semester</td></tr>
<tr><td>Core-III</td><td>Course Code : 25MBC1C3</td><td>Enzymology (K1-K5)</td><td>T</td><td>Credits: 4</td><td>Hours: 5</td></tr>
<tr><td colspan="6">UNIT-I</td></tr>
<tr><td>Objective -1</td><td colspan="5">To study enzyme classification, structure, coenzymes, and catalytic mechanisms involved in enzyme-substrate interactions.</td></tr>
<tr><td colspan="6">Enzyme Structure and Function: Classification of enzymes (IUBMB system), enzyme specificity, active site, coenzymes, and cofactors. Mechanisms of enzyme action. Lock and key and Induced fit hypothesis, Transition state stabilization, enzyme-substrate interactions, catalytic strategies (acid-base catalysis, covalent catalysis, metal ion catalysis).</td></tr>
<tr><td>Outcome - 1</td><td colspan="5">Students will be able to identify enzyme classes, explain active site interactions, and analyze catalytic mechanisms.</td></tr>
<tr><td colspan="6">UNIT-II</td></tr>
<tr><td>Objective - 2</td><td colspan="5">To understand steady-state kinetics, derive the Michaelis-Menten equation, and study bi-substrate reaction mechanisms.</td></tr>
<tr><td colspan="6">Enzyme Kinetics: Steady state theory – Definition and concept, Km - Michaelis constant. and Vmax; Michaelis Menten Derivation and significance of M.M equation. LB Plot , Eadie Hoftsee and Hanes plot, Mechanism of Bi-suction: Single displacement and Double displacement Reaction; Random – order mechanism- Ternary complex formation. Ping - pong mechanism, Factors influencing or affecting enzyme catalytic reaction-(Effect of pH ,Temperature, Enzyme, Substrate and Time - Mechanism and Graph).</td></tr>
<tr><td>Outcome - 2</td><td colspan="5">Students will be able to interpret kinetic plots, apply equations to enzyme data, and analyze bi-substrate kinetics.</td></tr>
<tr><td colspan="6">UNIT-III</td></tr>
<tr><td>Objective - 3</td><td colspan="5">To explore enzyme inhibition types, regulation mechanisms, zymogen activation,</td></tr>
</table>

	and multi-enzyme complexes.
Enzyme inhibition and regulation: competitive, non-competitive, uncompetitive and mixed. Allosteric and feedback inhibition with examples, suicide inhibition. Dose- response curves of enzyme inhibition, Enzyme regulation – cooperativity and allostery in proteins, models of allosteric behaviour. Covalently modulated enzymes - reversible and irreversible covalent modifications. Zymogen form of enzymes and zymogen activation. Multienzyme system –mechanism of action of pyruvate dehydrogenase and fatty acid synthase complexes. Isoenzymes- lactate dehydrogenase and creatine phosphokinase.	
Outcome - 3	Students will evaluate enzyme inhibition models, differentiate between regulation types, and examine isoenzyme behavior.
UNIT-IV	
Objective - 4	To study enzyme modification techniques and immobilization strategies for enhanced biocatalytic applications.
Enzyme Engineering and Immobilization: Strategies for enzyme engineering (site-directed mutagenesis, directed evolution). Methods of enzyme immobilization (adsorption, covalent bonding, entrapment, encapsulation). Applications of immobilized enzymes in biocatalysis and biosensors.	
Outcome - 4	Students will analyze immobilization methods, assess enzyme engineering strategies, and propose suitable applications.
UNIT-V	
Objective - 5	To understand enzyme roles in industries, diagnostics, therapeutics, and the use of extremozymes and biosensors
Industrial and Clinical Applications of Enzymes: Role of enzymes in food, pharmaceutical, and textile industries. Enzymes in diagnostics and therapeutics (streptokinase, asparaginase). Enzymatic biosensors. Extremozymes and their applications in biotechnology.	
Outcome - 5	Students will evaluate enzyme-based technologies in healthcare and industry and apply them in practical scenarios.

Suggested Readings

Reference Books

Palmer, T., & Bonner, P. L. (2011). Enzymes: Biochemistry, Biotechnology, Clinical Chemistry (2nd ed.). Woodhead Publishing.

Copeland, R. A. (2000). Enzymes: A Practical Introduction to Structure, Mechanism, and Data Analysis (2nd ed.). Wiley-VCH.

Price, N. C., & Stevens, L. (1999). Fundamentals of Enzymology: The Cell and Molecular Biology of Catalytic Proteins (3rd ed.). Oxford University Press.

Fersht, A. (2017). Structure and Mechanism in Protein Science: A Guide to Enzyme Catalysis and Protein Folding. World Scientific.

Textbooks

Nelson, D. L., & Cox, M. M. (2021). Lehninger Principles of Biochemistry (8th ed.). W. H. Freeman.

Voet, D., Voet, J. G., & Pratt, C. W. (2016). Fundamentals of Biochemistry: Life at the Molecular Level (5th ed.). Wiley.

Satyanarayana, U., & Chakrapani, U. (2020). Biochemistry (6th ed.). Elsevier.

Online Resources

BRENDA Enzyme Database – https://www.brenda-enzymes.org.

ExPASy Enzyme Portal – https://enzyme.expasy.org.

NCBI Enzyme Database – https://www.ncbi.nlm.nih.gov/protein.

MIT OpenCourseWare – Enzymology – https://ocw.mit.edu/courses/biology.

Course Outcome	K1	K2	K3	K4	K5	K6
CO1	✓	✓	✓	✓	✓	-
CO2	✓	✓	✓	✓	✓	-
CO3	✓	✓	✓	✓	✓	-
CO4	✓	✓	✓	✓	✓	-
CO5	✓	✓	✓	✓	✓	-

K1-Remember	*K2-Understand*	*K3- Apply*	*K4-Analyze*	*K5-Evaluate*	*K6-Create*

Course designed by: Dr. M. Mamutha

Course outcome Vs Programme outcome

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	3	3	3	2	2	2	2	2	3
CO2	3	3	3	3	3	2	2	2	2	3
CO3	3	3	3	3	1	3	3	3	2	2
CO4	3	3	3	3	1	2	2	2	2	2
CO5	3	3	3	3	3	2	1	3	3	2
W.AV	3	3	3	3	2	2.2	2	2.4	2.2	2.4

S-Strong (3) M-Medium (2) L-Low (1)

POs vs Cos Interpretation

PO	Weighted Average	Interpretation
PO1	3.0	Strongly aligned with all COs
PO2	3.0	Strongly aligned with all COs
PO3	3.0	Strongly aligned with all COs
PO4	3.0	Strongly aligned with all COs
PO5	2.0	Moderately supported
PO6	2.2	Moderately supported
PO7	2	Moderately supported
PO8	2.4	Moderately supported
PO9	2.2	Moderately supported
PO10	2.4	Moderately supported

Assignment topics:

- Classify enzymes using the IUBMB system and explain the significance of enzyme specificity and active sites with examples.
- Derive the Michaelis-Menten equation and interpret its relevance in enzyme kinetics with the help of real-world examples.
- Compare and contrast competitive, non-competitive, and uncompetitive inhibition mechanisms with graphical representations.
- Discuss the mechanisms of enzyme catalysis (acid-base, covalent, and metal ion catalysis) using well-characterized enzymes.
- Evaluate the advantages and limitations of different enzyme immobilization techniques for industrial applications.
- Analyze the role of allosteric enzymes in metabolic regulation with reference to feedback inhibition models.
- Describe the mechanism and physiological role of a multi-enzyme complex such as pyruvate dehydrogenase.
- Prepare a report on the therapeutic use of enzymes like asparaginase and streptokinase in clinical treatments.
- Investigate how enzyme engineering (site-directed mutagenesis or directed evolution) enhances enzyme stability or specificity.
- Explore the role of extremozymes in biotechnology and discuss their applications in harsh industrial environments.

SEMESTER-I

Course Depiction

Lab – I: Biomolecules, Cellular, and Enzymology Lab

Program: M.Sc.,	Semester : II (2025-2026 Onwards)
Course Title**: Lab – I:** Biomolecules, Cellular, and Enzymology Lab Subject Code: 25MBC1P1	Class Time: As per the time table
Name of Course Teachers	Dr. M. Jeyakumar & Dr. M. Mamutha
Mobile: +91 96559 07058 +91 91761 63179	E-mail: biotechjeya@gmail.com mamudha2014@gmail.com

Course Brief:

This laboratory course offers foundational training in biochemical, cellular, and microbial techniques essential for a career in life sciences. Students will gain hands-on experience in the quantitative estimation of key biomolecules, learn essential techniques in microbial culture and staining, and study enzyme kinetics under varying physiological conditions. The course emphasizes experimental design, data interpretation, and application of core biochemical principles in laboratory practice.

Teaching methods

The course will be based on the following teaching and learning activities:

- Lectures covering the theoretical part using PowerPoint presentations
- Case studies
- Review questions

Attendance: A student's academic performance and opportunity to gain knowledge largely depend on regular class attendance. According to university norms, maintaining at least 70–75% attendance is essential to be eligible to appear for the end-semester examinations.

Punctuality: Punctuality is one of the essential qualities that students must follow and maintain to achieve greater success. Students are required to arrive in class on time without any delay. Only important reasons such as personal or medical emergencies will be accepted as valid excuses. Otherwise, the student will be marked absent.

Class Participation: Classroom participation is important because learning is not just between the student and the teacher, but part of the whole classroom experience which involves questioning, inquiring and exchanging ideas. When students participate, they learn from each other and internalize the knowledge better.

Submission of Assignment: Assignments are an important part of the learning process, designed to help students apply the concepts and knowledge acquired during the course. Each student will receive two assignments that together cover the full syllabus. The course instructor will assign specific topics for each. Completing these assignments with proper effort and understanding will greatly benefit students in preparing for their final examinations.

Presentation of Seminar: Students are supposed to give an oral presentation during the class seminar hours in their assigned topic. Students will discuss on recent research finding related to the topic and participants are encouraged to ask valid questions. Seminars help the students to be updated in their course. In addition students will be able to learn their mistakes and can improve their communication skills during seminar presentation.

Preparedness: Students are expected to have read and be able to discuss the assigned chapter before attending

the lecture. In addition, students should be prepared to discuss homework problems.

Academic Dishonesty: Academic dishonesty includes giving, receiving, or using unconstitutional support on any academic work. This includes a person who has taken a test discussing what was on a test with a person who has not taken the test. A clear indication of academic dishonesty will result in a grade of "F" being assigned to that particular piece of work.

Subject to change clause: This syllabus, the course schedule and reading assignments are subject to change at the discretion of the Professor to accommodate instructional and/or student needs.

Important dates: Please note down the important dates and stick to the schedule.

CIA Test I	**CIA Test II**	**Assignment**	**Seminar**
As per Academic Calendar		After CIA Test-I	

Course Outline

- Perform colorimetric assays to estimate carbohydrates, proteins, lipids, DNA, and RNA using standard biochemical methods.
- Study cellular structures and stages of mitosis and meiosis using micrographs and permanent slides.
- Prepare various culture media and practice aseptic techniques for microbial culture and streaking.
- Apply simple and Gram staining techniques to identify and differentiate microbial species.
- Investigate the effects of pH, temperature, and substrate concentration on acid and alkaline phosphatase activity.

I – Semester					
Core-IV	**Course Code 25MBC1P1**	**Lab – I: Biomolecules, Cellular, and Enzymology Lab (K1-K5)**	**P**	**Credits: 4**	**Hours: 8**
UNIT-I					
Objective -1	To develop practical skills in the quantitative estimation of essential biomolecules such as carbohydrates, lipids, proteins, and nucleic acids.				
Module 1 : Biomolecules 1. Estimation of Carbohydrates by Anthrone method 2. Estimation of protein using Lowry's methods. 3. Estimation of DNA using DPA. 4. Estimation of RNA using Orcinol reagent. 5. Estimation of Total Cholesterol by ZAK"s method.					
Outcome - 1	Students will be able to accurately quantify and interpret the levels of key biomolecules using standard biochemical assays.				
UNIT-II					
Objective - 2	To develop practical skills in cellular observation, microbial culture techniques, staining methods, and antibiotic sensitivity testing.				

Module 2: Cellular Biochemistry

6. Preparation of culture media- Nutrient Broth, Nutrient Agar, Blood Agar, Macconkey Agar, Potato Dextrose Agar.
7. Preparation of Microbial Culture and streaking method.
8. Staining techniques – simple and gram staining.
9. Assay of antibiotics by disc diffusion method.

Outcome - 2	Students will be able to distinguish prokaryotic and eukaryotic cell structures, prepare culture media, perform microbial staining, and evaluate antibiotic effects using the disc diffusion method.

UNIT-III

Objective - 3	To investigate the influence of pH, temperature, and substrate concentration on the activity of acid and alkaline phosphatase enzymes.

Module 3: Enzymology

10. Effect of pH on Acid Phosphatase activity
11. Effect of Temperature on Acid Phosphatase activity
12. Effect of pH on Alkaline Phosphatase activity
13. Effect of Temperature on Alkaline Phosphatase activity
14. Effect of pH on Catalase activity
15. Effect of Temperature on Catalase activity

Outcome - 3	Students will understand how environmental and kinetic factors affect enzyme activity and be able to interpret enzyme behavior under varying conditions.

Suggested Readings

Nelson, D. L., & Cox, M. M. (2021). *Lehninger Principles of Biochemistry* (8th Ed.). W.H. Freeman and Company.

Plummer, D. T. (1987).*An Introduction to Practical Biochemistry* (3rd Ed.). Tata McGraw-Hill.

Raghuramulu, N., Madhavan Nair, K., & Kalyanasundaram, S. (2003). *A Manual of Laboratory Techniques*. National Institute of Nutrition (ICMR).

De Robertis, E. D. P., & De Robertis Jr, E. M. F. (2001). *Cell and Molecular Biology* (8th Ed.). Lippincott Williams & Wilkins.

Karp, G. (2021). *Cell and Molecular Biology: Concepts and Experiments* (8th Ed.). Wiley.

Verma, P. S., & Agarwal, V. K. (2013). *Cell Biology, Genetics, Molecular Biology, Evolution and Ecology*. S. Chand Publishing.

Pelczar, M. J., Chan, E. C. S., & Krieg, N. R. (2006). *Microbiology: An Application Based Approach* (5th Ed.). Tata McGraw-Hill.

Cappuccino, J. G., & Welsh, C. T. (2019). *Microbiology: A Laboratory Manual* (11th Ed.). Pearson Education.

Prescott, L. M., Harley, J. P., & Klein, D. A. (2016). *Microbiology* (10th Ed.). McGraw-Hill Education.

Course Outcome	K1	K2	K3	K4	K5	K6
CO1	✓	✓	✓	✓	✓	-
CO2	✓	✓	✓	✓	✓	-

CO3	✓	✓	✓	✓	✓	-
CO4	✓	✓	✓	✓	✓	-
CO5	✓	✓	✓	✓	✓	-
K1-Remember	***K2-Understand***	***K3- Apply***	***K4-Analyze***	***K5-Evaluate***	***K6-Create***	
Course designed by: Dr.M.Jeyakumar & Dr.M. Mamutha						

Course outcome Vs Programme outcome

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	3	3	3	3	2	2	3	3	3
CO2	3	3	3	3	3	2	2	3	3	3
CO3	3	3	3	3	3	2	3	3	3	3
CO4	3	3	3	3	3	2	3	3	3	3
CO5	3	3	3	3	3	2	3	3	3	3
W.AV	3	3	3	3	3	2	2.3	3	3	3

S-Strong (3) M-Medium (2) L-Low

POs VS COs Interpretation

PO	Weighted Average	Interpretation
PO1	3.0	Strongly aligned with all COs
PO2	3.0	Strongly aligned with all COs
PO3	3.0	Strongly aligned with all COs
PO4	3.0	Strongly aligned with all COs
PO5	3.0	Strongly aligned with all COs
PO6	2.0	Moderately supported
PO7	2.3	Moderately supported
PO8	3.0	Strongly aligned with all COs
PO9	3.0	Strongly aligned with all COs
PO10	3.0	Strongly aligned with all COs

SEMESTER-II

Course Depiction

Intermediary Metabolism and Regulation

Program: M.Sc.,	Semester : II (2025-2026 Onwards)
Course Title**: Intermediary Metabolism and Regulation** Subject Code: 25MBC2C1	Class Time: As per the time table
Name of Course Teachers	Dr. M. Jeyakumar
Mobile: +91 96559 07058	E-mail: biotechjeya@gmail.com

Course Brief:

This course delves into the complex biochemical pathways and regulatory mechanisms that govern the metabolism of carbohydrates, lipids, amino acids, and nucleotides in living systems. It emphasizes energy transformation, enzyme functions in redox reactions, and metabolic integration under normal and pathological conditions. Students will gain insight into bioenergetics, oxidative phosphorylation, and key metabolic disorders such as diabetes, obesity, and inborn errors of metabolism. The course also explores nucleotide and porphyrin metabolism with clinical relevance.

Teaching methods: The teaching includes lectures, discussions, demonstrations, concept maps and models, self-study and question times and an integrating project work. The project work is in-depth studies in groups with an emphasis on own work and literature studies. The course is completed with a written final examination.

Attendance: Regular class attendance improves a student's academic performance and learning experience. Students are expected to attend classes regularly, and as per university norms, those with at least 70–75% attendance are eligible to appear for the end-semester examinations.

Punctuality: Being punctual is a key habit that helps students reach important goals in their academic journey. Students must arrive on time for every class without unnecessary delays. Absences will only be excused for valid reasons such as personal or medical emergencies. In all other cases, late arrivals will be marked as absent.

Class Participation: Class participation and interaction helps to form a complete educational experience. However, class participation and interaction is to be relevant to course content and context. Deviant behavior may lead to dismissal or suspension.

Submission of Assignment: Assignments are given to the students to help them to apply the concepts and knowledge gained by the course. Each students will be assigned two assignments for the course, covering entire syllabus. Topic of assignments for each assignments will be assigned by the course instructor. Good preparation of assignment will help the students for their final exams.

Presentation of Seminar: Beyond regular assignments, students are expected to deliver an oral presentation during seminar sessions on a topic assigned by the instructor. These seminars aim to improve students' public speaking and communication skills. Active participation from classmates through relevant questions will be encouraged to foster engagement and build confidence. This interactive setting also helps students broaden their understanding and stay current with key concepts in the course.

Preparedness: Prior to attending the class the students are expected to collect information regarding the

topic given in advance, so that they will be able to discuss during the lecture.

Academic Dishonesty: Academic dishonesty is a serious violation of ethical conduct and is not tolerated under any circumstances. To promote academic integrity, faculty members proactively educate students about common forms of misconduct—such as plagiarism, copyright infringement, and unauthorized use of patented material. By understanding these issues and their consequences, students are better equipped to act responsibly and uphold honesty throughout their academic journey.

Subject to change clause: Depending upon the requirement of student's possibility, the course syllabus will be re-structured and updated accordingly at the discretion of the Professor(s) and Board of studies chairperson.

Important dates: Please note down the important dates and stick to the schedule.

CIA Test I	**CIA Test II**	**Assignment**	**Seminar**
As per Academic Calendar		After CIA Test-I	

Course outline:

- Explore the principles of thermodynamics in biological systems, redox reactions, ATP generation through oxidative phosphorylation, and the roles of respiratory chain enzymes and chemiosmotic mechanisms.
- Study glycolysis, gluconeogenesis, glycogen metabolism, pentose phosphate pathway, and the citric acid cycle. Learn how these pathways are regulated and how metabolic disorders like diabetes and glycogen storage diseases arise.
- Analyze the pathways of fatty acid oxidation, ketogenesis, fatty acid synthesis, and cholesterol metabolism. Understand lipoprotein transport, regulatory enzymes, and conditions like obesity, fatty liver, and atherosclerosis.
- Examine the degradation and biosynthesis of amino acids, nitrogen balance, urea cycle, and mechanisms like transamination and deamination. Understand genetic and metabolic disorders including PKU, MSUD, and alkaptonuria.
- Learn the biosynthesis and degradation of purines and pyrimidines through de novo and salvage pathways, and regulatory roles of key enzymes. Study porphyrin metabolism and its relevance to clinical conditions like porphyrias.

II- Semester					
Core : V	**Course Code : 25MBC2C1**	**Intermediary Metabolism and Regulation (K1-K5)**	**T**	**Credits: 4**	**Hours: 4**

UNIT-I	
Objective -1	To understand energy flow in biological systems, thermodynamic principles, and oxidative phosphorylation.
Bioenergetics: Energy transformation, Thermodynamics –First law of thermodynamics, second law of thermodynamics, Gibbs free energy, endergonic & exergonic reactions; Metabolism – Anabolism – Catabolism - Xenobiotic metabolism; Biological oxidation-reduction reactions, standard redox potentials, Hydrolysis of energy rich intermediates and ATP ,Respiratory transport, Electron Transport and Proton pump, Oxidative Phosphorylation and ATP synthesis, conformational changes and chemiosmotic theory, Enzymes involved in oxidation and reduction (oxidases, dehydrogenases, hydroperoxidases and oxygenases).	
Outcome - 1	Students will be able to explain ATP synthesis, redox reactions, and enzyme functions in energy metabolism**.**
UNIT-II	
Objective - 2	To study pathways of carbohydrate metabolism and their regulation under physiological and pathological conditions.
Carbohydrate Metabolism: Glycolysis, citric acid cycle, gluconeogenesis, glycogen metabolism, Glycogenesis and Glycogenolysis, Glycogen storage disease. pentose phosphate pathway, uronic acid pathway, Galactose and fructose metabolism, Regulation of carbohydrate metabolism.	
Outcome - 2	Students will analyze and interpret glycolysis, gluconeogenesis, and glycogen metabolism, including related disorders.
UNIT-III	
Objective - 3	To examine lipid catabolism and biosynthesis, lipid transport, and metabolic control mechanisms.
Lipid Metabolism: Hydrolysis of tri-glycerol**,** Beta-oxidation of fatty acids, ketogenesis, fatty acid synthesis, and cholesterol metabolism. Phospholipids metabolism, tri-glycerol synthesis. Regulation of lipid metabolism. Metabolic disorders such as obesity and fatty liver disease.	
Outcome - 3	Students will evaluate fatty acid oxidation, cholesterol metabolism, and identify key metabolic disorders.
UNIT-IV	
Objective - 4	To understand amino acid metabolism and nitrogen elimination processes such as the urea cycle.
Protein and Amino Acid Metabolism: Transamination and deamination, Amino acid degradation-Ammonia, urea cycle, Metabolism of individual amino acid – Glycine, Methionine and tyrosine metabolism, Metabolic disorders such as phenylketonuria, maple syrup urine disease, and alkaptonuria.	
Outcome - 4	Students will be able to describe amino acid catabolism and correlate inborn errors with clinical outcomes.
UNIT-V	
Objective - 5	To explore purine, pyrimidine, and porphyrin biosynthesis and degradation with regulatory mechanisms.

Nucleic acid metabolism: Purine biosynthesis – De novo and salvage pathways, Regulation of purine biosynthesis and degradation; pyrimidine biosynthesis - De novo and salvage pathways, Regulation of pyrimidine biosynthesis and degradation; Role of ribonucleotide reductase and its regulation. Degradation of purine and pyrimidine nucleotides. **Metabolism of Porphyrins:** Biosynthesis of Porphyrins;	
Outcome - 5	Students will analyze nucleotide metabolism and its clinical significance, including porphyrin-related disorders.

Suggested Readings

Reference Books

Berg, J. M., Tymoczko, J. L., Gatto, G. J., &Stryer, L. (2019). Biochemistry (9th ed.). W.H. Freeman

Lehninger, A. L., Nelson, D. L., & Cox, M. M. (2021). Lehninger Principles of Biochemistry (8th ed.). W.H. Freeman.

Voet, D., Voet, J. G., & Pratt, C. W. (2016). Fundamentals of Biochemistry: Life at the Molecular Level (5th ed.). Wiley.

Garrett, R. H., & Grisham, C. M. (2016). Biochemistry (6th ed.). Cengage Learning.

Devlin, T. M. (2010). Textbook of Biochemistry with Clinical Correlations (7th ed.). Wiley.

Rodwell, V. W., Bender, D. A., Botham, K. M., Kennelly, P. J., & Weil, P. A. (2018).

Textbooks

1. Lehninger, A. L., Nelson, D. L., & Cox, M. M. (2021). Lehninger Principles of Biochemistry (8th ed.).
2. Berg, J. M., Tymoczko, J. L., &Stryer, L. (2019). Biochemistry (9th ed.).

Online Resources

1. NCBI Bookshelf – Biochemistry and Metabolism – https://www.ncbi.nlm.nih.gov/books/.
2. Nature Metabolism – Research Articles – https://www.nature.com/natmetab/.
3. MIT OpenCourseWare – Metabolic Biochemistry – https://ocw.mit.edu/courses/biology/.

Course Outcome	K1	K2	K3	K4	K5	K6
CO1	✓	✓	✓	✓	✓	-
CO2	✓	✓	✓	✓	✓	-
CO3	✓	✓	✓	✓	✓	-
CO4	✓	✓	✓	✓	✓	-
CO5	✓	✓	✓	✓	✓	-

K1-Remember	***K2-Understand***	***K3- Apply***	***K4-Analyze***	***K5-Evaluate***	***K6-Create***

Course designed by: Dr. M. Jeyakumar

Course outcome Vs Programme outcome

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	3	3	3	2	2	2	2	2	2
CO2	3	3	3	3	2	2	3	3	2	2
CO3	3	3	3	3	2	2	2	2	3	2
CO4	3	3	3	3	2	2	2	2	3	2
CO5	3	3	3	3	2	3	2	1	3	2
W.AV	3	3	3	3	2	2.2	2.2	2	2.6	2

S-Strong (3) M-Medium (2) L-Low (1)

POs VS COs Interpretation

PO	Weighted Average	Interpretation
PO1	3.0	Strongly aligned with all COs
PO2	3.0	Strongly aligned with all COs
PO3	3.0	Strongly aligned with all COs
PO4	3.0	Strongly aligned with all COs
PO5	2.0	Moderately supported
PO6	2.2	Moderately supported
PO7	2.2	Moderately supported
PO8	2.0	Moderately supported
PO9	2.6	Moderately supported
PO10	2.0	Moderately supported

Assignment topics:

- Explain the principles of bioenergetics and the role of ATP as an energy currency in biological systems.
- Compare and contrast oxidative phosphorylation and substrate-level phosphorylation in energy metabolism.
- Write an analytical report on the regulation of glycolysis and gluconeogenesis under fed and fasting states.
- Discuss the metabolic basis and clinical manifestations of Type I and Type II diabetes mellitus.
- Describe the regulation of cholesterol biosynthesis and its relevance to atherosclerosis.
- Evaluate the biochemical pathways of ketogenesis and their significance in fasting and diabetes.
- Prepare a case study on an inborn error of amino acid metabolism (e.g., phenylketonuria or maple syrup urine disease).
- Illustrate the urea cycle and explain how its disruption can lead to hyperammonemia.
- Discuss purine and pyrimidine metabolism and relate it to clinical conditions such as gout and SCID.
- Analyze the biosynthesis and degradation of porphyrins, and explain the biochemical basis of porphyrias.

SEMESTER-II

Course Depiction

Molecular Basis of Development

Program: M.Sc.,	Semester : II (2025-2026 Onwards)
Course Title**: Molecular Basis of Development** Subject Code: 25MBC2C2	Class Time: As per the time table
Name of Course Teachers	Dr. M. Mamutha
Mobile: +91 91761 63179	E-mail: mamudha2014@gmail.com

Course Brief:

This course provides an advanced understanding of how energy flows through biological systems and how biomolecules are synthesized, broken down, and regulated in the human body. It explores the detailed biochemical pathways of carbohydrates, lipids, proteins, nucleotides, and porphyrins, along with the thermodynamic and enzymatic principles that drive metabolism. Emphasis is placed on the integration of these pathways under normal and pathological conditions, enabling students to connect molecular mechanisms with metabolic disorders and clinical applications.

Teaching methods

The course will be based on the following teaching and learning activities:

- Lectures covering the theoretical part using PowerPoint presentations
- Case studies
- Review questions

Attendance: A student's academic performance and opportunity to gain knowledge largely depend on regular class attendance. According to university norms, maintaining at least 70–75% attendance is essential to be eligible to appear for the end-semester examinations.

Punctuality: Punctuality is one of the essential qualities that students must follow and maintain to achieve greater success. Students are required to arrive in class on time without any delay. Only important reasons such as personal or medical emergencies will be accepted as valid excuses. Otherwise, the student will be marked absent.

Class Participation: Classroom participation is important because learning is not just between the student and the teacher, but part of the whole classroom experience which involves questioning, inquiring and exchanging ideas. When students participate, they learn from each other and internalize the knowledge better.

Submission of Assignment: Assignments are an important part of the learning process, designed to help students apply the concepts and knowledge acquired during the course. Each student will receive two assignments that together cover the full syllabus. The course instructor will assign specific topics for each. Completing these assignments with proper effort and understanding will greatly benefit students in preparing for their final examinations.

Presentation of Seminar: Students are supposed to give an oral presentation during the class seminar hours in their assigned topic. Students will discuss on recent research finding related to the topic and participants are

encouraged to ask valid questions. Seminars help the students to be updated in their course. In addition students will be able to learn their mistakes and can improve their communication skills during seminar presentation.

Preparedness: Students are expected to have read and be able to discuss the assigned chapter before attending the lecture. In addition, students should be prepared to discuss homework problems.

Academic Dishonesty: Academic dishonesty includes giving, receiving, or using unconstitutional support on any academic work. This includes a person who has taken a test discussing what was on a test with a person who has not taken the test. A clear indication of academic dishonesty will result in a grade of "F" being assigned to that particular piece of work.

Subject to change clause: This syllabus, the course schedule and reading assignments are subject to change at the discretion of the Professor to accommodate instructional and/or student needs.

Important dates: Please note down the important dates and stick to the schedule.

CIA Test I	**CIA Test II**	**Assignment**	**Seminar**
As per Academic Calendar		After CIA Test-I	

Course Outline :

- Learn the principles of biological thermodynamics, energy transformations, redox reactions, ATP hydrolysis, electron transport chain, proton gradient formation, and oxidative phosphorylation mechanisms including the chemiosmotic theory.
- Study metabolic pathways such as glycolysis, gluconeogenesis, glycogen metabolism, pentose phosphate pathway, and the citric acid cycle. Analyze the hormonal and allosteric regulation of these pathways and their link to diseases like diabetes.
- Explore fatty acid β-oxidation, ketogenesis, fatty acid synthesis, cholesterol metabolism, and lipid transport through lipoproteins. Understand regulatory checkpoints and metabolic conditions such as atherosclerosis and fatty liver.
- Examine amino acid degradation and synthesis, transamination, deamination, urea cycle, and nitrogen balance. Identify metabolic disorders such as phenylketonuria (PKU), maple syrup urine disease (MSUD), and alkaptonuria.
- Understand purine and pyrimidine biosynthesis and degradation (de novo and salvage pathways), regulation of nucleotide pools, and porphyrin metabolism. Discuss associated disorders including gout, SCID, and porphyrias.

III- Semester					
Core-VI	**Course Code 25MBC2C2**	**Molecular Basis of Development (K1-K5)**	**T**	**Credits: 4**	**Hours:4**

UNIT-I	
Objective -1	To introduce key concepts in gametogenesis, fertilization, and early embryonic development using model organisms.
Foundations of Developmental Biology: Definition, scope, and significance in modern biology. Gametogenesis: Spermatogenesis & Oogenesis – molecular control. Fertilization: Molecular interactions between sperm and egg. Cleavage patterns and blastulation in vertebrates. **Use of model organisms**: *Drosophila*, *C. elegans*, *Xenopus*, *Zebrafish*, *Mouse* – comparative embryogenesis.	
Outcome - 1	Students will be able to explain gamete formation, fertilization events, and comparative embryogenesis.
UNIT-II	
Objective - 2	To understand gene hierarchies and morphogen gradients involved in axis formation and patterning.
Molecular Patterning and Axis Specification: Maternal effect genes: bicoid, nanos. Segmentation genes: gap, pair-rule, segment polarity. Homeotic genes: Hox clusters in invertebrates and vertebrates. Morphogens and gradients: Sonic hedgehog (Shh), Wnt, BMP pathways. Axis formation in vertebrates: dorsal-ventral, anterior-posterior, left-right asymmetry.	
Outcome - 2	Students will analyze the role of maternal effect, segmentation, and homeotic genes in embryonic axis formation.
UNIT-III	
Objective - 3	To explore mechanisms of cell fate, gene expression regulation, and the role of stem cells in development.
Cell Fate Determination and Gene Regulation: Determination, specification, induction, competence. Transcription factors in lineage commitment. Epigenetic regulation: chromatin remodeling, DNA methylation in development. Small RNAs: microRNAs, siRNAs in developmental timing. Role of stem cells and niche: embryonic vs adult stem cells.	
Outcome - 3	**Students will evaluate lineage commitment, epigenetic changes, and compare embryonic vs adult stem cells.**
UNIT-IV	
Objective - 4	To study the molecular control of organ development, cell migration, ECM remodeling, and regeneration.
Organogenesis and Tissue Differentiation: Molecular mechanisms in limb, eye, and neural development. Cell migration, cell adhesion, extracellular matrix remodeling. Programmed cell death: molecular pathways of apoptosis in development. Regeneration: molecular basis and model systems.	
Outcome - 4	Students will apply knowledge to describe limb, eye, neural development and mechanisms of regeneration.
UNIT-V	
Objective - 5	To examine genetic and molecular causes of developmental disorders and advancements in developmental technologies.

Developmental Abnormalities and Emerging Trends: Genetic basis of human developmental disorders. Molecular teratology: mutagens, teratogens. Developmental genes and cancer: oncogenes and tumor suppressors. Reproductive cloning, transgenics, gene editing (CRISPR/Cas9). Applications: induced pluripotent stem cells (iPSCs), organoid technology.	
Outcome - 5	Students will critically evaluate developmental defects, gene editing tools, and applications like iPSCs and organoids.

Suggested Readings:

Moody, S. A. (Ed.). (2014). *Principles of Developmental Genetics* (2nd Ed). Academic Press.
Carlson, B. M. (2018). *Human Embryology and Developmental Biology* (6th Ed). Elsevier.
Larsen's Human Embryology (5th Ed). Elsevier – Great for clinical correlations.
Gilbert, S. F. (2020). *Developmental Biology* (12th Ed). Sinauer Associates.
Slack, J. M. W. (2012). *Essential Developmental Biology* (3rd Ed). Wiley-Blackwell.
Alberts et al. (2014). *Molecular Biology of the Cell* (6th Ed). Garland Science.
Tanaka, E. M., & Reddien, P. W. (2011). *The cellular basis for animal regeneration.* Dev. Cell, 21(1), 172–185.

Course Outcome	K1	K2	K3	K4	K5	K6
CO1	✓	✓	✓	✓	✓	-
CO2	✓	✓	✓	✓	✓	-
CO3	✓	✓	✓	✓	✓	-
CO4	✓	✓	✓	✓	✓	-
CO5	✓	✓	✓	✓	✓	-

K1-Remember	***K2-Understand***	***K3- Apply***	***K4-Analyze***	***K5-Evaluate***	***K6-Create***

Course designed by: Dr. M. Mamutha

Course outcome Vs Programme outcome

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	3	3	3	3	2	2	2	2	2
CO2	3	3	3	3	3	2	2	2	2	2
CO3	3	3	3	3	2	2	2	2	2	2
CO4	3	3	3	3	2	2	2	3	3	2
CO5	3	3	3	3	2	2	2	2	3	2
W.AV	3	3	3	3	2.4	2	2	2.2	2.4	2

S-Strong (3) M-Medium (2) L-Low (1)

POs vs COs Interpretations

PO	Weighted Average	Interpretation
PO1	3.0	Strongly aligned with all COs
PO2	3.0	Strongly aligned with all COs
PO3	3.0	Strongly aligned with all COs
PO4	3.0	Strongly aligned with all COs
PO5	2.4	Moderately supported
PO6	2.0	Moderately supported
PO7	2.0	Moderately supported
PO8	2.2	Moderately supported
PO9	2.4	Moderately supported
PO10	2	Moderately supported

Assignment Topics:

- Discuss the role of Gibbs free energy in biological systems and how it drives metabolic reactions.
- Describe the electron transport chain and oxidative phosphorylation, highlighting the role of the proton motive force.
- Compare and contrast the regulation of glycolysis and gluconeogenesis during fasting and fed states.
- Analyze the biochemical mechanisms behind Type I and Type II diabetes mellitus.
- Explain fatty acid β-oxidation and its regulation, including its clinical relevance to ketone body production.
- Evaluate the synthesis and transport of cholesterol and its role in cardiovascular disease.
- Write a detailed note on the urea cycle and its connection to ammonia detoxification.
- Prepare a case study on an inborn error of metabolism: phenylketonuria or maple syrup urine disease.
- Describe the de novo and salvage pathways for purine biosynthesis and relate them to gout or Lesch-Nyhan syndrome.
- Illustrate porphyrin biosynthesis and discuss the biochemical and clinical aspects of porphyria.

SEMESTER-II

Course Depiction

Immunology and Immunotechnology

Program: M.Sc.,	Semester : II (2025-2026 Onwards)
Course Title**: Immunology and Immunotechnology** Subject Code: 25MBC2C3	Class Time: As per the time table
Name of Course Teachers	Dr. P. Boomi
Mobile:+91 9486031423	E-mail: pboomi1983@gmail.com

Course Brief:

This course provides a comprehensive understanding of the immune system's structure, function, and regulatory mechanisms in health and disease. It integrates fundamental immunological principles with modern immunotechnological applications. Students will explore cellular and humoral immune responses, antigen-antibody interactions, immunoassays, therapeutic antibody production, immunogenetics, hypersensitivity reactions, autoimmunity, cancer immunotherapy, and computational immunology.

Teaching methods: The mode of teaching is based on the following learning activities:

- Lectures covering the theoretical part will be delivered using Power point presentations.
- A set of laboratory exercises to analyze biological problems using software and tools to develop student's interests in scientific discovery.
- Case studies in informatics-based research.

Attendance: Regular attendance is necessary for gaining academic success; hence the students are expected to attend all the classes. As per University norms, the students are qualified to write their end-semester examinations only if they have a minimum attendance of 75% in all the courses.

Punctuality: Punctuality is an important quality for the students to achieve success. Students arriving late to the class by 10 minutes without any valid reason will be marked absent in the attendance record. Excuse will be provided for personal or medical emergency with prior approval by the Head of the Department.

Class Participation: A student's growth and development not only relies on their presence in the classroom, but also on active participation in the class. Engaging in discussions and asking questions encourages the exchange of ideas, sparks critical thinking, and creates a more enriching classroom experience. When students actively participate, they learn from one another and strengthen their understanding of the subject.

Submission of Assignment: Assignments will help the students to apply the concepts which results in deeper understanding of the subject. Hence each student will be allocated two assignments for the course, covering the entire topic. Students will be provided deadline by the course instructor to submit the assignment. Proper preparation of assignment will help the students for final exams.

Presentation of Seminar: Students are expected to deliver an oral presentation on their assigned topic during scheduled seminar sessions. These presentations will involve discussions on recent research findings, and active participation through relevant questions is encouraged. Seminars serve to keep students up to date with their coursework, while also providing an opportunity to identify and learn from their mistakes. Additionally, they help enhance students' communication and presentation skills.

Preparedness: The course instructor tells the students about the information about topics to be covered in the next class, at the end of every classes. This will enhance the students interest and awareness about the topics.

Academic Dishonesty: This is an important aspect that every student should be aware of. Thus, the respective faculty members educate the students of possible means of academic malpractices (plagiarism, violation of copyrights and stealing the patented knowledge) and the following consequences that will make them more vigilant in their academic career.

Subject to change clause: Based on the requirement of student's feasibility and meeting the competitive demands of the discipline the syllabus courses will be re-structured and updated accordingly at the discretion of the Professor(s) and Board of studies chairman.

Important dates: Please note down the important dates and stick to the schedule.

CIA Test I	**CIA Test II**	**Assignment**	**Seminar**
As per Academic Calendar		After CIA Test-I	

Course outline:

- Learn the basic architecture of the immune system, including innate and adaptive branches, hematopoiesis, lymphocyte development, antigen characteristics, and immune recognition.
- Study antibody structure and functions, immune receptor signaling, clonal selection, immune tolerance, and principles of antigen-antibody interactions along with immunological techniques like RIA, and flow cytometry.
- Understand the roles of MHC I and II, antigen processing pathways, complement cascades, cytokine signaling, and the mechanisms of T- and B-cell mediated responses. Explore all four types of hypersensitivity reactions.
- Examine monoclonal antibody production, immunodiagnostic tools, vaccines (traditional, recombinant, DNA), immune checkpoint inhibitors, cytokine therapies, and transplantation immunology.
- Analyze autoimmune disease mechanisms, tumor immunology (e.g., CAR-T therapy), and bioinformatics tools used in immunology for vaccine prediction and epitope mapping.

II – Semester					
Core : VII	**Course Code 25MBC2C3**	**Immunology and Immunotechnology (K1-K5)**	**T**	**Credits: 4**	**Hours: 4**

UNIT-I	
Objective -1	To understand the basic concepts, components, and cellular players of innate and adaptive immunity.
Fundamentals of Immunology: Overview of the immune system, innate and adaptive immunity, cells and organs of the immune system, hematopoiesis, lymphocyte activation, and differentiation. Antigens and immunogenicity, properties of antigens, haptens, and epitopes.	
Outcome - 1	Students will be able to recall immune system components and explain antigenic properties and immune cell functions.
UNIT-II	
Objective - 2	To explore immunoglobulin structures, receptors, immune tolerance, and immunoassays.
Antibodies and Antigen-Antibody Interactions: Structure, classification, and functions of immunoglobulins. B-cell and T-cell receptors, clonal selection, and immune tolerance. Antigen-antibody interactions: affinity, avidity, precipitation, and agglutination reactions. Immunoassays: Radioimmunoassay, Immunoprecipitation, Immunofluorescence, Flow cytometry, ELISA	
Outcome - 2	Students will apply knowledge to assess antigen-antibody reactions and perform basic immunological assays.
UNIT-III	
Objective - 3	To study antigen presentation, complement pathways, cytokines, and hypersensitivity reactions.
Major Histocompatibility Complex and Immune Responses: MHC Class I and II molecules, antigen processing and presentation, cytokines and their roles, complement system pathways (classical, alternative, and lectin). Cell-mediated immunity, T-cell activation, and B-cell activation. Hypersensitivity reactions (Types I–IV).	
Outcome - 3	Students will analyze immune response mechanisms and differentiate among hypersensitivity types and MHC functions.
UNIT-IV	
Objective - 4	To understand therapeutic immunology, monoclonal antibody production, vaccines, and immunodiagnostics.
Immuno-technology and Therapeutic Applications: Monoclonal antibody production and hybridoma technology. Immunodiagnostic techniques – Flowcytometry, ELISA, RIA, immunotherapy, cytokine therapy, and immune checkpoint inhibitors. Immunogenetics and transplantation immunology. Vaccines: types, mechanisms, and advancements in recombinant and DNA vaccines.	
Outcome - 4	Students will evaluate modern immunotechnologies including recombinant vaccine strategies and immunotherapies.
UNIT-V	
Objective - 5	To examine the molecular basis of autoimmune diseases, tumor immunology, and computational immunology.

Autoimmunity, Tumor Immunology, and Immunoinformatics: Autoimmune diseases: Insulin-dependent diabetes mellitus, Rheumatoid arthritis, Multiple sclerosis. mechanisms, diagnosis, and treatment strategies. Tumor immunology: immune surveillance, tumor antigens, and cancer immunotherapy (CAR-T cell therapy, immune checkpoint inhibitors). Immunoinformatics and computational approaches in immunology.	
Outcome - 5	Students will critically evaluate immune disorders, cancer immunotherapies, and use of bioinformatics in immunology

Suggested Readings

Reference Books

Kuby, J., Kindt, T. J., Goldsby, R. A., & Osborne, B. A. (2013). Kuby Immunology (7th ed.). W. H. Freeman.

Abbas, A. K., Lichtman, A. H., & Pillai, S. (2022). Cellular and Molecular Immunology (10th ed.). Elsevier.

Janeway, C. A., Travers, P., Walport, M., &Shlomchik, M. J. (2017). Immunobiology: The Immune System in Health and Disease (9th ed.). Garland Science.

Roitt, I. M., Brostoff, J., & Male, D. (2017). Immunology (8th ed.). Mosby.

Delves, P. J., Martin, S. J., Burton, D. R., &Roitt, I. M. (2017). Roitt's Essential Immunology (13th ed.). Wiley-Blackwell.

Textbooks

Abbas, A. K., & Lichtman, A. H. (2022). Cellular and Molecular Immunology (10th ed.).

Kuby, J. (2013). Kuby Immunology (7th ed.).

Online Resources

NCBI Bookshelf – Immunology Resources – https://www.ncbi.nlm.nih.gov/books/.

Nature Reviews Immunology – Research Articles – https://www.nature.com/nri/.

MIT OpenCourseWare – Immunology – https://ocw.mit.edu/courses/biology/.

The American Association of Immunologists (AAI) – https://www.aai.org/.

Course Outcome	K1	K2	K3	K4	K5	K6
CO1	✓	✓	✓	✓	✓	-
CO2	✓	✓	✓	✓	✓	-
CO3	✓	✓	✓	✓	✓	-
CO4	✓	✓	✓	✓	✓	-
CO5	✓	✓	✓	✓	✓	-

K1-Remember *K2-Understand* *K3- Apply* *K4-Analyze* *K5-Evaluate* *K6-Create*

Course designed by: Dr. P. Boomi

Course outcome Vs Programme outcome

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	3	3	3	3	2	3	2	2	2
CO2	3	3	3	3	3	2	2	3	2	2
CO3	3	3	3	3	3	2	2	2	2	3
CO4	3	3	3	3	3	2	3	3	2	3
CO5	3	3	3	3	3	2	3	3	2	2
W.AV	3	3	3	3	3	2	2.6	2.6	2	2.4

S-Strong (3) M-Medium (2) L-Low (1)

POs vs COs interpretation

PO	Weighted Average	Interpretation
PO1	3.0	Strongly aligned with all COs
PO2	3.0	Strongly aligned with all COs
PO3	3.0	Strongly aligned with all COs
PO4	3.0	Strongly aligned with all COs
PO5	3.0	Strongly aligned with all COs
PO6	2.0	Moderately supported
PO7	2.6	Moderately supported
PO8	2.6	Moderately supported
PO9	2.0	Moderately supported
PO10	2.4	Moderately supported

Assignment Topics:

- Compare innate and adaptive immunity with examples of cellular components and their functions.
- Write a detailed report on the structure, types, and biological functions of immunoglobulins.
- Explain the principle and applications of ELISA and how it differs from RIA and Western blotting.
- Illustrate antigen processing and presentation pathways and the role of MHC molecules in immune response.
- Discuss the complement activation pathways and their biological significance in host defense.
- Evaluate the principles of hybridoma technology and its role in monoclonal antibody production.
- Prepare a case study on a type I or type IV hypersensitivity disorder and discuss its immunological basis.
- Explain the mechanism and therapeutic use of immune checkpoint inhibitors and CAR-T cell therapy.
- Summarize autoimmunity and describe the pathogenesis of any two autoimmune diseases.
- Explore the role of computational tools in immunology with an example of vaccine epitope prediction.

SEMESTER-II

Course Depiction

Clinical and Medical Biochemistry

Program: M.Sc.,	Semester : II (2025-2026 Onwards)
Course Title**: Clinical and Medical Biochemistry** Subject Code: 25MBC2C4	Class Time: As per the time table
Name of Course Teachers	Dr. M. Jeyakumar & Dr. M. Mamutha
Mobile: +91 96559 07058 & +91 91761 63179	E-mail:biotechjeya@gmail.com mamudha2014@gmail.com

Course Brief:

This course provides an in-depth understanding of clinical and medical biochemistry, focusing on the biochemical basis of disease, diagnostic markers, hormonal functions, and laboratory quality control. It emphasizes specimen handling, metabolic disorders, enzymology, endocrinology, and modern diagnostic technologies including biosensors and artificial intelligence.

Teaching methods: The teaching includes lectures, discussions, demonstrations, concept maps and models, self-study and question times and an integrating project work. The project work is in-depth studies in groups with an emphasis on own work and literature studies. The course is completed with a written final examination.

Attendance: Having good attendance record marks the student's sincerity and has an overall positive impact on his/her personality trait development. The students are asked to attend the classes on a regular note and those having a minimum scale of 70-75% attendance are eligible to take up the end-semester examinations as per the University norms.

Punctuality: It is the most important attribute to be followed and maintained by the student throughout his/her life which for sure will lead to the path of success. Students who arrive late by 10mins after the attendance has been taken will be marked absent unless there is a valid reason (medical/ personal emergency) at the discretion of the Head of the Department.

Class Participation: A student's overall growth and personality development is based on his/her involvement in the class not just by mere presence but rather being interactive through questioning that will lead to propagation of ideas, initiation of thought-provoking process and much more that will provide a wholesome enriched classroom experience. Therefore, students are advised to be more attentive so that they learn from one another and develop quality-based knowledge.

Submission of Assignment: Assignments are given to students with just one motive to get more quantitative and qualitative knowledge insights into the assigned topic/chapter that will lead to preparation and completion of the assignment in a constructive manner here just the knowledge provided is not merely counted but also completion prior to proposed deadline will also have a check on the student's serious consideration of the assignments.

Presentation of Seminar: Apart from the assignments the concerned instructors also allocate the students with a topic or based on their interests to present seminar that will aid them built their confidence levels, command over English language to communicate with precision and fluently. In addition, the fellow students are encouraged to pose questions that will instigate interest and provide update in that particular topic besides the information presented helping them to prepare for their examinations that can be taken as added advantage for the students.

Preparedness: At the end of every class, the concerned instructor tells the students what will be taken in the next class using these details the students should be aware of the topics that will be covered in the upcoming lectures which actually enhance the student's capability to grasp the knowledge and concepts provided much efficiently.

Academic Dishonesty: This is an important aspect that every student should be aware of. Thus, the respective faculty members educate the students of possible means of academic malpractices (plagiarism, violation of copyrights and stealing the patented knowledge) and the following consequences that will make them more vigilant in their academic career.

Subject to change clause: Based on the requirement of student's feasibility and meeting the competitive demands of the discipline the syllabus courses will be re-structured and updated accordingly at the discretion of the Professor(s) and Board of studies chairman.

Important dates: Please note down the important dates and stick to the schedule.

CIA Test I	CIA Test II	Assignment	Seminar
As per Academic Calendar		After CIA Test-I	

Course Outline:

- Understand the composition and function of blood and other body fluids. Learn specimen collection techniques and significance of plasma proteins and anticoagulants.
- Explore inborn errors of metabolism and metabolic disorders in carbohydrates, lipids, and proteins. Evaluate the role of free radicals and oxidative stress in disease pathology.

- Analyze the diagnostic utility of enzymes in organ function tests and interpret the significance of cancer, cardiac, liver, and inflammatory biomarkers.
- Study the classification, synthesis, and regulation of hormones from major endocrine glands including pituitary, thyroid, pancreas, adrenal, and gonads.
- Gain insight into laboratory practices, accreditation standards, and emerging innovations such as wearable diagnostics and AI-assisted biochemistry.

II- Semester					
Core-VIII	**Course Code : 25MBC2C4**	**Clinical and Medical Biochemistry (K1-K5)**	**T**	**Credits: 4**	**Hours: 4**
UNIT-I					
Objective -1	To understand the composition, functions, and clinical relevance of blood and body fluids in hematological processes.				
Hematology : Introduction and significance of Body fluids , Blood, Components of Blood, Red blood cells, White blood cells, Platelets. Functions of blood, plasma protein (serum albumin, globulin and fibrinogen), Homeostasis, coagulation of blood. Anticoagulants					
Outcome - 1	Students will be able to identify key blood components, explain their physiological roles, and interpret basic hematological functions including coagulation and anticoagulation.				
UNIT-II					
Objective - 2	To provide an understanding of metabolic disorders and their biochemical basis in disease diagnosis.				
Biochemical Basis of Diseases: Introduction to clinical biochemistry and its role in disease diagnosis. Inborn errors of metabolism including phenylketonuria, alkaptonuria, maple syrup urine disease, and homocystinuria. Disorders of carbohydrate metabolism such as diabetes mellitus, glycogen storage diseases, and galactosemia. Lipid metabolism disorders including hyperlipidemia, atherosclerosis, and lipid storage disorders. Protein metabolism disorders such as urea cycle disorders and amino-acidopathies. Role of free radicals and oxidative stress in disease progression.					
Outcome - 2	Students will understand the pathophysiology of inherited and acquired metabolic disorders and assess their clinical relevance.				
UNIT-III					
Objective - 3	To explain the diagnostic role of enzymes and biochemical markers in organ function and disease.				
Clinical Enzymology and Biochemical Markers: Enzymes as diagnostic markers in liver function tests (ALT, AST, ALP, GGT), kidney function tests (creatinine, urea, uric acid), and cardiac markers (CK-MB, troponins, LDH). Enzymes in pancreatitis (amylase, lipase) and muscle disorders (creatine kinase). Clinical significance of tumor markers such as AFP, CEA, PSA, and CA-125 in cancer diagnosis. Biomarkers for inflammation and infection (C-reactive protein, procalcitonin).					
Outcome - 3	Students will analyze enzymatic and biomarker profiles in clinical conditions including cardiac, liver, kidney, and cancer.				
UNIT-IV					
Objective - 4	To understand the classification, biosynthesis, circulation, and functions of major endocrine hormones and their physiological roles.				

Endocrinology: Hormones, Classification, biosynthesis, Circulation in blood, modification and degradation. Pituitary, hypothalamus, pancreatic, thyroid and parathyroid, adrenal and gonadal hormones. Hormonal disorders.	
Outcome - 4	Students will be able to explain hormone mechanisms, gland-specific functions, and regulatory pathways involved in endocrine homeostasis.
UNIT-V	
Objective - 5	To evaluate laboratory quality assurance, accreditation standards, and emerging diagnostic innovations.
Clinical Laboratory Management and Quality Control: Good laboratory practices (GLP) and biosafety measures in clinical laboratories. Standardization and calibration of diagnostic instruments. Internal and external quality control measures in biochemical assays. Accreditation standards (NABL, CAP, ISO 15189) for clinical laboratories. Ethical and regulatory aspects of diagnostic testing. Emerging trends in clinical diagnostics, including wearable biosensors, liquid biopsy, and artificial intelligence in diagnostics.	
Outcome - 5	Students will apply knowledge of GLP, quality control, and assess the significance of wearable biosensors and AI in diagnostics.

Suggested Readings

Reference Books

Tietz, N. W. (2018). Tietz Textbook of Clinical Chemistry and Molecular Diagnostics (6th ed.). Elsevier.

Burtis, C. A., & Bruns, D. E. (2021). Tietz Fundamentals of Clinical Chemistry and Molecular Diagnostics (8th ed.). Elsevier.

Marshall, W. J., Bangert, S. K., & Lapsley, M. (2019). Clinical Chemistry (8th ed.). Elsevier.

Bishop, M. L., Fody, E. P., & Schoeff, L. (2020). Clinical Chemistry: Principles, Techniques, and Correlations (8th ed.). Wolters Kluwer.

Baynes, J. W., &Dominiczak, M. H. (2018). Medical Biochemistry (5th ed.). Elsevier.

Textbooks

Tietz, N. W. Tietz Textbook of Clinical Chemistry and Molecular Diagnostics.

Marshall, W. J., & Bangert, S. K. Clinical Chemistry.

Online Resources

National Center for Biotechnology Information (NCBI) (https://www.ncbi.nlm.nih.gov/).

American Association for Clinical Chemistry (AACC) (https://www.aacc.org/).

Lab Tests Online (https://www.labtestsonline.org/).

World Health Organization (WHO) Clinical Diagnostics (https://www.who.int/).

MIT OpenCourseWare – Clinical Biochemistry (https://ocw.mit.edu/courses/health-sciences-and-technology/).

Course Outcome	K1	K2	K3	K4	K5	K6
CO1	✓	✓	✓	✓	✓	-
CO2	✓	✓	✓	✓	✓	-
CO3	✓	✓	✓	✓	✓	-
CO4	✓	✓	✓	✓	✓	-
CO5	✓	✓	✓	✓	✓	-

K1-Remember	*K2-Understand*	*K3- Apply*	*K4-Analyze*	*K5-Evaluate*	*K6-Create*

Course designed by: **Dr. M. Jeyakumar & Dr. M. Mamutha**

Course outcome Vs Programme outcome

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	3	3	3	3	2	1	2	2	2
CO2	3	3	3	3	3	2	2	2	1	2
CO3	3	3	3	3	3	2	3	2	2	2
CO4	3	3	3	3	3	2	2	2	2	2
CO5	3	3	3	3	3	2	2	2	3	2
W.AV	3	3	3	3	3	2	2	2	2	2

S-Strong (3) M-Medium (2) L-Low (1)

POs vs COs interpretation

PO	Weighted Average	Interpretation
PO1	3.0	Strongly aligned with all COs
PO2	3.0	Strongly aligned with all COs
PO3	3.0	Strongly aligned with all COs
PO4	3.0	Strongly aligned with all COs
PO5	3.0	Strongly aligned with all COs
PO6	2.0	Moderately supported
PO7	2.0	Moderately supported
PO8	2.0	Moderately supported
PO9	2.0	Moderately supported
PO10	2.0	Moderately supported

Assignment Topics:

- Compare and contrast blood collection methods and anticoagulants used in hematology.
- Describe the biochemical pathways involved in phenylketonuria and their clinical implications.
- Evaluate liver function using clinical enzymology: Role of ALT, AST, ALP, and GGT.
- Explain the diagnostic value of tumor markers in early cancer detection.
- Discuss the biosynthesis and regulatory control of insulin and glucagon.
- Outline oxidative stress mechanisms and their role in metabolic diseases.
- Prepare a flowchart of endocrine gland interactions and feedback mechanisms.
- Write a report on the role of wearable biosensors in non-invasive diagnostics.
- Critically review the NABL/ISO 15189 accreditation process in clinical labs.
- Conduct a case study presentation on diabetes mellitus: biochemical diagnosis and management.

SEMESTER-II

Course Depiction

Lab – II: Metabolism, Developmental, Immunology & Clinical Biochemistry Lab.

Program: M.Sc.,	Semester: II (2025-2026 Onwards)
Course Title: **Lab – II: Metabolism, Developmental, Immunology & Clinical Biochemistry Lab.** Subject Code: 25MBC2P1	Class Time: As per Time Table
Name of the Course Teacher	Dr. M. Jeyakumar & Dr. M. Mamutha
Mobile: +91 96559 07058 & +91 91761 63179	E-mail: biotechjeya@gmail.com mamudha2014@gmail.com

Course Brief:

This integrated laboratory course provides students with hands-on experience in clinical biochemistry, developmental biology, and immunological techniques. In the metabolism module, students will perform routine biochemical estimations of metabolic waste products and enzymes, which are crucial in assessing liver and kidney function. The developmental biology section enables learners to observe and interpret various embryonic and cellular stages in both animals and plants. The immunology and clinical biochemistry module offers foundational training in serological and hematological techniques, including blood grouping, immunodiffusion, and diagnostic assays such as Widal, CRP, and RA tests. The course aims to strengthen analytical thinking, laboratory proficiency, and interpretation of diagnostic results in biomedical contexts.

Teaching methods: The mode of teaching is based on the following learning activities:

- Lectures covering the theoretical part will be delivered using Power point presentations.
- A set of laboratory exercises to analyze biological problems using software and tools to develop student's interests in scientific discovery.
- Case studies in informatics-based research.

Attendance: Regular attendance is necessary for gaining academic success; hence the students are expected to attend all the classes. As per University norms, the students are qualified to write their end-semester examinations only if they have a minimum attendance of 75% in all the courses.

Punctuality: Punctuality is an important quality for the students to achieve success. Students arriving late to the class by 10 minutes without any valid reason will be marked absent in the attendance record. Excuse

will be provided for personal or medical emergency with prior approval by the Head of the Department.

Class Participation: A student's growth and development not only relies on their presence in the classroom, but also on active participation in the class. Engaging in discussions and asking questions encourages the exchange of ideas, sparks critical thinking, and creates a more enriching classroom experience. When students actively participate, they learn from one another and strengthen their understanding of the subject.

Submission of Assignment: Assignments will help the students to apply the concepts which results in deeper understanding of the subject. Hence each student will be allocated two assignments for the course, covering the entire topic. Students will be provided deadline by the course instructor to submit the assignment. Proper preparation of assignment will help the students for final exams.

Presentation of Seminar: Students are expected to deliver an oral presentation on their assigned topic during scheduled seminar sessions. These presentations will involve discussions on recent research findings, and active participation through relevant questions is encouraged. Seminars serve to keep students up to date with their coursework, while also providing an opportunity to identify and learn from their mistakes. Additionally, they help enhance students' communication and presentation skills.

Preparedness: The course instructor tells the students about the information about topics to be covered in the next class, at the end of every classes. This will enhance the students interest and awareness about the topics.

Academic Dishonesty: This is an important aspect that every student should be aware of. Thus, the respective faculty members educate the students of possible means of academic malpractices (plagiarism, violation of copyrights and stealing the patented knowledge) and the following consequences that will make them more vigilant in their academic career.

Subject to change clause: Based on the requirement of student's feasibility and meeting the competitive demands of the discipline the syllabus courses will be re-structured and updated accordingly at the discretion of the Professor(s) and Board of studies chairman.

Important dates: Please note down the important dates and stick to the schedule.

CIA Test I	CIA Test II	Assignment	Seminar
As per Academic Calendar		After CIA Test-I	

Course Outline:

- Perform estimations of key metabolites such as urea (DAM method), creatinine (Jaffe's method), liver glycogen, and liver enzymes (SGOT/SGPT) relevant to renal and hepatic diagnostics.
- Microscopic and gross observation of early development in chick, frog, and plant embryos, including mitotic stages in onion root tips.
- Learn to isolate serum from blood and perform basic hematological tests including bleeding time, clotting time, and blood grouping with Rh typing.
- Gain experience in clinical immunoassays like Widal, CRP, and RA tests, widely used in the diagnosis of typhoid, rheumatoid arthritis, and inflammation.
- Understand and apply immunodiffusion methods including single radial immunodiffusion, double diffusion, and rocket immunoelectrophoresis for antigen-antibody interaction studies.

<table>
<tr><th colspan="6">II - Semester</th></tr>
<tr><td>Core-IX</td><td>Course Code
25MBC2P1</td><td>Lab – II: Metabolism, Developmental, Immunology & Clinical Biochemistry Lab
(K1-K6)</td><td>P</td><td>Credits: 4</td><td>Hours: 8</td></tr>
<tr><td colspan="6">UNIT-I</td></tr>
<tr><td colspan="2">Objective -1</td><td colspan="4">To understand and perform estimations of key metabolic biomarkers and enzyme activities relevant to liver and renal function.</td></tr>
<tr><td colspan="6">Module 1 : Metabolism
1. Estimation of Creatinine by Jaffe’s Method
2. Estimation of urea by DAM method
3. Estimation of Uric acid
4. Isolation and Estimation of Liver Glycogen
5. Assay of serum transaminases – SGOT and SGPT.</td></tr>
<tr><td colspan="2">Outcome - 1</td><td colspan="4">Students will acquire practical skills in estimating metabolites like urea, creatinine, glycogen, and transaminases used in clinical diagnostics.</td></tr>
<tr><td colspan="6">UNIT-II</td></tr>
<tr><td colspan="2">Objective - 2</td><td colspan="4">To observe and interpret developmental stages in model organisms such as chick, frog, plants, and root tips.</td></tr>
<tr><td colspan="6">Module 2: Developmental Biology
6. Observation of Early Embryonic Stages in Chick Embryo.
7. Observation of Seed Germination and Early Development in Plants.
8. Observation of Mitosis in Early Embryo or Onion Root Tip</td></tr>
<tr><td colspan="2">Outcome - 2</td><td colspan="4">Students will develop the ability to identify and compare key stages of embryogenesis and cell division in animal and plant models.</td></tr>
<tr><td colspan="6">UNIT-III</td></tr>
</table>

Objective - 3	To explore and apply immunological techniques and routine clinical tests relevant to human health and disease diagnosis.

Module 3: Immunology and Clinical Biochemistry

9. Enumeration of RBC and WBC, Blood Grouping and Rh typing.
10. Determination of Erythrocyte sedimentation rate
11. Agglutination test : RA, CRP and WIDAL TEST
12. Rocket immunoelectrophoresis.
13. Immuno diffusion – single radial and double diffusion.
14. Heme Agglutination
15. Antibody titration.

Outcome – 3	Students will gain competency in handling blood samples, performing immunological assays, and interpreting test results like Widal, CRP, RA, and immunodiffusion.

Suggested Readings:

Plummer, D. T. (1990). An Introduction to Practical Biochemistry. McGraw Hill.

Sawhney, S. K., & Singh, R. (2014). Introductory Practical Biochemistry. Narosa Publishing House.

Jayaraman, J. (1981). Laboratory Manual in Biochemistry. New Age International.

Arumugam, N. (2021). Practical Zoology (Invertebrate & Vertebrate). Saras Publication.

Kuby, J., Kindt, T. J., & Goldsby, R. A. (2013). Immunology. W.H. Freeman & Co.

Turgeon, M. L. (2012). Clinical Hematology: Theory and Procedures. Lippincott Williams & Wilkins.

Talwar, G. P., & Gupta, S. K. (2017). A Handbook of Practical and Clinical Immunology. CBS Publishers.

Course Outcome	K1	K2	K3	K4	K5	K6
CO1	✓	✓	✓	✓	✓	-
CO2	✓	✓	✓	✓	✓	-
CO3	✓	✓	✓	✓	✓	-
CO4	✓	✓	✓	✓	✓	-
CO5	✓	✓	✓	✓	✓	-

K1-Remember	***K2-Understand***	***K3- Apply***	***K4-Analyze***	***K5-Evaluate***	***K6-Create***

Course designed by: Dr. M. Jeyakumar & Dr. M. Mamutha

Course outcome Vs Programme outcome

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	3	3	3	3	2	2	1	2	2
CO2	3	3	3	3	3	2	3	2	2	3
CO3	3	3	3	3	3	2	2	3	2	3
CO4	3	3	3	3	3	2	2	2	2	2
CO5	3	3	3	3	3	2	2	2	2	3
W.AV	3	3	3	3	3	2	2.3	2	2	2.6

S-Strong (3) M-Medium (2) L-Low (1)

POs vs COs Interpretation

PO	Weighted Average	Interpretation
PO1	3.0	Strongly aligned with all COs
PO2	3.0	Strongly aligned with all COs
PO3	3.0	Strongly aligned with all COs
PO4	3.0	Strongly aligned with all COs
PO5	3.0	Strongly aligned with all COs
PO6	2.0	Moderately supported
PO7	2.3	Moderately supported
PO8	2.0	Moderately supported
PO9	2.0	Moderately supported
PO10	2.6	Moderately supported

SEMESTER-III

Course Depiction

Genetics

Program: M.Sc.,	Semester : III (2025-2026 Onwards)
Course Title**: Genetics** Subject Code: 25MBC3C1	Class Time: As per the time table
Name of Course Teachers	Dr. M. Jeyakumar
Mobile:+ +91 96559 07058	E-mail: biotechjeya@gmail.com

Course Brief:

This course offers a comprehensive understanding of classical and molecular genetics, from Mendelian principles to cutting-edge technologies like CRISPR and genome-wide association studies. It covers gene expression, chromosomal behavior, population genetics, and epigenetics, along with applications in gene therapy, synthetic biology, and ethical issues surrounding genetic technologies. Students will gain critical insights into how genetic variation and inheritance impact evolution, health, and biotechnology.

Teaching methods: The course will be based on the following teaching and learning activities:

- Lectures covering the theoretical part using PowerPoint presentations
- Case studies
- Review questions

Attendance: A student's academic performance and opportunity to gain knowledge largely depend on regular class attendance. According to university norms, maintaining at least 70–75% attendance is essential

to be eligible to appear for the end-semester examinations.

Punctuality: Punctuality is one of the essential qualities that students must follow and maintain to achieve greater success. Students are required to arrive in class on time without any delay. Only important reasons such as personal or medical emergencies will be accepted as valid excuses. Otherwise, the student will be marked absent.

Class Participation: Classroom participation is important because learning is not just between the student and the teacher, but part of the whole classroom experience which involves questioning, inquiring and exchanging ideas. When students participate, they learn from each other and internalize the knowledge better.

Submission of Assignment: Assignments are an important part of the learning process, designed to help students apply the concepts and knowledge acquired during the course. Each student will receive two assignments that together cover the full syllabus. The course instructor will assign specific topics for each. Completing these assignments with proper effort and understanding will greatly benefit students in preparing for their final examinations.

Presentation of Seminar: Students are supposed to give an oral presentation during the class seminar hours in their assigned topic. Students will discuss on recent research finding related to the topic and participants are encouraged to ask valid questions. Seminars help the students to be updated in their course. In addition students will be able to learn their mistakes and can improve their communication skills during seminar presentation.

Preparedness: Students are expected to have read and be able to discuss the assigned chapter before attending the lecture. In addition, students should be prepared to discuss homework problems.

Academic Dishonesty: Academic dishonesty includes giving, receiving, or using unconstitutional support on any academic work. This includes a person who has taken a test discussing what was on a test with a person who has not taken the test. A clear indication of academic dishonesty will result in a grade of "F" being assigned to that particular piece of work.

Subject to change clause: Depending upon the requirement of student's possibility, the course syllabus will be re-structured and updated accordingly at the discretion of the Professor(s) and Board of studies chairperson.

Important Dates: Please note down the important dates and stick to the schedule.

CIA Test I	CIA Test II	Assignment	Seminar
As per Academic Calendar		After CIA Test-I	

Course Outline:

- Learn Mendel's laws and their molecular basis, gene interactions (epistasis, pleiotropy), linkage and recombination mapping, and sex-based inheritance patterns.
- Study chromatin organization, karyotyping, structural/numerical chromosomal abnormalities, and the evolutionary and regulatory roles of transposons.
- Understand replication, transcription, RNA processing, mutations, and DNA repair mechanisms in both prokaryotes and eukaryotes.
- Explore Hardy-Weinberg principles, factors affecting gene frequency, and epigenetic mechanisms like DNA methylation and histone modification in disease and adaptation.
- Analyze the principles and applications of NGS, CRISPR, gene therapy, and synthetic biology with a focus on bioethics, legal aspects, and personalized medicine.

<table>
<tr><th colspan="6">III- Semester</th></tr>
<tr><td>Core-X</td><td>Course Code : 25MBC3C1</td><td>Genetics (K1-K5)</td><td>T</td><td>Credits: 5</td><td>Hours: 5</td></tr>
<tr><td colspan="6">UNIT-I</td></tr>
<tr><td>Objective -1</td><td colspan="5">To understand Mendelian laws and their extensions, gene interactions, linkage, recombination, and sex-based inheritance.</td></tr>
<tr><td colspan="6">Principles of Classical Genetics: Mendelian principles of inheritance, including dominance, segregation, and independent assortment, with molecular explanations. Extensions of Mendelian genetics, including incomplete dominance, codominance, multiple alleles, epistasis, pleiotropy, polygenic inheritance, and maternal inheritance. Gene linkage and crossing over, recombination mapping in prokaryotes and eukaryotes, and the concept of genetic markers in mapping studies. Chromosomal theory of inheritance and sex-linked, sex-influenced, and sex-limited traits.</td></tr>
<tr><td>Outcome - 1</td><td colspan="5">Students will explain classical genetics concepts, including Mendelian and non-Mendelian inheritance, and describe genetic mapping and chromosomal theories.</td></tr>
<tr><td colspan="6">UNIT-II</td></tr>
<tr><td>Objective - 2</td><td colspan="5">To explore chromatin structure, karyotyping, chromosomal aberrations, and genome variation through transposons.</td></tr>
<tr><td colspan="6">Chromosomal Organization and Genetic Variation: Structure and function of chromosomes, chromatin organization, nucleosome model, and heterochromatin vs. euchromatin. Karyotyping techniques and their applications in genetic diagnosis. Chromosomal aberrations including deletions, duplications, inversions, and translocations and their effects on gene expression. Numerical chromosomal anomalies such as aneuploidy (Down syndrome, Turner syndrome, Klinefelter syndrome) and polyploidy in plants and animals. Role of transposable elements in genome evolution and gene regulation.</td></tr>
<tr><td>Outcome - 2</td><td colspan="5">Students will describe chromosomal structure and abnormalities, and analyze the role of numerical and structural variations in genetic expression and evolution.</td></tr>
<tr><td colspan="6">UNIT-III</td></tr>
<tr><td>Objective - 3</td><td colspan="5">To understand DNA replication, transcriptional control, RNA processing, types of mutations, and repair mechanisms.</td></tr>
</table>

Molecular Basis of Genetics and Mutations: DNA replication mechanisms in prokaryotes and eukaryotes, including origin recognition, helicase activity, primase function, polymerase activity, and ligation. Transcriptional regulation in bacteria (lac operon and trp operon) and eukaryotes (enhancers, silencers, transcription factors, and epigenetic modifications). Post-transcriptional modifications such as splicing, capping, and polyadenylation. Mutations: types (point mutations, frameshift mutations, nonsense mutations), causes (spontaneous and induced mutations), and repair mechanisms (base excision repair, nucleotide excision repair, mismatch repair, non-homologous end joining, and homologous recombination repair).	
Outcome - 3	Students will explain molecular processes of gene expression and mutation, and describe how cells repair genetic damage.
UNIT-IV	
Objective - 4	To study gene frequency dynamics in populations and the role of epigenetic mechanisms in health and disease.
Population Genetics and Epigenetics: Hardy-Weinberg equilibrium and its significance in population genetics. Factors affecting allele frequencies: genetic drift, gene flow, mutation, natural selection, and inbreeding. Founder effect and bottleneck effect in genetic variation. Epigenetic regulation of gene expression, including DNA methylation, histone modifications, chromatin remodeling, and non-coding RNAs. Role of epigenetics in cancer, metabolic disorders, and environmental adaptation.	
Outcome - 4	Students will explain allele frequency factors and epigenetic regulation, and relate them to human disease and environmental adaptation.
UNIT-V	
Objective - 5	To understand genome sequencing/editing, gene therapy, and synthetic biology, while considering ethical implications.
Advances in Genetics: Gene therapy approaches, including in vivo and ex vivo strategies, with case studies in genetic disorders like cystic fibrosis and sickle cell anemia. Synthetic biology and its applications in biotechnology and medicine. Ethical, legal, and social implications of genome editing, genetic counseling, and personalized medicine.	
Outcome - 5	Students will evaluate genome sequencing and editing technologies, describe gene therapy and synthetic biology, and assess associated ethical and legal concerns.

Suggested Readings

Reference Books

1. Griffiths, A. J. F., Wessler, S. R., Carroll, S. B., &Doebley, J. (2020). Introduction to Genetic Analysis (12th ed.). W. H. Freeman.
2. Snustad, D. P., & Simmons, M. J. (2020). Principles of Genetics (7th ed.). Wiley.
3. Klug, W. S., Cummings, M. R., Spencer, C. A., & Palladino, M. A. (2019). Concepts of Genetics (12th ed.). Pearson.
4. Strachan, T., & Read, A. (2019). Human Molecular Genetics (5th ed.). Garland Science.
5. Hartl, D. L., & Ruvolo, M. (2020). Genetics: Analysis of Genes and Genomes (9th ed.). Jones & Bartlett Learning.

Textbooks

1. Griffiths, A. J. F. Introduction to Genetic Analysis.
2. Strachan, T., & Read, A. Human Molecular Genetics.

Online Resources

1. National Human Genome Research Institute (https://www.genome.gov/).

2. Online Mendelian Inheritance in Man (OMIM) (https://omim.org/).
3. Ensembl Genome Browser (https://www.ensembl.org/).
4. NCBI Genetic Resources (https://www.ncbi.nlm.nih.gov/genetics/).
5. MIT OpenCourseWare – Genetics (https://ocw.mit.edu/courses/biology/).

Course Outcome	K1	K2	K3	K4	K5	K6
CO1	✓	✓	✓	✓	✓	-
CO2	✓	✓	✓	✓	✓	-
CO3	✓	✓	✓	✓	✓	-
CO4	✓	✓	✓	✓	✓	-
CO5	✓	✓	✓	✓	✓	-

K1-Remember	*K2-Understand*	*K3- Apply*	*K4-Analyze*	*K5-Evaluate*	*K6-Create*

Course designed by: Dr. M. Jeyakumar

Course outcome Vs Programme outcome

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	3	3	3	3	3	2	2	1	1
CO2	3	3	3	3	3	3	2	2	2	2
CO3	3	3	3	3	3	3	2	2	2	3
CO4	3	3	3	3	3	3	2	2	3	3
CO5	3	3	3	3	3	3	2	2	3	2
W.AV	3	3	3	3	3	3	2	2	2.2	2.2

S-Strong (3) M-Medium (2) L-Low (1)

POs vs COs Interpretation

PO	Weighted Average	Interpretation
PO1	3.0	Strongly aligned with all COs
PO2	3.0	Strongly aligned with all COs
PO3	3.0	Strongly aligned with all COs
PO4	3.0	Strongly aligned with all COs
PO5	3.0	Strongly aligned with all COs
PO6	3.0	Strongly aligned with all COs
PO7	2.0	Moderately supported
PO8	2.0	Moderately supported
PO9	2.2	Moderately supported
PO10	2.2	Moderately supported

Assignment Topics:

- Explain Mendelian and non-Mendelian inheritance with suitable genetic crosses and examples.
- Discuss the chromosomal theory of inheritance and the significance of recombination mapping.
- Describe the structure and function of transposable elements and their impact on genome evolution.

- Compare and contrast different types of chromosomal aberrations and their phenotypic effects.
- Illustrate DNA replication in eukaryotes and describe key enzymes involved.
- Describe the lac operon and its regulation as a model of transcriptional control in bacteria.
- Evaluate the role of epigenetics in cancer and metabolic diseases with examples.
- Calculate gene frequencies using Hardy-Weinberg equations and interpret population genetics data.
- Explain CRISPR-Cas9 genome editing and discuss its applications in correcting genetic disorders.
- Analyze ethical concerns surrounding genome editing technologies and propose mitigation strategies.

SEMESTER-III

Course Depiction

rDNA Technology

Program: M.Sc.,	Semester : III (2025-2026 Onwards)
Course Title**: rDNA Technology** Subject Code: 25MBC3C2	Class Time: As per the time table
Name of Course Teachers	Dr. M. Mamutha
Mobile: +91 91761 63179	E-mail: mamudha2014@gmail.com

Course Brief:

This course introduces students to the principles and techniques of recombinant DNA (rDNA) technology. It focuses on the molecular basis of DNA replication, the function of enzymes involved in genetic engineering, cloning vectors, gene transfer methods, screening of recombinants, and modern molecular tools. Through this course, students will gain theoretical and practical knowledge crucial for genetic manipulation, biotechnology applications, and molecular diagnostics.

Teaching methods: The course will be based on the following teaching and learning activities:

- Lectures covering the theoretical part using PowerPoint presentations
- Case studies
- Review questions

Attendance: A student's academic performance and opportunity to gain knowledge largely depend on regular class attendance. According to university norms, maintaining at least 70–75% attendance is essential to be eligible to appear for the end-semester examinations.

Punctuality: Punctuality is one of the essential qualities that students must follow and maintain to achieve greater success. Students are required to arrive in class on time without any delay. Only important reasons such as personal or medical emergencies will be accepted as valid excuses. Otherwise, the student will be marked absent.

Class Participation: Classroom participation is important because learning is not just between the student and the teacher, but part of the whole classroom experience which involves questioning, inquiring and exchanging ideas. When students participate, they learn from each other and internalize the knowledge better.

Submission of Assignment: Assignments are an important part of the learning process, designed to help students apply the concepts and knowledge acquired during the course. Each student will receive two assignments that together cover the full syllabus. The course instructor will assign specific topics for each. Completing these assignments with proper effort and understanding will greatly benefit students in preparing for their final examinations.

Presentation of Seminar: Students are supposed to give an oral presentation during the class seminar hours in their assigned topic. Students will discuss on recent research finding related to the topic and participants are encouraged to ask valid questions. Seminars help the students to be updated in their course. In addition students will be able to learn their mistakes and can improve their communication skills during seminar presentation.

Preparedness: Students are expected to have read and be able to discuss the assigned chapter before attending the lecture. In addition, students should be prepared to discuss homework problems.

Academic Dishonesty: Academic dishonesty includes giving, receiving, or using unconstitutional support on any academic work. This includes a person who has taken a test discussing what was on a test with a person who has not taken the test. A clear indication of academic dishonesty will result in a grade of "F" being assigned to that particular piece of work.

Subject to change clause: Depending upon the requirement of student's possibility, the course syllabus will be re-structured and updated accordingly at the discretion of the Professor(s) and Board of studies chairperson.

Important Dates: Please note down the important dates and stick to the schedule.

CIA Test I	CIA Test II	Assignment	Seminar
As per Academic Calendar		After CIA Test-I	

Course Outline

- Mechanisms of DNA replication, key enzymes, Okazaki fragments, DNA repair pathways, and replication inhibitors.
- Structure and function of plasmids, cosmids, bacteriophage vectors, and viral vectors in prokaryotic and eukaryotic systems.
- DNA delivery methods including transformation, electroporation, Agrobacterium-mediated transfer, and microinjection.
- Construction of genomic and cDNA libraries, use of marker genes, immunochemical screening, and DNA chip technologies.
- PCR, blotting methods, DNA fingerprinting, sequencing, FISH, ELISA, gene silencing, and microarray applications.

III- Semester					
Core-XI	**Course Code 25MBC3C2**	**rDNA Technology (K1-K5)**	**T**	**Credits: 5**	**Hours: 5**
UNIT-I					
Objective -1	To understand the mechanisms of DNA replication, associated enzymes, and repair systems involved in genetic fidelity and disease.				
DNA replication and regulation: Regulators of DNA replication - Restriction enzymes, DNA Polymerase, Reverse Transcriptase, Terminal Transferases, T4 Polynucleotide kinases & Alkaline phosphatase, DNA dependent RNA polymerases, DNA ligases, Nucleases, helicase, gyrase, primosome, repliosome, topoisomerase and Okazaki fragments. DNA repair – Mutation, mutagenes, paramutation; Disease associated with repair mechanisms, DNA replication inhibitors.					
Outcome - 1	Students will be able to describe replication processes, identify key enzymes, and explain the impact of mutations and repair deficiencies.				
UNIT-II					
Objective - 2	To study the types, structures, and functional roles of various cloning vectors used in recombinant DNA experiments.				
Cloning Vectors: Vectors- Definition, types and properties of good vectors, Plasmids and Cosmids - Plasmids- Types, Structural and Functional Organization of Plasmids, Cosmids- Principle and cloning, Bacteriophage vector - Lambda phage, M13 single strand phage vector, yeast cloning vectors - YAC, YEP, Animal viral vector - SV 40, Plant viral vector - Cauliflower mosaic virus vector (CaMV).					
Outcome - 2	Students will be able to classify and compare cloning vectors and explain their applications in gene cloning across organisms.				
UNIT-III					
Objective - 3	To learn various gene transfer methods and strategies for introducing foreign DNA into host cells.				
Gene transfer techniques: Transformation of DNA to bacterial, plant and animal cells - Transformation, Microinjection, Lipofection, Electroporation, Nuclear transplantation, Homologous recombination, Natural genetic engineering by Agrobacterium - Ti plasmid, binary vector strategy.					
Outcome - 3	Students will understand gene delivery systems, evaluate host-vector compatibility, and prepare competent cells for transformation.				
UNIT-IV					

Objective - 4	To explore recombinant screening techniques, including library construction and functional genomics tools.
Screening of Recombinants: Construction of genomic and CDNA libraries; Functional genomics - DNA chips and microarray gene screen technology, site directed Mutagenesis; Immunochemical methods for screening - colony/plaque screening with antibodies; Merker genes - Neomycin , hygromycin, green fluorescence protein, lacZ complementation;	
Outcome - 4	Students will be able to apply screening methods and interpret results using molecular and immunochemical markers.
UNIT-V	
Objective - 5	To familiarize students with key molecular biology techniques and applications of recombinant DNA technology.
Techniques in rDNA technology: Blotting (Southern, Western, Northern) techniques; PCR - basic steps in DNA amplification, RAPD, RFLP and their applications; DNA finger printing; DNA microarray analysis; DNA sequencing; oligonucleotide synthesis; Southern and Northern hybridization; FISH; RAPD; RFLP; mutagenesis; Gene silencing; ELISA; DNA sequencing; Applications of recombinant DNA technology.	
Outcome - 5	Students will be able to perform and analyze molecular techniques like PCR, blotting, DNA fingerprinting, and gene silencing for research and diagnostics.

Suggested Readings

Textbooks:

Brown, T. A. (2016). Gene Cloning and DNA Analysis: An Introduction (7th ed.). Wiley-Blackwell.
Primrose, S. B., Twyman, R. M., & Burton, G. R. (2013). Principles of Gene Manipulation and Genomics (7th ed.). Wiley-Blackwell.
Old, R. W., & Primrose, S. B. (2001). Principles of Gene Manipulation (6th ed.). Blackwell Science.
Watson, J. D., et al. (2014). Recombinant DNA: Genes and Genomes – A Short Course (3rd ed.). W. H. Freeman.

Reference Books:

Sambrook, J., & Russell, D. W. (2001). Molecular Cloning: A Laboratory Manual (3rd ed.). Cold Spring Harbor Laboratory Press.
Glick, B. R., & Patten, C. L. (2017). Molecular Biotechnology: Principles and Applications of Recombinant DNA (5th ed.). ASM Press.
Lewin, B. (2013). Genes XI. Jones and Bartlett Learning.
Lodish, H., et al. (2021). Molecular Cell Biology (9th ed.). W. H. Freeman.
Karp, G. (2021). Cell and Molecular Biology: Concepts and Experiments (8th ed.). Wiley.

Course Outcome	K1	K2	K3	K4	K5	K6
CO1	✓	✓	✓	✓	✓	-
CO2	✓	✓	✓	✓	✓	-
CO3	✓	✓	✓	✓	✓	-
CO4	✓	✓	✓	✓	✓	-
CO5	✓	✓	✓	✓	✓	-

K1-Remember	*K2-Understand*	*K3- Apply*	*K4-Analyze*	*K5-Evaluate*	*K6-Create*

Course designed by: Dr. M. Mamutha

Course outcome Vs Programme outcome

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	3	3	3	3	2	2	3	2	2
CO2	3	3	3	3	3	2	2	2	2	2
CO3	3	3	3	3	3	2	2	1	3	3
CO4	3	3	3	3	3	2	2	2	3	3
CO5	3	3	3	3	3	2	2	3	2	3
W.AV	3	3	3	3	3	2	2	2.2	2.4	2.6

S-Strong (3) M-Medium (2) L-Low (1)

POs vs COs Interpretation

PO	Weighted Average	Interpretation
PO1	3.0	Strongly aligned with all COs
PO2	3.0	Strongly aligned with all COs
PO3	3.0	Strongly aligned with all COs
PO4	3.0	Strongly aligned with all COs
PO5	3.0	Strongly aligned with all COs
PO6	2.0	Moderately supported
PO7	2.0	Moderately supported
PO8	2.2	Moderately supported
PO9	2.4	Moderately supported
PO10	2.6	Moderately supported

Assignment Topics:

- Explain the role of DNA polymerases and ligases in the process of replication and cloning.
- Compare and contrast plasmid vectors and bacteriophage vectors in terms of structure and use.
- Describe the mechanism of transformation in bacterial cells and how competent cells are prepared.
- Discuss the principle and application of Agrobacterium-mediated gene transfer in plants.
- Write a detailed note on construction and screening of a cDNA library.
- Explain the role of marker genes in identifying recombinant clones.
- Describe the principle and steps involved in Southern blotting and its applications.
- Differentiate between PCR, RAPD, and RFLP with suitable applications.
- Elaborate on the process and significance of gene silencing in therapeutic biotechnology.
- Discuss the applications of recombinant DNA technology in medicine and agriculture.

SEMESTER-III

Course Depiction

Analytical and Instrumentation Techniques

Program: M.Sc.,	Semester : III (2025-2026 Onwards)
Course Title**: Analytical and Instrumentation Techniques** Subject Code: 25MBC3C3	Class Time: As per the time table
Name of Course Teachers	Dr. P. Boomi
Mobile:+91 – 9486031423	E-mail: pboomi1983@gmail.com

Course Brief:

This course provides a comprehensive understanding of modern analytical and instrumentation techniques widely employed in biochemical, molecular, and cellular analysis. It explores the fundamental principles, working mechanisms, and applications of spectroscopic, chromatographic, electrophoretic, and microscopic tools, along with advanced methods in structural biology. The course aims to equip students with the skills necessary to analyze, interpret, and apply a variety of instrumental techniques to investigate the structure, interaction, and behavior of biomolecules.

Teaching methods

The course employs a variety of teaching methods, including lectures, discussions, demonstrations, concept mapping, models, self-directed study, and dedicated Q&A sessions. A key component is an integrative project carried out in groups, focusing on independent work and in-depth literature review. The course concludes with a written final examination.

Attendance: Attendance and participation are vital to the student's success in this course. Students are expected to attend class every day. Minimum attendance to be eligible to take end-semester-examination is 70-75%. It is also essential that the students study regularly.

Punctuality: Being punctual is a key habit that helps students reach important goals in their academic journey. Students must arrive on time for every class without unnecessary delays. Absences will only be excused for valid reasons such as personal or medical emergencies. In all other cases, late arrivals will be marked as absent.

Class Participation: Class participation and interaction helps to form a complete educational experience. However, class participation and interaction is to be relevant to course content and context. Deviant behavior may lead to dismissal or suspension.

Submission of Assignment: Assignments are given to the students to help them to apply the concepts and

knowledge gained by the course. Each students will be assigned two assignments for the course, covering entire syllabus. Topic of assignments for each assignments will be assigned by the course instructor. Good preparation of assignment will help the students for their final exams.

Presentation of Seminar: Beyond regular assignments, students are expected to deliver an oral presentation during seminar sessions on a topic assigned by the instructor. These seminars aim to improve students' public speaking and communication skills. Active participation from classmates through relevant questions will be encouraged to foster engagement and build confidence. This interactive setting also helps students broaden their understanding and stay current with key concepts in the course.

Preparedness: Prior to attending the class the students are expected to collect information regarding the topic given in advance, so that they will be able to discuss during the lecture.

Academic Dishonesty: Academic dishonesty is a serious violation of ethical conduct and is not tolerated under any circumstances. To promote academic integrity, faculty members proactively educate students about common forms of misconduct—such as plagiarism, copyright infringement, and unauthorized use of patented material. By understanding these issues and their consequences, students are better equipped to act responsibly and uphold honesty throughout their academic journey.

Subject to change clause: Depending upon the requirement of student's possibility, the course syllabus will be re-structured and updated accordingly at the discretion of the Professor(s) and Board of studies chairperson.

Important Dates: Please note down the important dates and stick to the schedule

CIA Test I	CIA Test II	Assignment	Seminar
As per Academic Calendar		After CIA Test-I	

Course Outline:

- Introduction to light-matter interactions, Beer-Lambert's law, and instrumentation behind UV-Vis, IR, fluorescence, atomic absorption, and mass spectrometry for biomolecular analysis.
- Fundamentals of chromatography with techniques including paper, TLC, ion-exchange, gel filtration, affinity, gas-liquid chromatography, and HPLC for biomolecule separation and purification.
- Electrophoresis principles using agarose, SDS-PAGE, 2D-PAGE, and capillary methods; applications of blotting techniques for nucleic acid and protein analysis.
- Working and applications of light, fluorescence, inverted, confocal, scanning and transmission electron microscopes, and STM for cellular and subcellular visualization.

- High-resolution molecular analysis using NMR (1D & 2D), mass spectrometry (ESI, MALDI, TOF), X-ray crystallography, Cryo-EM, and Surface Plasmon Resonance (SPR) for studying biomolecular structures and interactions.

<table>
<tr><th colspan="6">III- Semester</th></tr>
<tr><td>Core-XII</td><td>Course Code
25MBC3C3</td><td>Analytical and Instrumentation Techniques
(K1-K5)</td><td>T</td><td>Credits: 5</td><td>Hours: 5</td></tr>
<tr><td colspan="6">UNIT-I</td></tr>
<tr><td colspan="2">Objective -1</td><td colspan="4">To understand the principles and applications of absorption and emission spectroscopy in biochemical analysis.</td></tr>
<tr><td colspan="6">Photometry & Spectroscopy: Fundamental fluorescence & phosphorescence, absorption, transmission and reflections of light, Beer-Lambart’s law. Instrumentation and working principle of Colorimeter, flame photometer, UV, visible and IR spectroscopy, spectrofluorimetry, atomic absorption spectrometry, Mass spectroscopy, Turbidimetry, Nephelometry and Luminometry. vibration Spectra – IR – Principles and Applications. Raman spectroscopy, Electron spin resonance spectroscopy.</td></tr>
<tr><td colspan="2">Outcome - 1</td><td colspan="4">Students will be able to explain the working principles of UV-Vis, IR, and fluorescence spectroscopy and apply them to characterize biomolecules.</td></tr>
<tr><td colspan="6">UNIT-II</td></tr>
<tr><td colspan="2">Objective - 2</td><td colspan="4">To study the principles and applications of various chromatographic methods used for the separation and purification of biomolecules.</td></tr>
<tr><td colspan="6">Chromatographic techniques: Basic principles of chromatography- adsorption and partition techniques. Paper chromatography, Thin layer chromatography, Column, Ion-exchange, Affinity chromatography, Gas liquid chromatography, gel filtration chromatography, High performance liquid chromatography (HPLC),</td></tr>
<tr><td colspan="2">Outcome - 2</td><td colspan="4">Students will understand and apply chromatographic techniques like TLC, ion exchange, affinity, and HPLC for biomolecule separation.</td></tr>
<tr><td colspan="6">UNIT-III</td></tr>
<tr><td colspan="2">Objective - 3</td><td colspan="4">To understand the principles, types, and applications of electrophoresis and blotting techniques in the separation and identification of nucleic acids and proteins.</td></tr>
<tr><td colspan="6">Electrophoretic Techniques: General principles of electrophoresis, Agarose, Polyacrylamide gel, SDS-PAGE, Native gels, Gradient gel, Isoelectric focusing, pulse field , high voltage, Capillary and 2-D gel electrophoresis (2-D PAGE), cellulose acetate electrophoresis. Blotting techniques and its applications – Western, Northern & Southern.</td></tr>
<tr><td colspan="2">Outcome - 3</td><td colspan="4">Students will distinguish electrophoresis types and apply blotting techniques for biomolecule analysis.</td></tr>
<tr><td colspan="6">UNIT-IV</td></tr>
<tr><td colspan="2">Objective - 4</td><td colspan="4">To understand light, fluorescence, and electron microscopy techniques for visualizing cells and subcellular structures.</td></tr>
</table>

Microscopic techniques: Instrumentation, working Principle and applications of Light, Compound, Dark field, Fluorescence, Inverted and confocal microscopy, Scanning Electron Microscopy - Transmission Electron Microscopy (TEM) - Scanning Tunneling Microscopy- (STM) – Confocal Microscopy	
Outcome - 4	Students will assess the capabilities of optical and electron imaging tools to study cell morphology and biomolecular localization.
UNIT-V	
Objective - 5	To understand the principles and applications of advanced structural biology tools for biomolecular identification and interaction studies.
Molecular and Structural Analysis Techniques: Mass Spectrometry (MS) - ESI, MALDI, TOF, Nuclear Magnetic Resonance (NMR) - Principles, 1D & 2D NMR (COSY, NOESY), structural elucidation of metabolites and peptides. X-ray Crystallography- Crystal growth, diffraction, and structure determination of proteins and nucleic acids. Cryo-Electron Microscopy (Cryo-EM)- Single-particle analysis, tomography, application in large biomolecular complexes. Surface Plasmon Resonance (SPR)- Real-time biomolecular interaction analysis.	
Outcome - 5	Students will interpret molecular structures using MS, NMR, X-ray, Cryo-EM, and analyze interactions using SPR.

Suggested Reading:

Skoog, D. A., Holler, F. J., & Crouch, S. R. – Principles of Instrumental Analysis

Wilson, K., & Walker, J. – Principles and Techniques of Biochemistry and Molecular Biology

Braun, R. D. – Introduction to Instrumental Analysis

Dasgupta, B., & Lutfullah, M. – Instrumental Methods of Analysis

Shrivastava & Jain – Advanced Instrumental Methods of Chemical Analysis

James, P. Allen. (2008). Biophysical Chemistry, Wiley Blackwell, New Jersey.

Wilson, K. and Walker, J. (2010) Principles and Techniques of Biochemistry and Molecular Biology, Cambridge University Press, Cambridge.

Horst, F. (2010) Basic One and Two-dimensional NMR Spectroscopy, Wiley-VCH, New Jersey.

Murphy, D.B. and Davidson, M. W. (2012) Fundamentals of Light Microscopy and Electron Imaging, Wiley-Blackwell, New Jersey.

Freifelder, D.M. (1983) Physical Biochemistry- Application to Biochemistry and Molecular Biology, W.H. Freeman, New York

Course Outcome	K1	K2	K3	K4	K5	K6
CO1	✓	✓	✓	✓	✓	-
CO2	✓	✓	✓	✓	✓	-
CO3	✓	✓	✓	✓	✓	-
CO4	✓	✓	✓	✓	✓	-
CO5	✓	✓	✓	✓	✓	-

K1-Remember	*K2-Understand*	*K3- Apply*	*K4-Analyze*	*K5-Evaluate*	*K6-Create*

Course designed by: **Dr. P. Boomi**

Course outcome Vs Programme outcome

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	3	3	3	3	1	2	2	2	3
CO2	3	3	3	3	3	1	2	3	2	3
CO3	3	3	3	3	3	1	2	3	2	3
CO4	3	3	3	3	3	1	2	3	2	3
CO5	3	3	3	3	3	2	2	2	2	3
W.AV	3	3	3	3	3	1.2	2	2.6	2	3

S-Strong (3) M-Medium (2) L-Low (1)

POs vs COs Interpretation

PO	Weighted Average	Interpretation
PO1	3.0	Strongly aligned with all COs
PO2	3.0	Strongly aligned with all COs
PO3	3.0	Strongly aligned with all COs
PO4	3.0	Strongly aligned with all COs
PO5	3.0	Strongly aligned with all COs
PO6	1.2	Low alignment
PO7	2	Moderately supported
PO8	2.6	Moderately supported
PO9	2	Moderately supported
PO10	3.0	Strongly aligned with all COs

Assignment Topics:

- Compare and contrast UV-Vis Spectroscopy and Fluorescence Spectroscopy in biomolecular analysis.
- Chromatographic techniques in protein purification: A case study using affinity and ion-exchang chromatography.
- Instrumentation and applications of Atomic Absorption Spectroscopy (AAS) in trace element detection.
- Electrophoretic techniques used in the diagnosis of genetic disorders.
- Role of blotting techniques in gene expression studies: Western, Southern, and Northern blot.
- Confocal vs. Electron Microscopy: Comparative applications in cellular and subcellular imaging.
- Structural elucidation of peptides using 1D and 2D NMR spectroscopy.
- Application of Mass Spectrometry (ESI & MALDI-TOF) in proteomics and metabolomics.
- X-ray crystallography and its role in drug discovery and protein structure determination.
- Surface Plasmon Resonance (SPR) in biomolecular interaction analysis: Principles and real-time applications

SEMESTER-III

Course Depiction

Lab – III : Genetics, rDNA Technology and Advanced Biochemistry Lab

Program: M.Sc.,	Semester: III (2025-2026 Onwards)
Course Title: **Lab – III : Genetics, rDNA Technology and Advanced Biochemistry Lab** Subject Code: 25MBC3P1	Class Time: As per Time Table
Name of the Course Teacher	Dr. M. Jeyakumar & Dr. M. Mamutha
Mobile: +91 96559 07058 & +91 91761 63179	E-Mail: biotechjeya@gmail.com mamudha2014@gmail.com

Course Brief:

This lab-intensive course provides practical training in the foundational and advanced techniques of genetics, recombinant DNA (rDNA) technology, and molecular biochemistry. Through a blend of wet-lab experiments and computational tools, students will gain hands-on experience in nucleic acid isolation, amplification, restriction digestion, and biomolecule separation techniques such as electrophoresis and chromatography. The course equips learners with essential skills required for molecular cloning, genetic diagnostics, and biochemical research.

Teaching methods: The course will be based on the following teaching and learning activities:

- Lectures covering the theoretical part using PowerPoint presentations
- Case studies
- Review questions

Attendance: A student's academic performance and opportunity to gain knowledge largely depend on regular class attendance. According to university norms, maintaining at least 70–75% attendance is essential to be eligible to appear for the end-semester examinations.

Punctuality: Punctuality is one of the essential qualities that students must follow and maintain to achieve greater success. Students are required to arrive in class on time without any delay. Only important reasons such as personal or medical emergencies will be accepted as valid excuses. Otherwise, the student will be marked absent.

Class Participation: Classroom participation is important because learning is not just between the student and the teacher, but part of the whole classroom experience which involves questioning, inquiring and exchanging ideas. When students participate, they learn from each other and internalize the knowledge

better.

Submission of Assignment: Assignments are an important part of the learning process, designed to help students apply the concepts and knowledge acquired during the course. Each student will receive two assignments that together cover the full syllabus. The course instructor will assign specific topics for each. Completing these assignments with proper effort and understanding will greatly benefit students in preparing for their final examinations.

Presentation of Seminar: Students are supposed to give an oral presentation during the class seminar hours in their assigned topic. Students will discuss on recent research finding related to the topic and participants are encouraged to ask valid questions. Seminars help the students to be updated in their course. In addition students will be able to learn their mistakes and can improve their communication skills during seminar presentation.

Preparedness: Students are expected to have read and be able to discuss the assigned chapter before attending the lecture. In addition, students should be prepared to discuss homework problems.

Academic Dishonesty: Academic dishonesty includes giving, receiving, or using unconstitutional support on any academic work. This includes a person who has taken a test discussing what was on a test with a person who has not taken the test. A clear indication of academic dishonesty will result in a grade of "F" being assigned to that particular piece of work.

Subject to change clause: Depending upon the requirement of student's possibility, the course syllabus will be re-structured and updated accordingly at the discretion of the Professor(s) and Board of studies chairperson.

Important dates: Please note down the important dates and stick to the schedule.

CIA Test I	**CIA Test II**	**Assignment**	**Seminar**
As per Academic Calendar		After CIA Test-I	

Course Outline:

- Hands-on extraction of plasmid DNA, RNA, and chromosomal DNA from various biological sources including bacteria, animal tissues, and humans.
- Application of molecular biology techniques such as restriction enzyme digestion and polymerase chain reaction (PCR) for gene-level manipulation and analysis.
- Separation and analysis of biomolecules like amino acids, proteins, lipids, and DNA using paper, thin-layer, and column chromatography, along with gel-based techniques.

- Use of SDS-PAGE and agarose gel electrophoresis for the identification and quality assessment of nucleic acids and proteins.

<table>
<tr><th colspan="6">III - Semester</th></tr>
<tr><td>Core-XIII</td><td>Course Code
25MBC3P1</td><td>Lab – III : Genetics, rDNA Technology and Advanced Biochemistry Lab (K1-K6)</td><td>P</td><td>Credits: 4</td><td>Hours: 8</td></tr>
<tr><td colspan="6">UNIT-I</td></tr>
<tr><td>Objective -1</td><td colspan="5">To provide hands-on training in DNA/RNA isolation, PCR amplification, and genetic mutation analysis using computational tools.</td></tr>
<tr><td colspan="6">Module 1 : Genetics
1. Extraction of plasmid DNA from E. coli using alkaline lysis method.
2. Extraction of total RNA from tissues or cultured cells.
3. Isolation of chromosomal DNA from bacteria.
4. Isolation of Chromosomal DNA from Goat Liver.
5. Isolation of Chromosomal DNA from human.</td></tr>
<tr><td>Outcome - 1</td><td colspan="5">Students will be able to independently isolate nucleic acids, perform PCR, and identify genetic mutations using both wet-lab and bioinformatic techniques.</td></tr>
<tr><td colspan="6">UNIT-II</td></tr>
<tr><td>Objective – 2</td><td colspan="5">To equip students with core molecular biology techniques including genomic DNA isolation, restriction digestion, and PCR amplification for genetic analysis.</td></tr>
<tr><td colspan="6">Module : rDNA Technology
6. Isolation of genomic DNA from plant .
7. Isolation of genomic DNA animal tissues.
8. Restriction digestion of DNA
9. Polymerase Chain Reaction.</td></tr>
<tr><td>Outcome – 2</td><td colspan="5">Students will develop proficiency in isolating genomic DNA from various sources and performing enzymatic and amplification-based manipulations essential for recombinant DNA technology.</td></tr>
<tr><td colspan="6">UNIT-III</td></tr>
<tr><td>Objective - 3</td><td colspan="5">To train students in modern biomolecular separation techniques including chromatography, electrophoresis, and subcellular fractionation.</td></tr>
<tr><td colspan="6">Module 3: Advanced Biochemistry
10. Separation of amino acids from a biological mixture using paper chromatography.
11. Separation of lipids or plant pigments using thin layer chromatography
12. Separation of a protein mixture using column chromatography
13. Separation of DNA using Gel Electrophoresis
14. Separation of proteins using SDS-PAGE
15. Separation of cell components using differential centrifugation.</td></tr>
<tr><td>Outcome - 3</td><td colspan="5">Students will develop skills in separating and analyzing biomolecules like amino acids, proteins, lipids, and nucleic acids using advanced instrumentation and protocols.</td></tr>
</table>

Suggested Readings:

Sambrook, J., & Russell, D. W. (2001). Molecular Cloning: A Laboratory Manual. Cold Spring Harbor Laboratory Press.
Wilson, K., & Walker, J. (2010). Principles and Techniques of Biochemistry and Molecular Biology. Cambridge University Press.
Plummer, D. T. (1990). An Introduction to Practical Biochemistry. McGraw Hill.
Jayraman, J. (1981). Laboratory Manual in Biochemistry. New Age International Publishers.
Brown, T. A. (2010). Gene Cloning and DNA Analysis: An Introduction. Wiley-Blackwell.
Sawhney, S. K., & Singh, R. (2014). Introductory Practical Biochemistry. Narosa Publishing House.

Course Outcome	K1	K2	K3	K4	K5	K6
CO1	✓	✓	✓	✓	✓	-
CO2	✓	✓	✓	✓	✓	-
CO3	✓	✓	✓	✓	✓	-
CO4	✓	✓	✓	✓	✓	-
CO5	✓	✓	✓	✓	✓	-

K1-Remember	*K2-Understand*	*K3- Apply*	*K4-Analyze*	*K5-Evaluate*	*K6-Create*

Course designed by: Dr. M. Jeyakumar & Dr. M. Mamutha

Course outcome Vs Programme outcome

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	3	3	3	3	2	2	3	2	3
CO2	3	3	3	3	3	2	3	2	2	3
CO3	3	3	3	3	3	2	2	2	2	3
CO4	3	3	3	3	3	2	2	2	2	3
CO5	3	3	3	3	3	2	2	2	2	3
W.AV	3	3	3	3	3	2	2.3	2.3	2	3

S-Strong (3) M-Medium (2) L-Low (1)

POs vs COs Interpretation

PO	Weighted Average	Interpretation
PO1	3.0	Strongly aligned with all COs
PO2	3.0	Strongly aligned with all COs
PO3	3.0	Strongly aligned with all COs
PO4	3.0	Strongly aligned with all COs
PO5	3.0	Strongly aligned with all COs
PO6	2	Moderately supported
PO7	2.3	Moderately supported
PO8	2.3	Moderately supported
PO9	2	Moderately supported
PO10	3.0	Strongly aligned with all COs

SEMESTER-IV

Course Depiction

Computational and Structural Biology

Program: M.Sc.,	Semester: IV (2025-2026 Onwards)
Course Title: **Computational and structural Biology** Subject Code: 25MBC4C1	Class Time: As per Time Table
Name of the Course Teacher	Dr. J. Jeyakanthan
Mobile: +91 97898 09245	E-Mail-jjkanthan@gmail.com

Course Brief: This course provides an in-depth exploration of computational and structural approaches in modern biology. It covers theoretical and practical aspects of sequence alignment, molecular modeling, crystallography, and structure determination techniques such as X-ray crystallography, NMR, and Cryo-EM. Learners will gain proficiency in interpreting biological macromolecules at the atomic level and integrating AI tools in structural analysis.

Teaching Methods: The mode of teaching is based on the following learning activities:

- Lectures covering the theoretical part will be delivered using PowerPoint presentations.
- A set of laboratory exercises to analyze biological problems using softwares and tools to develop student's interests in scientific discovery.
- Case studies in informatics-based research.

Attendance: The students are expected to attend the classes regularly, since regular attendance is essential to gain academic achievement. As per the University norms, the students having a minimum scale of 70-75% attendance are only qualified to write their end-semester examinations.

Punctuality: Punctuality is the most important quality for the student to be followed and maintained to achieve success. Students who arrive late by 10 mins to the class without any vital reason will be marked absent in the attendance register. On the other hand, valid excuse including personal or medical emergency is acceptable, with prior consent by the Head of the Department.

Class Participation: A student's overall growth and personality development is based on his/her involvement in the class not just by mere presence but rather being interactive through questioning that will lead to propagation of ideas, initiation of thought-provoking practice and much more that will provide a wholesome enriched classroom experience. When students participate, they learn from one another and gain their knowledge better.

Submission of Assignment: Assignments are given to students in order to apply the concepts for deeper understanding of the subject. Therefore, each student will be allocated two assignments for the course, covering the entire topic. Students will be given deadline to submit the assignment by the course instructor and good preparation of assignment will help the students for their final exams.

Presentation of Seminar: Apart from the assignments, students are supposed to give an oral presentation during the class seminar hours in their assigned topic. The concerned instructor will encourage the participants to ask valid questions during seminar presentation in order to put up their confidence levels and communication skills. In addition, students will be able to gain information and can be updated in their course.

Preparedness: At the end of every class, the concerned instructor conveys the students about the details that will be handled in the next class to increase the student's awareness related to the topics.

Academic Dishonesty: Academic dishonesty is a completely unacceptable mode of conduct and every student should be aware of this important aspect. Thus, the respective faculty members educate the students of possible means of academic malpractices (plagiarism, violation of copyrights and stealing the patented knowledge) and the following consequences that will make them more vigilant in their academic career.

Subject to change clause: Depending upon the requirement of student's possibility, the course syllabus will be re-structured and updated accordingly at the discretion of the Professor(s) and Board of studies chairperson.

Important dates: Scheduled dates for the various activities related to the course

CIA Test I	**II CIA Test**	**Assignment**	**Seminar**
As per Academic Calendar		After CIA Test-I	

Course Outline

- Fundamentals of sequence alignment methods, scoring systems, and substitution matrices.
- Techniques for pairwise and multiple sequence alignments using computational approaches.
- Principles of crystallography and symmetry used in structural biology.
- Structure determination methods including X-ray diffraction, NMR, Cryo-EM, SAXS, and CD.
- Practical applications in protein crystallography, structure refinement, validation, and AI-assisted modeling.

IV- Semester					
Core-XIV	**Course Code 25MBC4C1**	**Computational and Structural Biology (K1-K5)**	**T**	**Credits: 4**	**Hours: 4**

UNIT-I	
Objective -1	To introduce the fundamental concepts of sequence alignment and scoring systems.
Introduction to Computational Biology: Introduction to Computational Biology: Nature and scope of Computational Biology, Alignment definition, Pairwise sequence alignment, biological interpretation of the alignment problem, scoring alignment, Global alignment, local alignment, overlap alignment, banded alignment, normalized local alignment, maximizing Vs minimizing score, similarity and distance measures, PAM matrices, BLOSUM matrices, comparison between PAM and BLOSUM matrices, Application of substitution matrices	
Outcome - 1	Learners will understand how biological sequences are compared and interpreted computationally.
UNIT-II	
Objective - 2	To teach computational techniques for sequence matching and restriction mapping.
Pairwise sequence matching analysis: Sequence matching method-Dot plot visualization method, Dynamic programming method, Word method, Bayesian method, progressive method, Markov chain model, Hidden Markov Models and Kernal methods. **Computational Sequences and Maps:** General ideas of sequence alignment, multiple sequence alignment, Restriction map-Graph, Interval graphs and Measuring fragment sizes. Multiple maps-double design problems, reflection, overlap equivalence, overlap size equivalence, restriction map and border block graph, Cassettle transformation of restriction map. Vector and plasmid design.	
Outcome - 2	Students will be able to perform and interpret sequence analysis and plasmid design.
UNIT-III	
Objective - 3	To understand the principles and mathematical foundations of crystallography.
Introduction to Crystallography: General concepts, overview of Crystals and their properties. Single crystal, powder crystal and Amorphous solid. Unit cell, Lattices, Planes and Indices, stereographic projection of point groups and space groups. Crystal systems and Symmetry. X-ray generator, diffraction and its applications; Laue equations, Braggs' Law and its applications in X-ray diffraction, Atomic scattering factor, Structure factor and Electron density calculations, phase problem	
Outcome - 3	Learners will be able to explain symmetry, diffraction, and structure factor calculations.
UNIT-IV	
Objective - 4	To study modern experimental tools for determining biomolecular structures.
Structure Determination Techniques: Synchrotron radiation and its implications in structure determination. Introduction to X-ray Free Electron Laser technology (XFEL), importance and applications. Cryo-electron microscopy, Fiber, Powder and Neutron diffraction. NMR- Introduction and general aspects of structure determination. NMR Sample preparation. Importance of NMR in Structural Biology, Cryo-EM. Nuclear Magnetic Resonance: Chemical Shift, Coupling constant, spin-spin relaxation, spin-lattice relaxation, COSY, NOESY and NOE. small-angle X-ray scattering (SAXS), circular dichroism (CD). Time-resolved X-ray Crystallography	

Outcome - 4	Students will gain practical knowledge of NMR, Cryo-EM, SAXS, and related techniques.

UNIT-V

Objective - 5	To apply protein crystallization and structural validation techniques in real-world scenarios.

Protein X-ray Crystallography: Crystallization methods (sitting, hanging drop, microbatch methods etc.,), Soaking and Co-Crystallization methods, Heavy atoms screening, X-ray data collection, data reduction and Integration, various Protein structure determination methods, interpretation of electron density maps, structure solution, structure refinement, Structure Validation and analysis. AL/ML integration in Protein Crystallography. Synergistic Approach for effective protein structure determination. Structural Classification, Folds and Motifs, Deposition of structure in Protein Data Bank (PDB).

Outcome-5	Learners will be able to interpret electron density maps, refine protein structures, and integrate AI/ML tools.

Suggested Readings

Mount, D. W. (2004). Bioinformatics: Sequence and Genome Analysis. 2nd Edition, Cold Spring Harbor Laboratory Press.

Lesk, A. M. (2019). Introduction to Bioinformatics. 5th Edition, Oxford University Press.

Setubal, J. C., & Meidanis, J. (1997). Introduction to Computational Molecular Biology. PWS Publishing Company.

Glusker, J. P., Lewis, M., & Rossi, M. (1994). Crystal Structure Analysis for Chemists and Biologists. VCH Publishers.

Rhodes, G. (2006). Crystallography Made Crystal Clear: A Guide for Users of Macromolecular Models. 3rd Edition, Academic Press.

Cavanagh, J., Fairbrother, W. J., Palmer, A. G., Rance, M., & Skelton, N. J. (2007). Protein NMR Spectroscopy: Principles and Practice. 2nd Edition, Academic Press.

Petoukhov, M. V., & Svergun, D. I. (2015). Small-angle X-ray and neutron scattering from solutions: studies of biological macromolecules in solution. Oxford University Press.

Online Resources and Tools

RCSB Protein Data Bank – https://www.rcsb.org.

EMBL-EBI Tools – https://www.ebi.ac.uk/services

SWISS-MODEL – https://swissmodel.expasy.org/

Course Outcome	K1	K2	K3	K4	K5	K6
CO1	✓	✓	✓	✓	✓	-
CO2	✓	✓	✓	✓	✓	-
CO3	✓	✓	✓	✓	✓	-
CO4	✓	✓	✓	✓	✓	-
CO5	✓	✓	✓	✓	✓	-

K1-Remember	*K2-Understand*	*K3- Apply*	*K4-Analyze*	*K5-Evaluate*	*K6-Create*

Course designed by: **Dr. J. Jeyakanthan**

Course Outcome VS Programme Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	1	3	3	3	2	3	2	3	2
CO2	2	2	1	3	3	1	2	2	1	2
CO3	3	3	3	1	1	2	2	2	3	2
CO4	2	3	3	3	2	3	3	2	3	2
CO5	3	2	3	3	3	3	3	2	3	2
W.AV	2.6	2.2	2.6	2.6	2.4	2.2	2.6	2	2.6	2

S –Strong (3), M-Medium (2), L- Low (1)

POs vs COs Interpretation

PO	Weighted Average	Interpretation
PO1	2.6	Moderately aligned.
PO2	2.2	Moderately aligned.
PO3	2.6	Moderately aligned.
PO4	2.6	Moderately aligned.
PO5	2.4	Moderately aligned.
PO6	2.2	Moderately aligned.
PO7	2.6	Moderately aligned.
PO8	2.0	Moderately aligned.
PO9	2.6	Moderately aligned.
PO10	2.0	Moderately aligned.

Assignment Topics

- Compare and contrast PAM and BLOSUM substitution matrices with biological relevance.
- Write a script or algorithm to perform basic global alignment of two protein sequences.
- Create a dot plot for two DNA sequences and interpret the results.
- Discuss the working principle and applications of Hidden Markov Models in bioinformatics.
- Analyze a protein structure using PyMOL and generate its secondary structure representation.
- Prepare a detailed flowchart of X-ray crystallographic data processing steps.
- Explain the phase problem in crystallography and discuss possible solutions.
- Review the use of Cryo-EM in determining large macromolecular complexes.
- Describe the process of protein crystallization and factors affecting crystal growth.
- Write a short report on the role of artificial intelligence in structure prediction (e.g., AlphaFold).

SEMESTER-IV

Course Depiction

Industrial and Environmental Biochemistry

Program: M.Sc.,	Semester : IV (2025-2026 Onwards)
Course Title**: Industrial and Environmental Biochemistry** Subject Code: 25MBC4C2	Class Time: As per the time table
Name of Course Teachers	Dr. M. Jeyakumar & Dr. M. Mamutha
Mobile:+ +91 96559 07058 & +91 91761 63179	E-mail:biotechjeya@gmail.com mamudha2014@gmail.com

Course Brief:

This course introduces the principles and applications of biochemistry in industrial and environmental contexts. Students will explore enzyme kinetics, fermentation technology, bioreactor design, and large-scale biochemical processes relevant to industry. The environmental component emphasizes biochemical cycles, pollutant toxicity, detoxification mechanisms, and bioremediation strategies. This integrated approach equips students with knowledge for careers in biotechnology, bioprocessing, and environmental sustainability.

Teaching methods: The course will be based on the following teaching and learning activities:

- Lectures covering the theoretical part using PowerPoint presentations
- Case studies
- Review questions

Attendance: A student's academic performance and opportunity to gain knowledge largely depend on regular class attendance. According to university norms, maintaining at least 70–75% attendance is essential to be eligible to appear for the end-semester examinations.

Punctuality: Punctuality is one of the essential qualities that students must follow and maintain to achieve greater success. Students are required to arrive in class on time without any delay. Only important reasons such as personal or medical emergencies will be accepted as valid excuses. Otherwise, the student will be marked absent.

Class Participation: Classroom participation is important because learning is not just between the student and the teacher, but part of the whole classroom experience which involves questioning, inquiring and exchanging ideas. When students participate, they learn from each other and internalize the knowledge

better.

Submission of Assignment: Assignments are an important part of the learning process, designed to help students apply the concepts and knowledge acquired during the course. Each student will receive two assignments that together cover the full syllabus. The course instructor will assign specific topics for each. Completing these assignments with proper effort and understanding will greatly benefit students in preparing for their final examinations.

Presentation of Seminar: Students are supposed to give an oral presentation during the class seminar hours in their assigned topic. Students will discuss on recent research finding related to the topic and participants are encouraged to ask valid questions. Seminars help the students to be updated in their course. In addition students will be able to learn their mistakes and can improve their communication skills during seminar presentation.

Preparedness: Students are expected to have read and be able to discuss the assigned chapter before attending the lecture. In addition, students should be prepared to discuss homework problems.

Academic Dishonesty: Academic dishonesty includes giving, receiving, or using unconstitutional support on any academic work. This includes a person who has taken a test discussing what was on a test with a person who has not taken the test. A clear indication of academic dishonesty will result in a grade of "F" being assigned to that particular piece of work.

Subject to change clause: Depending upon the requirement of student's possibility, the course syllabus will be re-structured and updated accordingly at the discretion of the Professor(s) and Board of studies chairperson.

Important dates: Please note down the important dates and stick to the schedule.

CIA Test I	**CIA Test II**	**Assignment**	**Seminar**
As per Academic Calendar		After CIA Test-I	

Course Outline:

- Enzyme regulation, fermentation basics, media optimization, industrial enzyme production, and strain improvement techniques.
- Types of bioreactors, control of process parameters, scale-up strategies, downstream processing, and automation.
- Production of primary and secondary metabolites, single-cell proteins, biopolymers, bioplastics, and bioprocess economics.

- Biogeochemical cycles, microbial interactions, chemical speciation, and concepts like bioaccumulation and trophic transfer.
- Pollutants classification, toxicity mechanisms, detoxification pathways, and microbial biodegradation strategies including phytoremediation and biosorption.

IV- Semester					
Core-XV	**Course Code 25MBC4C2**	**Industrial and Environmental Biochemistry (K1-K5)**	**T**	**Credits: 4**	**Hours: 4**
UNIT-I					
Objective -1	To introduce the core principles of industrial biochemistry and enzyme applications in bioprocesses.				
Fundamentals of Industrial Biochemistry: Historical evolution and scope; Enzyme kinetics & regulation in industrial applications; Production, purification, and immobilization of industrial enzymes; Fermentation technology: principles, media optimization; Industrial strain improvement: mutation, selection, recombinant DNA.					
Outcome - 1	Students will understand enzyme kinetics, fermentation principles, and strain improvement strategies in industrial settings.				
UNIT-II					
Objective - 2	To explore bioreactor design and operational strategies for biochemical production.				
Biochemical Engineering and Bioreactor Design: Types of bioreactors: batch, fed-batch, continuous, airlift, packed-bed; Process parameters: temperature, pH, oxygen transfer, agitation; Scale-up and scale-down: challenges and strategies; Downstream processing: filtration, centrifugation, chromatography, drying; Instrumentation and automation in industrial bioprocesses					
Outcome - 2	Students will be able to analyze reactor types, optimize bioprocess parameters, and understand scale-up and automation.				
UNIT-III					
Objective - 3	To study industrial production of biochemicals through fermentation and evaluate process efficiency.				
Industrial Fermentation Processes: Production of primary metabolites: ethanol, citric acid, lactic acid, butyric acid and amino acids; Production of secondary metabolites: antibiotics (penicillin, streptomycin); Biotransformation and whole-cell catalysis; Single cell proteins, biopolymers, Bioplastics; Bioprocess economics: yield, productivity, and cost analysis.					
Outcome - 3	Students will describe fermentation-based production of metabolites and assess bioprocess economics.				
UNIT-IV					
Objective - 4	To understand environmental biochemical processes, cycles, and microbial roles in ecosystems.				
Principles of Environmental Biochemistry: Definition, scope, and interdisciplinary nature; Fundamental laws of thermodynamics in environmental systems; **Environmental Toxicology:** Classification of pollutants: inorganic, organic, radioactive; Mechanism of toxicity: enzyme inhibition, oxidative stress, Genotoxicity; Biochemical effects of heavy metals (Hg, Pb, Cd, As); Pesticide toxicity: organophosphates, chlorinated hydrocarbons; Phase I & Phase II detoxification					

pathways, cytochrome P450 system;	
Outcome - 4	Students will be able to explain biogeochemical cycles, chemical speciation, and ecological biochemical interactions.
UNIT-V	
Objective - 5	To analyze pollutant toxicity, detoxification, and bioremediation strategies.
Biodegradation and Bioremediation: Microbial metabolism of hydrocarbons, xenobiotics;biotransformation, Aerobic vs anaerobic biodegradation pathways; Enzymes involved: oxygenases, peroxidases, dehalogenases; Biosorption, bioaccumulation, and phytoremediation Applications: oil spill remediation, sewage treatment. **Global Environmental Challenges and Sustainable Solutions**: Climate change biochemistry: greenhouse gases, global warming potential; Acid rain, ozone depletion: biochemical impact on plants and animals; Eutrophication and algal blooms: biochemical basis; Sustainable development:	
Outcome-5	Students will evaluate pollutant effects, detox mechanisms, and biodegradation applications in environmental management.

Suggested Readings

Textbooks:

Satyanarayana, U. (2013). Biotechnology. Books and Allied Pvt. Ltd.

Moo-Young, M. (2011). Comprehensive Biotechnology (2nd ed.). Elsevier.

Casida, L. E. (1991). Industrial Microbiology. Wiley Eastern.

Dubey, R. C. (2014). A Textbook of Biotechnology (Revised ed.). S. Chand Publishing.

Reference Books:

Pelczar, M. J., Chan, E. C. S., & Krieg, N. R. (2006). Microbiology: An Application Based Approach. Tata McGraw-Hill.

Prescott, L. M., Harley, J. P., & Klein, D. A. (2016). Microbiology (10th ed.). McGraw-Hill Education.

Rao, C. S. (2006). Environmental Pollution Control Engineering. New Age International.

Aneja, K. R. (2016). Experiments in Microbiology, Plant Pathology and Biotechnology. New Age International.

Course Outcome	K1	K2	K3	K4	K5	K6
CO1	✓	✓	✓	✓	✓	-
CO2	✓	✓	✓	✓	✓	-
CO3	✓	✓	✓	✓	✓	-
CO4	✓	✓	✓	✓	✓	-
CO5	✓	✓	✓	✓	✓	-

Course designed by: **Dr. M. Jeyakumar & Dr. M. Mamutha**

Course outcome Vs Programme outcome

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	3	3	3	3	2	3	3	2	3
CO2	3	3	3	3	3	2	2	2	2	3
CO3	3	3	3	3	3	2	2	3	3	3
CO4	3	3	3	3	3	2	2	2	3	3
CO5	3	3	3	3	3	2	2	2	3	3
W.AV	3	3	3	3	3	2	2.2	2.4	2.6	3

S-Strong (3) M-Medium (2) L-Low (1)

POs vs COs Interpretation

PO	Weighted Average	Interpretation
PO1	3.0	Strongly aligned with all COs
PO2	3.0	Strongly aligned with all COs
PO3	3.0	Strongly aligned with all COs
PO4	3.0	Strongly aligned with all COs
PO5	3.0	Strongly aligned with all COs
PO6	2.0	Moderately supported
PO7	2.2	Moderately supported
PO8	2.4	Moderately supported
PO9	2.6	Moderately supported
PO10	3.0	Strongly aligned with all COs

Assignment Topics:

- Describe the historical evolution of industrial biochemistry and its modern-day applications.
- Compare and contrast batch, fed-batch, and continuous bioreactor systems.
- Discuss the principles and challenges involved in scaling up industrial fermentation processes.
- Write a note on the production and purification of industrial enzymes and their immobilization methods.
- Explain the biosynthesis and commercial production of ethanol and citric acid via fermentation.
- Discuss the significance of microbial biotransformation in the production of pharmaceuticals and fine chemicals.
- Illustrate the nitrogen and phosphorus biogeochemical cycles and the microbial role in nutrient cycling.
- Analyze the mechanism of heavy metal toxicity and its biochemical impact on living organisms.
- Describe the detoxification of xenobiotics via Phase I and Phase II metabolic pathways.
- Write a detailed account of microbial biodegradation of hydrocarbons and its application in oil spill remediation.

SEMESTER-IV

Course Depiction

Lab – IV: Industrial, Environmental, and Structural Biology Lab

Program: M.Sc.,	Semester : IV (2025-2026 Onwards)
Course Title**: Lab – IV: Industrial, Environmental, and Structural Biology Lab** Subject Code: 25MBC4P1	Class Time: As per the time table
Name of Course Teachers	Dr. M. Jeyakumar & Dr. M. Mamutha
Mobile: +91 96559 07058 & +91 91761 63179	E-mail:biotechjeya@gmail.com mamudha2014@gmail.com

Course Brief:

This advanced laboratory course is designed to equip students with practical skills in analyzing environmental pollutants, performing industrially relevant biochemical assays, and purifying biomolecules for structural studies. The course blends environmental biochemistry, fermentation technology, and structural biology, providing hands-on exposure to pollutant quantification, enzyme assays, microbial product synthesis, protein/nucleic acid purification, and protein crystallization methods. Emphasis is placed on real-world applications in environmental monitoring, industrial product development, and molecular structure analysis.

Teaching methods: The course will be based on the following teaching and learning activities:

- Lectures covering the theoretical part using PowerPoint presentations
- Case studies
- Review questions

Attendance: A student's academic performance and opportunity to gain knowledge largely depend on regular class attendance. According to university norms, maintaining at least 70–75% attendance is essential to be eligible to appear for the end-semester examinations.

Punctuality: Punctuality is one of the essential qualities that students must follow and maintain to achieve greater success. Students are required to arrive in class on time without any delay. Only important reasons such as personal or medical emergencies will be accepted as valid excuses. Otherwise, the student will be marked absent.

Class Participation: Classroom participation is important because learning is not just between the student and the teacher, but part of the whole classroom experience which involves questioning, inquiring and exchanging ideas. When students participate, they learn from each other and internalize the knowledge better.

Submission of Assignment: Assignments are an important part of the learning process, designed to help students apply the concepts and knowledge acquired during the course. Each student will receive two

assignments that together cover the full syllabus. The course instructor will assign specific topics for each. Completing these assignments with proper effort and understanding will greatly benefit students in preparing for their final examinations.

Presentation of Seminar: Students are supposed to give an oral presentation during the class seminar hours in their assigned topic. Students will discuss on recent research finding related to the topic and participants are encouraged to ask valid questions. Seminars help the students to be updated in their course. In addition students will be able to learn their mistakes and can improve their communication skills during seminar presentation.

Preparedness: Students are expected to have read and be able to discuss the assigned chapter before attending the lecture. In addition, students should be prepared to discuss homework problems.

Academic Dishonesty: Academic dishonesty includes giving, receiving, or using unconstitutional support on any academic work. This includes a person who has taken a test discussing what was on a test with a person who has not taken the test. A clear indication of academic dishonesty will result in a grade of "F" being assigned to that particular piece of work.

Subject to change clause: Depending upon the requirement of student's possibility, the course syllabus will be re-structured and updated accordingly at the discretion of the Professor(s) and Board of studies chairperson.

Important dates: Please note down the important dates and stick to the schedule.

CIA Test I	**CIA Test II**	**Assignment**	**Seminar**
As per Academic Calendar		After CIA Test-I	

Course Outline:

- Quantitative estimation of industrial contaminants such as phenol, phosphorus, heavy metals, and cyanide using standard colorimetric methods.
- Isolation of environmental microbes from polluted sites for use in bioremediation and microbial ecology studies.
- Estimation of industrially important enzymes like α-amylase and lipase through activity-based biochemical assays.
- Microbial production of ethanol and citric acid using *Saccharomyces cerevisiae* and *Aspergillus niger*, with practical understanding of fermentation principles.
- Experimental approaches for purifying proteins and nucleic acids, followed by application of hanging drop, sitting drop, and microbatch crystallization techniques.

IV - Semester					
Core-XVI	**Course Code 25MBC4P1**	**Lab – IV: Industrial, Environmental, and Structural Biology Lab (K1-K5)**	**P**	**Credits: 4**	**Hours: 8**

UNIT-I

Objective -1	To train students in the quantitative analysis of industrial pollutants and detection of toxic substances in environmental samples.

Module 1 : Environmental Biochemistry

1. Estimation of Phenol in industrial waste- Colorimetry method
2. Estimation of Phosphorous - Fiske - Subbarow method
3. Estimation of cadmium – colorimetry method.
4. Estimation of mercury – colorimetry method.
5. Estimation of cyanide – colorimetric method
6. Isolation of microbes from industrial polluted environments.

Outcome - 1	Students will be able to estimate environmental pollutants like phenol, heavy metals, and cyanide using standard colorimetric and titrimetric methods, and isolate microbes from polluted environments.

UNIT-II

Objective - 2	To provide hands-on experience in biochemical assays of industrial relevance and microbial production of bio-products.

Module 2: Industrial Biochemistry

7. Estimation of Lipase enzyme activity.
8. Production of ethanol using yeast fermentation.
9. Production of citric acid using aspergillus niger.
10. Estimation of casein

Outcome - 2	Students will gain competency in enzyme assays, fermentation technology, and quality testing of food and industrial products including microbial screening and cultivation.

UNIT-III

Objective - 3	To train students in the experimental techniques for purifying biomolecules and applying various protein crystallization methods.

Module 3: Structural Biology

11. Purification of protein
12. Purification of Nucleic acids
13. Protein Crystallization method - Hanging drops method.
14. Protein Crystallization method - sitting drops method.
15. Protein Crystallization method - Micro batch method.

Outcome - 3	Learners will acquire hands-on experience in protein/nucleic acid purification and develop technical proficiency in different protein crystallization strategies essential for structural biology research.

Suggested Readings

Textbooks & References

Sawyer, C. N., McCarty, P. L., & Parkin, G. F. (2002). Chemistry for Environmental Engineering and Science, 5th Ed., McGraw-Hill.

Manahan, S. E. (2017). Environmental Chemistry, 10th Ed., CRC Press.
Patwardhan, A. D. (2017). Industrial Wastewater Treatment, PHI Learning.
Cappuccino, J. G., & Welsh, C. (2019). Microbiology: A Laboratory Manual, 11th Ed., Pearson.
Trevan, M. D., Boffey, S., Goulding, K. H., & Stanbury, P. F. (2003). Biotechnology: The Biological Principles, 2nd Ed., Taylor & Francis.
Stanbury, P. F., Whitaker, A., & Hall, S. J. (2016). Principles of Fermentation Technology, 3rd Ed., Butterworth-Heinemann.
Nelson, D. L., & Cox, M. M. (2021). Lehninger Principles of Biochemistry, 8th Ed., Macmillan.
Plummer, D. T. (1990). An Introduction to Practical Biochemistry, 3rd Ed., Tata McGraw-Hill.
Scopes, R. K. (2013). Protein Purification: Principles and Practice, 3rd Ed., Springer.
Wilson, K., & Walker, J. (2010). Principles and Techniques of Biochemistry and Molecular Biology, 7th Ed., Cambridge University Press.

Online Resources

NCBI Bookshelf: https://www.ncbi.nlm.nih.gov/books/
PDB-101 (Protein Data Bank Education): https://pdb101.rcsb.org/
JoVE (Journal of Visualized Experiments): https://www.jove.com/

Course Outcome	K1	K2	K3	K4	K5	K6
CO1	✓	✓	✓	✓	✓	-
CO2	✓	✓	✓	✓	✓	-
CO3	✓	✓	✓	✓	✓	-
CO4	✓	✓	✓	✓	✓	-
CO5	✓	✓	✓	✓	✓	-

Course designed by: Dr. M. Jeyakumar & Dr. M. Mamutha

Course outcome Vs Programme outcome

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	3	3	3	3	2	1	2	3	3
CO2	3	3	3	3	3	2	3	2	3	3
CO3	3	3	3	3	3	2	2	2	3	3
CO4	3	3	3	3	3	2	2	2	3	3
CO5	3	3	3	3	3	2	2	2	3	3
W.AV	3	3	3	3	3	2	2	2	3	3

S-Strong (3) M-Medium (2) L-Low (1)

POs vs COs interpretation

PO	Weighted Average	Interpretation
PO1	3.0	Strongly aligned with all COs
PO2	3.0	Strongly aligned with all COs
PO3	3.0	Strongly aligned with all COs
PO4	3.0	Strongly aligned with all COs
PO5	3.0	Strongly aligned with all COs
PO6	2.0	Moderately supported
PO7	2.0	Moderately supported
PO8	2.0	Moderately supported

PO9	3.0	Strongly aligned with all COs
PO10	3.0	Strongly aligned with all COs

SEMESTER-IV

Course Depiction

Project Work & Viva-Voce

Program: M.Sc.,	Semester : IV (2025 – 2026 Onwards)
Course Title**: Project Work & Viva-Voce** Subject Code: 25MBC4PR	Class Time: As per the time table
Name of Course Teachers	Dr. J. Jeyakanthan Dr. P. Boomi Dr. M. Jeyakumat Dr. M. Mamutha
Mobile: +91 97898 09245 +91 9486031423 +91 96559 07058 +91 91761 63179	E-mail: jjkanthan@gmail.com pboomi1983gmail.com biotechjeya@gmail.com mamudha2014@gmail.com

Course Brief:

The study of PG course in biochemistry includes a six months project work in the thrust areas of specialization which is broadly classified into six categories keeping in mind the number of faculties present. First, is the Structural Biology and Bio - Computing where Molecular Biology concepts such as Protein Cloning, Expression, Purification and Crystallization are performed to work on the isolation of the desired protein where the structural and functional characteristics that are yet to be explored. Hence, through X-ray Crystallography one can deduce the same and collect the insight details based on these inputs computational studies such as screening, molecular dynamics simulation, quantum based approaches, structure based drug design, QSARetc (Drug Discovery and Design, CADD & Structural Bioinformatics) are performed to identify suitable leads from commercial/natural sources for a disease – associated targets. Either way, leads identified by targeting the molecular fingerprints of an individual known as Personalized medicine (Pharmacogenomics & CADD) as this soughtto be the most preferred, selected and specific approaches by the Pharma related Industries to further validate the compounds with the aid of assay to estimate its inhibitory potential against that target conferring to life-threatening diseases such as cancer, TB, Diabetes, HIV, Inference of Vitamin D – Deficiency on population through genetic studies, Implications of *Vibrio* species to the aquaculture residential species by the application of phage therapy. Additionally, these collected inputs such as the availability of different targets in association in many pathways (cross-talk), establishedcompounds based on experimental evidences either commercially or from natural sources (Isolation from plants that is claimed to have therapeutic significance) is well collected,

documented and maintained in the form of databases and also the information that are collected from several sources are also included. Thus, the scholars can frame their thesis based on these areas mentioned above along with updated working of methodologies within the stipulated period of time.

Major Research Areas

- Small and Macro molecule X-ray Crystallography.
- Human Molecular Genetics.
- Cheminformatics.
- Computer Aided Drug Designing (CADD).
- Plant tissue Culture, Genetic Transformation, Plant Molecular Biology, Virologyand Plant Pathology.
- Molecular Oncology, Pharmacology and Environmental Toxicology.

Reference/Text Books:
As per the area of study taken

Course Objectives: To make the students:

- Demonstrate knowledge and understanding of the molecular machinery of livingcells.
- Demonstrate knowledge and understanding of the principles and basicmechanisms of the research area.
- Use basic laboratory skills and apparatus to obtain reproducible data frombiochemical experiments.
- Implement experimental protocols, and adapt them to plan and carry out simpleinvestigations.

Course Outcomes: The student shall be able to:

- Analyze, interpret, and participate in reporting to their peers on the results of their laboratory experiments.
- Participate in and report orally on team work investigations of problem-based assignments.
- Build on their knowledge and understanding in tackling more advanced andspecialized courses, and more widely to pursue independent, self-directed and critical learning.
- Formulate hypotheses based on current concepts in the field and design, conduct, and interpret their own research projects.
- Present research results in peer-reviewed publications and in a dissertation.
- Communicate research results effectively through oral presentations at scientific seminars, conferences, and other venues.
- Write a competitive application for research funding.
- Develop ancillary skills, where necessary, to obtain positions outside of scientific research.

Teaching Methods:

- Literature review, analysis and data collection
- Case-studies and Review questions
- Allowed for interaction with Research scholars
- Daily guidance and monitoring the work flow
- Presentation

Attendance: Having good attendance record marks the student's sincerity and has an overall positive impact on his/her personality trait development. The students are asked to attend the classes on a regular note and those having a minimum scale of 70-75% attendance are eligible to take up the end-semester examinations as per the University norms.

Semester – IV						
Core-XVII	**Course Code 25MBC4PR**	**Project Work (K1-K6)**			**Credits:6**	**Hours :10**
Course Outcome	**K1**	**K2**	**K3**	**K4**	**K5**	**K6**
CO1	✓	✓	✓	✓	✓	-
CO2	✓	✓	✓	✓	✓	-
CO3	✓	✓	✓	✓	✓	-
CO4	✓	✓	✓	✓	✓	-
CO5	✓	✓	✓	✓	✓	-

Skill Enhancement Course
Semester- I
Introduction to Bioinformatics

Program: M.Sc.,	Semester : I (2025 – 2026 Onwards)
Course Title**: Introduction to Bioinformatics** Subject Code: 25MBC1S1	Class Time: As per the time table
Name of Course Teachers	Dr. J. Jeyakanthan
Mobile: +91 97898 09245	E-Mail: jjkanthan@gmail.com

Course Brief:

The course depicts the fundamental concepts and methods in Bioinformatics, a field at the junction of Biology and Computing. Data intensive, large-scale biological problems are addressed from a computational point of view. The most common problems are modeling biological processes at the

molecular level and making inferences from collected data. The course covers the principles and methods used to search and compare DNA, RNA and proteins, cast as biological "sequences". The course explains why they can give us answers to fundamental biological questions important tofields such as Cell Biology, Biochemistry and Medical science. The important public data banks that provide details of biological systems and components will be discussed. It reviews a wide range of topics including open resources in bioinformatics, computational sequence analysis, sequence homology searching, gene finding and genome annotation, protein structure analysis and prediction, genomics, proteomics, phylogenetic analysis, biological databases, cheminformatics and medical informatics. Protein structures are three-dimensional data and the associated problems are structure prediction (secondary and tertiary), analysis of protein structures for clues regarding function, and structural alignment. It serves a gateway course for all science students.

Teaching Methods: The mode of teaching is based on the following learning activities:

- Lectures covering the theoretical part will be delivered using PowerPoint presentations.
- A set of laboratory exercises to analyze biological problems using softwares andtools to develop student's interests in scientific discovery.
- Case studies in informatics-based research.

Attendance: The students are expected to attend the classes regularly, since regular attendance is essential to gain academic achievement. As per the University norms, the students having a minimum scale of 70-75% attendance are only qualified to write their end-semester examinations.

Punctuality: Punctuality is the most important quality for the student to be followed andmaintained to achieve success. Students who arrive late by 10 mins to the class without any vital reason will be marked absent in the attendance register. On the other hand, valid excuse including personal or medical emergency is acceptable, with prior consent by the Head of the Department.

Class Participation: A student's overall growth and personality development is based on his/her involvement in the class not just by mere presence but rather being interactive through questioning that will lead to propagation of ideas, initiation of thought-provoking practice and much more that will provide a wholesome enriched classroom experience. When students participate, they learn from one another and gain their knowledge better.

Submission of Assignment: Assignments are given to students in order to apply the concepts for deeper understanding of the subject. Therefore, each student will be allocated two assignments for the course, covering the entire topic. Students will be given deadline to submit the assignment by the course instructor and good preparationof assignment will help the students for their final exams.

Presentation of Seminar: Apart from the assignments, students are supposed to give anoral presentation during the class seminar hours in their assigned topic. The concerned instructor will encourage the participants to ask valid questions during seminar presentation in order to put up their confidence levels and communication skills. In addition, students will be able to gain information and can be updated in their course.

Preparedness: At the end of every class, the concerned instructor conveys the students about the details that will be handled in the next class to increase the student's awareness related to the topics.

Academic Dishonesty: Academic dishonesty is a completely unacceptable mode of conduct and every student should be aware of this important aspect. Thus, the respective faculty members educate the students of possible means of academic malpractices (plagiarism, violation of copyrights and stealing the patented knowledge) and the following consequences that will make them more vigilant in their academic career.

Subject to change clause: Depending upon the requirement of student's possibility, the course syllabus will be re-structured and updated accordingly at the discretion of the Professor(s) and Board of studies chairperson.

Important dates: Scheduled dates for the various activities related to the course

CIA Test I	CIA Test II	Assignment	Seminar
As per Academic Calendar		After CIA Test I	

Course Outline: Core: Introduction to Bioinformatics

- Students will gain foundational knowledge of bioinformatics and understand how computational tools and operating systems support biological data analysis. They will learn to execute basic commands in Windows, Unix, and Linux environments, and effectively navigate open-source bioinformatics platforms and databases to retrieve and analyze biological information.
- Bioinformatics Sequence analysis - biological basics needed in bioinformatics, Sequence alignment- Global and Local- Pairwise Alignment, Multiple Alignment- ClustalW.
- Gain knowledge of major nucleotide databases such as GenBank, DDBJ, EMBL, RefSeq, GISAID, IMG/M, RNAcentral, and ENA, as well as key protein databases like UniProt, SWISS-PROT, UniProtKB, UniRef, UniMES, PIR, PDB, InterPro, and Pfam. Students will learn how to access these databases, retrieve sequence information, and utilize it for comparative and functional genomics, protein analysis, and other bioinformatics applications.
- They will be able to distinguish between various data types and sources, including protein sequence and structural databases, nucleic acid and genome databases, and specialized repositories such as carbohydrate and drug-drug interaction databases.
- Students will also gain practical skills in retrieving biological and clinical data using tools like the Entrez system, TCGA databases, and BioPortal. This knowledge will enhance their ability to conduct data-driven research and support decision-making in bioinformatics and computational biology.
- They will gain insights into key applications such as phylogenetic analysis, 2D and 3D protein structure prediction, small molecule design, and NGS data analysis. Students will also learn to interpret genetic variations like SNPs and SSRs
- Explore their relevance in pharmacogenomics, metabolomics, and metabolic flux analysis. Additionally, they will become aware of the major challenges in bioinformatics, including data

interpretability and reproducibility, and understand the role of structural bioinformatics in modern research.

I - Semester					
SEC-1	**Course Code: 25MBC1S1**	**Introduction toBioinformatics (K1-K5)**	**T**	**Credits:2**	**Hours:2**
UNIT-I					
Objective-1	To introduce the fundamental concepts and computational tools used in Bioinformatic.				
Basics of Bioinformatics: Introduction to Bioinformatics; Computers in Biology to understand Biological System; Basic commands of Windows, Unix and Linux operating systems; Concept of open resources in Bioinformatics.					
Outcome-1	Understand and apply foundational computer operations and open-source bioinformatics tools to study biological systems effectively.				
UNIT-II					
Objective-2	To provide foundational knowledge and tools for analyzing biological sequences through various alignment methods.				
Sequence Analysis: Biological background for sequence analysis; Sequence alignment: Global, Local, Pair wise and Multiple sequence analysis; Algorithm for alignments; Database Searching; Tools for Sequence alignment.					
Outcome-2	Apply sequence alignment techniques (global, local, pairwise, multiple) using standard algorithms and tools for biological data analysis.				
UNIT-III					
Objective-3	To familiarize students with major nucleotide and protein sequence databases used in bioinformatics.				
Sequence Databases: Nucleotide Sequence Databases; GenBank, DDBJ, EMBL, RefSeq, GISAID, IMG/M, RNAcentral and ENA. Protein Sequence Databases; UniProt, SWISS-PROT, UniProtKB, UniRef, UniMES, PIR, PDB, InterPro, and Pfam.					
Outcome-3	Retrieve, interpret, and utilize data from major nucleotide and protein sequence databases such as GenBank, UniProt, and Pfam for analysis.				
UNIT-IV					
Objective-4	To introduce various biological databases and methods for retrieving biological and clinical data.				
Biological Databases: Database concepts; Introduction to Data types and source; Protein Sequence and Structural Databases; Nucleic acid databases; Genome databases; Specialized Databases; Carbohydrate Databases; Clinically relevant drug-drug interactions databases; Information retrieval from Biological databases: Entrez system, TCGA data bases, Bio portal					
Outcome-4	Apply data retrieval strategies using tools like Entrez, TCGA, and BioPortal to gather clinically and biologically relevant information from diverse databases.				

UNIT-V	
Objective-5	To explore key applications and computational challenges in modern bioinformatics across genomics, structural biology, and drug discovery.
Challenges and Applications of Bioinformatics: Challenges in Bioinformatics, Phylogenic analysis, 2D and 3D Protein structure prediction, Design and discovery of small molecules, NGS data analysis, SNPs (Single Nucleotide Polymorphisms) and SSRs (Simple Sequence Repeats), Pharmacogenomics, Metabolomics and Metabolic flux analysis and Structural Bioinformatics.	
Outcome-5	Analyze and evaluate advanced applications such as NGS analysis, structural predictions, pharmacogenomics, and metabolomics, understanding the key challenges in bioinformatics.

Suggested Readings :

Lesk, A.M. (2014) "*Introduction to Bioinformatics*"; Oxford University Press, UK, Fourthedition.

Gretchen Kenney, (2016) "*Bioinformatics: Principles and Analysis*"; Syrawood Publishing House USA.

Higgins D. and Taylor W. (2000). *Bioinformatics*. Cary: Oxford University Press, 1st edition, ISBN 13: 9780199637904.

Scott Markel (2003). "*Sequence Analysis in a Nutshell* – A Guide to Common Tools & Databases"; O′Reilly; 1 edition, ISBN-13: 978-0596004941.

Bergeron B. (2003). *Bioinformatics Computing - The Complete Practical Guide to Bioinformatics for Life Scientists*, by Prentics- Hall, Inc., New Jersey 07458, USA, 1st edition, ISBN :81-203-2258-4.

Bourne P. E. Weissig H. (2003). *Structural Bioinformatics*, published by John Wiley &Sons, Inc., Hoboken, New Jersey, 1st edition, ISBN: 0-471-20200-2.

David Mount, (2004), "*Bioinformatics: Sequence and Genome Analysis*"; Cold Springharbor laboratory Press, US Revised Edition.

Ole Lund, Nielsen, M., Lundegaard, C. Kesmir, C. and Brnak, S. (2005) "*Immunological Bioinformatics*"; The MIT press.

Xiong J. (2006). *Essential Bioinformatics. Cambridge*: Cambridge University Press, 1st edition, ISBN-13 978-0-511-16815-4.

Jean-Michel, Cand Notredame, C. (2006) "*Bioinformatics for Dummies*"; John Wiley&Sons, Second Edition.

Kindreas D Batevanis, (2006) "*Bioinformatics: A Practical Guide to the Analysis of Geneand Protein*"; Wiley Inter Science, Singapore, 3rd Edition.

Andrew R. Leach & Valerie J. Gillet, (2007) "*An Introduction to Chemoinformatics*"; Springer, Revised Edition.

David Edward, (2007) "*Plant Bioinformatics*": Methods and Protocol, Humana Press. Rastogi S. C. Mendiratta N. and Rastogi P. (2008).

Bioinformatics Methods andApplications - Genomics, Proteomics and Drug Discovery, published by PHI LearningPrivate Limited, New Delhi, Third edition, ISBN: 978-81-203-3595-0.

Posada D. (2009). *Bioinformatics for DNA sequence analysis*. New York: Humana Press,1st edition, ISBN-13: 978-1588299109

Gopal S. Jones R. Tymann P. and Haake A. (2010). *Bioinformatics*. Tata McGraw-Hill,1st edition, ISBN-10: 0073133647

Yang, Z. (2010). *Machine learning approaches to bioinformatics*. Singapore: WorldScientific, 1st edition, ISBN-13: 978-9814287302

Baxevanis, A.D. and Francis Ouellellette, B.F. (2011) "*Bioinformatics* –a practical guideto the analysis of Genes and Proteins"; John Wiley & Sons, UK, Third Edition.

Hossein G. Gilani, Katia G. Samper, Reza Khodaparast Haghi, (2012) "*Chemoinformatics: Advanced Control and Computational Techniques*"; Apple Academic Press, First edition.

Peerez-Saanchez, H. (2012). *Bioinformatics*, Rijeka, Croatia: InTech, 1st edition, ISBN: 980-953-307-202-4

Caroline St Clair, Jonathan E. Visick, (2013) "*Exploring Bioinformatics*"; Jones and Bartlett Publishers, Inc; 2nd Edition, ISBN-13: 978-1284034240.

Arthur Lesk, (2013) "*Introduction to Bioinformatics*"; OUP Oxford; 4 Edition, ISBN-13: 978-0199651566.

Kayvan Najarian, Siamak Najarian, Shahriar Gharibzadeh, (2017) "*Systems Biology and Bioinformatics: A Computational Approach*"; CRC Press; 1 Edition, ISBN-13: 978-1138118034.

Keith J. (2017). *Bioinformatics*. Totowa, NJ: Humana Press, a part of Springer Science Business Media, LLC, 2nd edition, ISBN 978-1-60327-429-6.

Text Book:

Dev Bukhsh Singh, and Rajesh Kumar PathkBioinformatics methods and Applications , Academic Press, 2021.

Kevin Byron, Katherine G. Herbert, and Jason T. L. Wang, Bioinformatics Database Systems CRC Press, 2016

Online Resource :-

1. https://www.google.co.in/books/edition/Introduction_to_Bioinformatics.
2. https://www.google.co.in/books/edition/Chemoinformatics.

Course Outcome	K1	K2	K3	K4	K5	K6
CO1	✓	✓	✓	✓	✓	-
CO2	✓	✓	✓	✓	✓	-
CO3	✓	✓	✓	✓	✓	-
CO4	✓	✓	✓	✓	✓	-
CO5	✓	✓	✓	✓	✓	-

K1-Remember	*K2-Understand*	*K3- Apply*	*K4-Analyze*	*K5-Evaluate*	*K6-Create*

Course designed by : Dr. J. Jeyakanthan

Course Outcome VS Programme Outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	3	3	1	2	1	-	1	1	1
CO2	3	3	3	2	3	2	-	1	1	1
CO3	3	3	3	3	3	2	2	1	1	1
CO4	3	3	3	3	3	2	3	1	1	1
CO5	3	3	3	3	3	2	3	1	2	2
W.AV	3	3	3	2.4	2.8	1.8	1.6	1	1.2	1.2

S –Strong (3), M-Medium (2), L- Low (1)

POs vs COs Interpretation

PO	Weighted Average	Interpretation
PO1	3.0	Strongly aligned with all COs
PO2	3.0	Strongly aligned
PO3	3.0	Strongly aligned with all COs
PO4	2.4	Moderately supported
PO5	2.8	Moderately supported
PO6	1.8	Low alignment
PO7	1.6	Low alignment
PO8	1.0	Low alignment
PO9	1.2	Low alignment
PO10	1.2	Low alignment

Assignment & Seminar - Introduction to Bioinformatics

- Basic commands of Windows, Unix and Linux operating systems
- To learn Sequence Analysis using a known gene/protein
- Database analysis using publicly available datasets.
- To analyze the structure using Cheminformatics tools.
- To practice an example of Pharmacy Informatics.
- Explain the concept of open resources in bioinformatics.
- Write a short note on global and local alignment.
- Describe the salient features and importance of NCBI.
- Give a detailed note on nucleotide sequence databases.
- Explain the applications of Markov chains and Hidden Markov Model to geneanalysis.

Skill Enhancement Course

Course Depiction

Molecular Modeling and Drug Design

Program: M.Sc., Bioinformatics	Semester : II (2022 Onwards)
Course Title: **Molecular Modeling and Drug Design** Subject Code: 25MBC2S2	Class Time: As per Time Table
Name of Course Teachers	Dr. J. Jeyakanthan
Mobile: +91 97898 09245	E-Mail: jjkanthan@gmail.com

Course Brief:

The course depicts the basic theory of molecular modeling and drug design. It reviews a vast range of topics including the concept of molecular modeling; Quantum and Molecular Mechanics, *Ab initio* structure modeling and active site prediction, theories and to recognize drug like properties, computer molecular dynamics simulation and changes in conformations, pharmacophore, lead identification and *de novo* ligand design methods, molecular docking, QSAR, HTVS, Lipinski's rule, ADMEproperties, energy concepts, Bond structure and bending angles, finding new drug targets to treat diseases; drug discovery and development. It also discusses the recent advances and limitations of molecular modelling methods. This course serves as a basic introduction of molecular modeling to the students. As it covers a vast range of topics in molecular modeling, it could provide sound basic knowledge as well.

Teaching Methods:

The mode of teaching is based on the following learning activities:

- Lectures covering the theoretical part will be delivered using PowerPointpresentations.
- A set of laboratory exercises to analyze biological problems using softwares and tools to develop student's interests in scientific discovery.
- Case studies in informatics-based research.

Attendance: The students are expected to attend the classes regularly, since regular attendance is essential to gain academic achievement. As per the University norms, the students having a minimum scale of 70-75% attendance are only qualified to write their end-semester examinations.

Punctuality: Punctuality is the most important quality for the student to be followed andmaintained to achieve success. Students who arrive late by 10 mins to the class without any vital reason will be marked absent in the attendance register. On the other hand, valid excuse including personal or medical emergency is acceptable, with prior consent by the Head of the Department.

Class Participation: A student's overall growth and personality development is based on his/her involvement in the class not just by mere presence but rather being interactive through questioning that will lead to propagation of ideas, initiation of thought-provoking practice and much more that will provide

a wholesome enriched classroom experience. When students participate, they learn from one another and gain their knowledge better.

Submission of Assignment: Assignments are given to students in order to apply the concepts for deeper understanding of the subject. Therefore, each student will be allocated two assignments for the course, covering the entire topic. Students will be given deadline to submit the assignment by the course instructor and good preparationof assignment will help the students for their final exams.

Presentation of Seminar: Apart from the assignments, students are supposed to give anoral presentation during the class seminar hours in their assigned topic. The concerned instructor will encourage the participants to ask valid questions during seminar presentation in order to put up their confidence levels and communication skills. In addition, students will be able to gain information and can be updated in their course.

Preparedness: At the end of every class, the concerned instructor conveys the students about the details that will be handled in the next class to increase the student's awareness related to the topics.

Academic Dishonesty: Academic dishonesty is a completely unacceptable mode of conduct and every student should be aware of this important aspect. Thus, the respectivefaculty members educate the students of possible means of academic malpractices (plagiarism, violation of copyrights and stealing the patented knowledge) and the following consequences that will make them more vigilant in their academic career.

Subject to change clause: Depending upon the requirement of student's possibility, the course syllabus will be re-structured and updated accordingly at the discretion of the Professor(s) and Board of studies chairperson.

Important dates: Scheduled dates for the various activities related to the course

CIA Test I	CIA Test II	Assignment	Seminar
As per Academic Calendar		After CIA Test I	

Course Outline: Molecular Modeling and Drug Design

- Role of Bioinformatics in drug design, Target identification and validation, lead optimization and validation, Structure-based drug design and ligand based drug design.
- Concepts in Molecular Modeling: Introduction; Coordinate System; potential energy surfaces molecular graphics; Quantum mechanics; Molecular Mechanics: Features of molecular mechanics, force fields
- Bond structure and bending angles – electrostatic, van der Waals and non-bonded interactions, hydrogen bonding, Inter and intramolecular interactions: Weak interactions in drug molecules; hydrogen bonding in molecular mechanics
- Homology modeling, concepts of homology modeling, secondary structure prediction methods: Threading, *ab initio* structure prediction Protein folding andmodel generation; analyzing secondary structures; Protein loop searching, loop generating methods, loop analysis.
- Molecular Dynamics using simple models; Molecular Dynamics with continuous potentials and at constant temperature and pressure; Time dependent properties; Solvent effects in Molecular Dynamics; Conformational changes in Molecular Dynamics.

- Structure and Ligand based Drug Design: Pharmacophore identification, methodsto identify lead compounds, Molecular Docking, *De-novo* ligand design methods, Applications of 3D Database Searching in Molecular docking. Random Screening, Virtual Screening, HTVS, QSAR, Target identification and Validation.
- Receptorology: Drug-receptor interactions, receptor theories and drug action. Theories of enzyme inhibition and inactivation; Enzyme activation of drugs and prodrugs. Drug like molecules and theories associated with the recognition of drug like properties. Physical organic chemistry of drug-metabolism, drug deactivation and elimination; Phase-I and phase-II transformations; Concept of hard and soft drugs; Chemistry of ADME and toxicity properties of drugs.Lipinski rule.

Semester-II					
SEC-2	**Course Code 25MBC2S1**	**Molecular Modeling and DrugDesign (K1-K5)**	**T**	**Credits: 2**	**Hours: 2**
Unit - I					
Objective - 1	To let students to understand the use of informatics in drug design and development, finding new targets to treat disease; mechanism of drug designing				
Introduction to Molecular Modeling: Molecular Modeling and Pharmacoinformatics in Drug Design, Phases of Drug Discovery, Target identification and validation, lead identification and optimization, finding of new drug targets, Artificial Intelligence and Machine Learning in Drug Design along with GPU-accelerated computations, cloud computing, and an overview of future quantum computing architectures.					
Outcome - 1	The students would understand the process and steps for designing new drugs along with identifying new target and its validation and the use AI/ML in Molecular Modeling				
Unit – II					
Objective - 2	To understand the concept of molecular modeling, mechanics and interactions				
Concepts in Molecular Modeling: Coordinate System; potential energy surfaces; molecular graphics; Quantum mechanics; Molecular Mechanics**:** Features of molecular mechanics, force fields; Bond structure and bending angles – electrostatic, van der Waals and non-bonded interactions, hydrogen bonding, Inter and intramolecular interactions: Weak interactions in drug molecules; hydrogen bonding in molecular mechanics; Energy concept and its importance in drug action, application of energy minimization. Advance AI/ML based approaches in coordinate systems such as force field, potential energy surfaces and energy minimization.					
Outcome - 2	The students would be able to understand the concepts of Molecular Modelling and molecular dynamics simulation				
Unit – III					
Objective - 3	To provide clear concepts on bond angle, bond stretching, bond distance and roleon different types of bonds in interactions				
Protein Structure Prediction and Analysis: Protein Structure prediction methods: Secondary Structure Prediction, Homology modeling, Threading and *abinitio* method, Tools for Structure prediction; Protein structural visualization; Geometry optimization and Loop refinement; Structure validation tools; Ramachandran Plot. Integration of Artificial Intelligence in Protein Structure Prediction and Analysis					

Outcome - 3	The students will understand concepts of protein structure prediction and validation, and gain insights into enzyme inhibition, inactivation, drug deactivation, and the role of artificial intelligence in enhancing structural analysis and prediction accuracy.
Unit –IV	
Objective - 4	To study about protein structure prediction and conformational changes throughout the simulation
Structure and Ligand Based Drug Design: Pharmacophore identification and Mapping; methods to identify lead compounds, Molecular Docking, *De-novo* ligand design, 3D Database Searching in Molecular docking., Virtual Screening, HTVS, , QSAR and Molecular Descriptors and its applications. **Molecular Dynamic Simulation,** Principal component analysis (PCA) and Free Energy Landscape (FEL), Free Energy Perturbation (FEP). Integrating advanced AI/ML tools such as Generative AI-based molecular design, and AI-enhanced virtual screening.	
Outcome - 4	The students will be able to apply structure- and ligand-based drug design approaches, understand key concepts like pharmacophore modeling, molecular docking, QSAR, and utilize advanced AI/ML tools for efficient lead identification and drug discovery.
Unit –IV	
Objective - 5	To provide brief idea of receptor and receptor-ligand complex, inhibition and inactivation of enzyme, receptor theories
Receptorology: Drug receptor interactions, receptor theories and drug action; Theories of enzyme inhibition and inactivation; Enzyme activation of drugs and prodrugs. Concept of Drug like molecules; Chemistry of drug metabolism, Pharmacodynamics and pharmacokinetics; Phase I and phase II transformations; Concept of hard and soft drugs; Chemistry of ADME and toxicity properties of drugs. Lipinski rule, agonist and antagonist. AI/ML based approaches for ADMET, DMPK, PK/PD analysis of drug like molecule.	
Outcome - 5	Describe the Drug action mechanism
Suggested Readings: Leach, AR (2001) "Molecular Modeling – Principles and Applications"; Second Edition, Prentice Hall, USA Schlick T, "Molecular Modeling and Simulation An Interdisciplinary Guide", Springer, Acc. No. 73052 Doucet J. and Weber J. (1996). Computer-aided molecular design. London: Academic Press, 1st edition, ISBN0-12-221285-1 Gundertofte K, (2000) "Molecular Modeling and Prediction of Bioactivity", Springer, ISBN-978-1-4613-6857-1. Jiang T. Xu Y. Zhang M. (2002). Current topics in computational molecular biology. Cambridge, Mass.: MIT Press, 2nd edition, *ISBN*-10: 0262100924 Schneider G. and So S. (2003). Adaptive systems in drug design. CRC press, 1st edition, *ISBN:* 9781587060595 Cramer CJ (2004) "Essentials of Computational Chemistry: Theories and Models", Wiley-Blackwell, ISBN-978-0470091821. Pirrung MC (2004) "Molecular Diversity and Combinatorial Chemistry: Principles and Applications",Elsevier, ISBN-0-08-044493-8. Bajorath JB (2004) "Chemoinformatics-Concepts, Methods, and Tools for Drug Discovery", Springer, ISBN978-1-59259-802-1.	

Kukol A. (2008). Molecular modeling of proteins. Totowa, N.J.: Humana Press, 1st edition, ISBN 978-1-59745-177-2
Ramachandran KI (2008) "Computational Chemistry and Molecular Modeling: Principles and Applications", Springer, ISBN- 978-3-540-77304-7.
Hinchliffe (2008) "Molecular Modelling for Beginners"; Second Edition, Wiley-Blackwell, ISBN- 978-0470513149.
Gilani HG, Samper KG and Haghi RK (2012) "Chemoinformatics: Advanced Control and ComputationalTechniques", CRC Press, ISBN-9781466559332.
Bladon P and Hammond RB (2012), "Molecular Modelling: Computational Chemistry Demystified" RSCpublishing, ISBN: 978-1-84973-352-6.
Silverman RB and Holladay MW (2014) "The Organic Chemistry of Drug Design and Drug Action", thirdedition, Elsevier, ISBN-978-0-12-38-2030-3.
Czechtizky W and Hamley P (2016) "Small Molecule Medicinal Chemistry: Strategies and Technologies", John Wiley & Sons, ISBN-978-1-118-77160-0.
Dastmalchi S. Hamzeh-Mivehroud M. and Babak Sokouti (2018). Quantitative Structure - Activity Relationship: A Practical Approach. CRC Press. ISBN: 9780815362098
Sehgal, A. Mirza H. Tahir R. A. Mir A. (2018). Quick Guideline for Computational Drug Design. BenthamScience. ISBN: 978-1-68108-603-3
Hey-Hawkins E. Teixidor C. V. (2018). Boron-Based Compounds: Potential and Emerging Applications inMedicine. John Wiley & Sons. ISBN: 978-1-119-27558-9
Gervasio F. L. Spiwok V. Mannhold R. (2019). Biomolecular Simulations in Structure-Based Drug Discovery. John Wiley & Sons. ISBN: 978-3-527-342655
Andricopulo A. D. and Ferreira L. L. G. (2019). Chemoinformatics Approaches to Structure- and Ligand-Based Drug Design. Frontiers Media SA. ISBN: 978-2-88945-744-

Online Resources:

https://www.sciencedirect.com/book/9780444626479/elementary-molecular-quantum-mechanics
https://link.springer.com/book/9780792347927

Course Outcome	K1	K2	K3	K4	K5	K6
CO1	✓	✓	✓	✓	✓	-
CO2	✓	✓	✓	✓	✓	-
CO3	✓	✓	✓	✓	✓	-
CO4	✓	✓	✓	✓	✓	-
CO5	✓	✓	✓	✓	✓	-

K1-Remember	*K2-Understand*	*K3- Apply*	*K4-Analyze*	*K5-Evaluate*	*K6-Create*

Course designed by: Dr. J. Jeyakanthan

Course Outcome VS Programme Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	**3**	**1**	**3**	**3**	**3**	**2**	**3**	**2**	**3**	**1**
CO2	**2**	**-**	**1**	**3**	**3**	**1**	**2**	**-**	**1**	**1**
CO3	**3**	**3**	**3**	**1**	**1**	**2**	**2**	**1**	**3**	**2**
CO4	**2**	**3**	**3**	**3**	**2**	**3**	**3**	**2**	**3**	**2**
CO5	**3**	**2**	**3**	**3**	**3**	**3**	**3**	**2**	**3**	**2**
W.AV	**2.6**	**1.6**	**2.6**	**2.6**	**2.4**	**2.2**	**2.6**	**1.4**	**2.6**	**1.4**

S –Strong (3), M-Medium (2), L- Low (1)

POs vs COs Interpretation

PO	Weighted Average	Interpretation
PO1	2.6	Moderately aligned.
PO2	1.6	Low alignment
PO3	2.6	Moderately aligned.
PO4	2.6	Moderately aligned.
PO5	2.4	Moderately aligned.
PO6	2.2	Moderately supported
PO7	2.6	Moderately supported
PO8	1.4	Low alignment
PO9	2.6	Moderately supported
PO10	1.4	Low alignment

Assignment & Seminar – Molecular Modeling and Drug Design

- Role of Bioinformatics in drug design
- Structure Based Drug Design
- Coordinate System
- Quantum Mechanics
- Energy concept and its importance in drug action
- *Ab initio* method of structure prediction
- Solvent effects in Molecular Dynamics
- Application of 3D Database searching in Molecular Docking
- Receptor theories and drug action
- Concept of Hard and Soft drugs

Student Choice and it may be conducted by parallel sections (DSE)

Major Electives-DSE-I

Microbial Biochemistry

Program: M.Sc.,	Semester : I (2025-2026 Onwards)
Course Title**: Microbial Biochemistry** Subject Code: 25MBC1E1	Class Time: As per the time table
Name of Course Teachers	Dr. M. Jeyakumar
Mobile: 91 96559 07058	E-mail: biotechjeya@gmail.com

Course Brief:

This course introduces the structural, functional, and biochemical aspects of microorganisms with a focus on their roles in health, industry, food, and agriculture. It encompasses microbial taxonomy, cell composition, metabolic pathways, and applied microbiology in food and soil ecosystems. Students will gain a strong foundation in microbial biochemistry with practical insights into microbial growth, control, nutrient cycling, fermentation, and bio-product formation.

Teaching methods:

The course will be based on the following teaching and learning activities:

- Lectures covering the theoretical part using PowerPoint presentations
- Case studies
- Review questions

Attendance: A student's academic performance and opportunity to gain knowledge largely depend on regular class attendance. According to university norms, maintaining at least 70–75% attendance is essential to be eligible to appear for the end-semester examinations.

Punctuality: Punctuality is one of the essential qualities that students must follow and maintain to achieve greater success. Students are required to arrive in class on time without any delay. Only important reasons such as personal or medical emergencies will be accepted as valid excuses. Otherwise, the student will be marked absent.

Class Participation: Classroom participation is important because learning is not just between the student and the teacher, but part of the whole classroom experience which involves questioning, inquiring and exchanging ideas. When students participate, they learn from each other and internalize the knowledge better.

Submission of Assignment: Assignments are an important part of the learning process, designed to help

students apply the concepts and knowledge acquired during the course. Each student will receive two assignments that together cover the full syllabus. The course instructor will assign specific topics for each. Completing these assignments with proper effort and understanding will greatly benefit students in preparing for their final examinations.

Presentation of Seminar: Students are supposed to give an oral presentation during the class seminar hours in their assigned topic. Students will discuss on recent research finding related to the topic and participants are encouraged to ask valid questions. Seminars help the students to be updated in their course. In addition students will be able to learn their mistakes and can improve their communication skills during seminar presentation.

Preparedness: Students are expected to have read and be able to discuss the assigned chapter before attending the lecture. In addition, students should be prepared to discuss homework problems.

Academic Dishonesty: Academic dishonesty includes giving, receiving, or using unconstitutional support on any academic work. This includes a person who has taken a test discussing what was on a test with a person who has not taken the test. A clear indication of academic dishonesty will result in a grade of "F" being assigned to that particular piece of work.

Subject to change clause: This syllabus, the course schedule and reading assignments are subject to change at the discretion of the Professor to accommodate instructional and/or student needs.

Important dates: Please note down the important dates and stick to the schedule.

CIA Test I	**CIA Test II**	**Assignment**	**Seminar**
As per Academic Calendar		After CIA Test-I	

Course Outline :

- This section introduces the historical development and scope of microbiology. It covers the classification and nomenclature of microorganisms, including the five kingdom and three domain systems.
- Focuses on the biochemical composition and structure of microbial cells across bacteria, archaea, and fungi. It explores the roles of cell wall components like lipopolysaccharides, teichoic acids, and peptidoglycans. Key biomolecules such as microbial proteins, lipids, carbohydrates, and nucleic acids are discussed.
- Covers the biosynthesis of primary metabolites like amino acids, lipids, and nucleotides in microbes. Discusses the production and biochemical relevance of secondary metabolites such as antibiotics and pigments. Also introduces microbial responses to stress, including oxidative,

osmotic, and thermal adaptations.

- Explores the dual roles of microorganisms in food spoilage and fermentation. Covers major foodborne pathogens, spoilage patterns, and toxin-producing microbes. Highlights beneficial microbes in fermented foods and the significance of probiotics in health.
- Focuses on the role of microbes in soil fertility, biogeochemical cycles, and biofertilization. Explains microbial processes involved in nitrogen fixation, phosphorus solubilization, and organic matter degradation. Includes microbial biodegradation of pesticides and organic waste recycling for biogas and compost.

I - Semester					
DSE-1	**Course Code 25MBC1E1**	**Microbial Biochemistry (K1-K5)**	**T**	**Credits: 3**	**Hours: 3**
UNIT-I					
Objective -1	To provide foundational understanding of microbial structure, classification, growth, and control methods.				
Introduction to general microbiology: History and Scope of Microbiology, Classification and Nomenclature of microorganisms, Five kingdom and three domain system, Classification of bacteria, viruses, fungi, protozoa, and algae, Structure and Function Prokaryotic vs. eukaryotic cells, Viral structure and types, Nutritional types of microbes, Culture media and growth conditions, Growth curve and factors affecting growth, Sterilization and disinfection methods(Physical (heat, radiation) and chemical (alcohols, halogens) methods) Antibiotics and antimicrobial agents.					
Outcome - 1	Students will gain the ability to identify and describe microbial types, understand their growth behavior, and apply methods to control them effectively.				
UNIT-II					
Objective - 2	To study microbial cell composition and structures, and the roles of key biomolecules in bacteria, archaea, and fungi.				
Microbial Cell Structure and Biomolecules: Biochemical composition of microbial cells. Cell wall and membrane structures in bacteria, archaea, and fungi. Role of lipopolysaccharides, peptidoglycans, and teichoic acids. Microbial proteins, carbohydrates, lipids, and nucleic acids.					
Outcome - 2	Students will describe microbial cell structures and explain the roles of major biomolecules in microbial physiology.				
UNIT-III					
Objective - 3	To understand biosynthesis of primary and secondary microbial metabolites and the stress response mechanisms.				
Microbial Biochemical Pathways: Amino acid, lipid, and nucleotide biosynthesis in microbes. Secondary metabolite production: antibiotics, pigments, and toxins. Microbial stress responses and adaptations (osmotic, oxidative, and heat shock responses).					
Outcome - 3	Students will explain microbial biosynthesis and describe secondary metabolite production and biochemical stress adaptations.				
UNIT-IV					
Objective - 4	To explore the beneficial and harmful roles of microorganisms in food processing,				

	spoilage, and safety.
Roles of microbes in food technology: Introduction to Food Microbiology, Types (Bacteria, yeasts, molds, viruses), Pros and conc of microbes in food. Food Spoilage Spoilage patterns in milk, meat, vegetables, canned foods, Signs and microbial causes of spoilage. Foodborne Pathogens(Salmonella, Listeria, E. coli, Clostridium botulinum), Mycotoxins and fungal food contamination. Microbial Food Fermentation, Role in production of yogurt, cheese, pickles, and soy-based foods, Probiotics and their health significance	
Outcome - 4	Students will be able to distinguish between beneficial and harmful microbes in food and explain their roles in fermentation, spoilage, and foodborne illnesses.
UNIT-V	
Objective - 5	To understand the biochemical roles of soil microorganisms in nutrient cycling, soil fertility, and sustainable agriculture.
Agriculture microbial biochemistry: Soil microbial ecology, types of organisms in different soils; Soil microbial biomass; Role of Micro-organisms in soil fertility - soil and environmental factors on microbes, Microbiology and biochemistry of Nitrogen Fixation root-soil interface; Rhizosphere phyllosphere, Biofertilizers, Biogeochemical Cycles - Microbial transformations of nitrogen, phosphorus, sulphur, iron and manganese in soil. Biodegradation of pesticides, Organic wastes and their use for production of biogas and manures.	
Outcome - 5	Students will be able to explain the ecological and biochemical functions of soil microbes and apply microbial processes in agriculture for nutrient management and waste recycling.

Suggested Readings

Reference Books

Moat, A. G., Foster, J. W., & Spector, M. P. (2002). Microbial Physiology (4th ed.). Wiley-Liss.
Gottschalk, G. (1986). Bacterial Metabolism (2nd ed.). Springer.
Madigan, M. T., Bender, K. S., Buckley, D. H., Sattley, W. M., & Stahl, D. A. (2021). Brock Biology of Microorganisms (16th ed.). Pearson.
Schlegel, H. G. (1993). General Microbiology (7th ed.). Cambridge University Press.

Textbooks

Nelson, D. L., & Cox, M. M. (2021). Lehninger Principles of Biochemistry (8th ed.). W. H. Freeman.
Voet, D., Voet, J. G., & Pratt, C. W. (2016). Fundamentals of Biochemistry: Life at the Molecular Level (5th ed.). Wiley.
Madigan, M. T., & Martinko, J. M. (2017). Brock Biology of Microorganisms (15th ed.). Pearson.

Online Resources

NCBI Microbial Biochemistry Database – https://www.ncbi.nlm.nih.gov.
MIT OpenCourseWare – Microbial Biochemistry – https://ocw.mit.edu/courses/biology.

Course Outcome	K1	K2	K3	K4	K5	K6
CO1	✓	✓	✓	✓	✓	-
CO2	✓	✓	✓	✓	✓	-
CO3	✓	✓	✓	✓	✓	-
CO4	✓	✓	✓	✓	✓	-
CO5	✓	✓	✓	✓	✓	-

K1-Remember	*K2-Understand*	*K3- Apply*	*K4-Analyze*	*K5-Evaluate*	*K6-Create*

Course designed by: Dr. M. Jeyakumar

Course outcome Vs Programme outcome

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	3	3	3	3	2	2	2	2	1
CO2	3	3	3	3	2	2	3	2	2	2
CO3	3	3	3	3	3	2	3	3	2	3
CO4	3	3	3	3	2	2	3	2	2	2
CO5	3	3	3	3	2	3	2	2	2	2
W.AV	3	3	3	3	2.4	2.2	2.6	2.2	2	2

S-Strong (3) M-Medium (2) L-Low (1)

POs vs Cos Interpretation

PO	Weighted Average	Interpretation
PO1	3.0	Strongly aligned with all COs
PO2	3.0	Strongly aligned with all COs
PO3	3.0	Strongly aligned with all COs
PO4	3.0	Strongly aligned with all COs
PO5	2.4	Moderately supported
PO6	2.2	Moderately supported
PO7	2.6	Moderately supported
PO8	2.2	Moderately supported
PO9	2.0	Moderately supported
PO10	2.0	Moderately supported

Assignment topics:

- History and Scope of Microbiology
- Classification and Nomenclature of Microorganisms
- Structure and Function of Microbial Cells
- Microbial Growth and Control
- Biochemical Composition of Microbial Cells
- Cell Wall and Membrane Biochemistry
- Microbial Metabolism and Biosynthesis
- Secondary Metabolites and Stress Responses
- Microbial Biochemistry in Food
- Microbial Biochemistry in Agriculture

Student Choice and it may be conducted by parallel sections (DSE)
Major Electives-DSE-I
General Chemistry

Program: M.Sc., Bioinformatics	Semester : III (2025-2026 Onwards)
Course Title: **GeneralChemistry** Subject Code: 25MBC1E2	Class Time: As per Time Table
Name of Course Teacher:	Dr. P. Boomi
Mobile: +91-9486031423	Email : pboomi1983@gmail.com

Course Brief:

Chemistry is a branch of science that deals with the study of the composition, properties, and reactivity of matter that includes organic chemistry, in-organic chemistry, physical chemistry etc. In bioinformatics, chemistry has a pivotal role to systematic investigation of the properties, structure, behavior of matter and the changesmatter undergoes. The student will need to improve the basic aspects of chemistry andit will expose to develop in related disciplines like interaction between the chemical compounds and the bio-molecules. Hence, the syllabus is framed to provide sound knowledge and understanding of chemistry to divulge biological and biomedical science. The purpose of this syllabus is to develop scientific temper and analytical capability through learning physical concepts and their applications in pharmaceutical. This syllabus for the course covers with organic chemistry, inorganic chemistry, nano- chemistry, bio-organic chemistry, bio-inorganic chemistry and important analytical techniques to gain an insight into the basics of knowledge of chemistry. This course highlights the information regarding synthesis of drug compound using organic and in- organic materials for drug discovery, therapy, imaging and diagnosis. It will also guide the students to understand how chemistry will be used for a high technology area of Bioinformatics.

Teaching method:

- There are a number of different teaching methods used such as:
- Lecture using power point presentation
- Discussion (Boards and Blogs)
- Case studies
- Review questions

Attendance: Having good attendance record marks the student's sincerity and has an overall positive impact on his/her personality trait development. The students are asked to attend the classes on a regular note and those having a minimum scale of 70-75% attendance are eligible to take up the end-semester examinations as per the University norms.

Punctuality: It is the most important attribute to be followed and maintained by the student throughout his/her life which for sure will lead to the path of success. Students who arrive late by 10mins after the attendance has been taken will be marked absent unless there is a valid reason (medical/ personal emergency) at the discretion of the Head of the Department.

Class Participation: A student's overall growth and personality development is based on his/her involvement in the class not just by mere presence but rather being interactive through questioning that will lead to propagation of ideas, initiation of thought-provoking process and much more that will provide a wholesome enriched classroom experience. Therefore, students are advised to be more attentive so that they learn from one another and develop quality-based knowledge.

Submission of Assignment: Assignments are given to students with just one motive to get more quantitative and qualitative knowledge insights into the assigned topic/chapter that will lead to preparation and completion of the assignment in a constructive manner here just the knowledge provided is not merely counted but also completion prior to proposed deadline will also have a check on the student's serious consideration of the assignments.

Presentation of Seminar: Apart from the assignments the concerned instructors also allocate the students with a topic or based on their interests to present seminar that will aid them built their confidence levels, command over English language to communicate with precision and fluently. In addition, the fellow students are encouraged to pose questions that will instigate interest and provide update in that particular topic besidesthe information presented helping them to prepare for their examinations that can be taken as added advantage for the students.

Preparedness: At the end of every class, the concerned instructor tells the students what will be taken in the next class using these details the students should be aware of thetopics that will be covered in the upcoming lectures which actually enhance the student's capability to grasp the knowledge and concepts provided much efficiently.

Academic Dishonesty: This is an important aspect that every student should be aware of. Thus, the respective faculty members educate the students of possible means of academic malpractices (plagiarism, violation of copyrights and stealing the patented knowledge) and the following consequences that will make them more vigilant in their academiccareer.

Subject to change clause: Based on the requirement of student's feasibility and meeting the competitive demands of the discipline the syllabus courses will be re-structured and updated accordingly at the discretion of the Professor(s) and Board of studies chairman.

Important dates: Please note down the important dates and stick to the schedule

CIA Test I	**CIA Test II**	**Assignment**	**Seminar**
As per Academic Calendar		After CIA Test-I	

Course Outline: Elective: General chemistry

- **Organic chemistry:** can be describing the aromatic substances that involve the study of carbon and its compounds**.** It includes aromaticity, synthesis of organic compound and heterocyclic compound.
- **Chemical bonding:** It is one of the most important basic fundamentals of chemistry that explains how compounds form based on the electrostatic interaction and other concepts such as various bonding theory. Chemical Bonding and Acid base theory
- **Nano Chemistry:** It is an emerging field that involves study of unique properties associated with assemblies of atoms or molecules of nanoscale, the types of nano structures such as one, two and

three dimensional. **Polymer chemistry and pharmaceutical chemistry** include classification of polymer with their uses andapplications.

- **Bio-inorganic chemistry:** It examines the role of metals in biology**,** which covers the metalloprotein like hemoglobin and myoglobin, Electron transfer proteins: Active site structure and functions of ferredoxin, rubridoxin and cytochromes.
- **Medicinal Chemistry:** It involves the drug action and synthesis of various drug such as antibacterial, antibiotics, antifungal and anticancer agent.

More books for Reading and Referencing

Amit Arora, "Organic Chemistry: Aromatic, Alcohols Aldehydes & Acids", (2006), Publisher- Discovery Publishing House, (**ISBN:8183561896, 9788183561891**)
John A. Joule and Keith Mills, "Heterocyclic Chemistry", (2013), Publisher- John
Wiley & Sons, (**ISBN: 1118681649, 9781118681640**)
Marye Anne Fox, James K. Whitesell, "Organic chemistry", (2004), Publisher-Jones & Bartlett Learning, (**ISBN: 763721972, 9780763721978**)
Paul M. Dewick, "Essentials of Organic Chemistry: For Students of Pharmacy,Medicinal Chemistry and Biological Chemistry", (2006), Publisher-John Wiley & Sons, (**ISBN: 0470016655, 9780470016657**)
J. Newton Friend, "A text book of in-organic chemistry" (2012), Publisher-Hardpress, (**ISBN: 290327793, 9781290327794**)
I. David Brown, "The Chemical Bond in Inorganic Chemistry" (2006), Publisher-Oxford University Press, (**ISBN: 0199298815, 9780199298815**)
John C. Kotz, Paul M. Treichel and John Townsend, "Chemistry and Chemical Reactivity", (2014), 9th Edition, Publisher- Cengage Learning, (**ISBN:1305176464, 9781305176461**)
Geoffrey A. Ozin, and Andre C. Arsenault, (Nanochemistry: A Chemical Approach to Nanomaterials", (2015), Publisher- Royal Society of Chemistry, (**ISBN:1782626263, 9781782626268**)
Kenneth J. Klabunde, and Gleb B. Sergeev "Nanochemistry " (2013) 2nd Edition, Publisher- Newnes, (**ISBN: 0444594094, 9780444594099**)
A. Ravve, " Principles of Polymer Chemistry", (2013), Pubisher- Springer Science & Business Media, (**ISBN: 1489912835, 9781489912831**)
Gauri Shankar Misra, "Introductory Polymer Chemistry", (1993), (**ISBN: 8122404715, 9788122404715**)
S. M. Khopkar, "Basic Concepts Of Analytical Chemistry", (1998), Publisher-New Age International, (**ISBN: 8122411592, 9788122411591**)
John Kenkel, "Analytical Chemistry for Technicians, Fourth Edition", (2013), Publisher-CRC Press, (**ISBN: 1439881065, 9781439881064**)

David Van Vranken and Gregory Weiss, "Introduction to Bioorganic Chemistry and Chemical Biology", (2012), Publisher- Garland Science, (**ISBN: 1135054827,9781135054823**)
K. Hussain Reddy "Bioinorganic Chemistry", (2007), Publisher-New Age International, (**ISBN: 8122414370, 9788122414370**)
Ivano Bertini, "Biological Inorganic Chemistry: Structure and Reactivity", (2007), Publisher-University Science Books, (**ISBN: 1891389432, 9781891389436**)

I - Semester					
DSE- 1	**Course Code: 25MBC1E2**	**General Chemistry (K1-K5)**	**T**	**Credits:3**	**Hours:3**
UNIT-I					
Objective-1	To understand the fundamental types of chemical bonds and their formation, with emphasis on their role in the structure and stability of biological macromolecules.				
Chemical Bonding: Chemical bonding theory, Hydrogen bond, Ionic bond, Metallic bond, Covalent bond, Types of Covalent bond-Sigma bond and pi bond with overlapping, non-covalent bonds, Peptide bond, Disulfide bond, Hydrophobic interaction, Vander- Waals forces, Glycosidic bond, Phosphodiester bonds, Role of bonding in biological molecules.					
Outcome-1	Be able to identify and explain various chemical bonds and bonding interactions to biological function, molecular stability, and computational structure prediction in bioinformatics.				
UNIT-II					
Objective-2	To understand the structural and stereochemical properties of organic compounds, including isomerism, aromaticity, and heterocyclic synthesis, with relevance to biomolecular structure and function.				
Organic Chemistry: Carbon and its compounds, Tetravalency of carbon, cyclic structure, Delocalization, Conjugation, Resonance, Hyperconjugation, catenation, functional groups, oxidation number, Concept of isomerism, types of isomerism, optical isomerism, elements of symmetry, molecular chirality, enantiomers, diastereomers. Concept of aromaticity, non-aromaticity and anti-aromaticity, Huckel's rule, Synthesis of aromatic heterocyclic compounds such as Indole, Pyrazole, Imidazole, Oxazole, and Thiazole.					
Outcome-2	Be able to analyze and classify organic molecules based on their structure, functional groups, isomerism, and aromatic character, and explain the synthesis and significance of biologically relevant heterocyclic compounds.				
UNIT-III					
Objective-3	To understand and apply the fundamental principles of thermodynamics such as Gibbs free energy, enthalpy, and entropy to biological systems, focusing on biomolecular stability, folding, and interactions.				
Thermodynamics of Biomolecules: Laws of Thermodynamics, Gibbs free energy, Enthalpy**,** Entropy, Enthalpy-entropy compensation, Thermodynamics of protein folding and denaturation, Predicting ΔG and ΔH using computational tools, Thermodynamics in protein modeling, Thermodynamics of Biochemical Pathways, Thermodynamically feasible vs. infeasible pathways, Thermodynamic Integration Molecular Dynamics, Estimation of Binding Free Energy between biomolecules.					

Outcome-3	Be able to analyze and predict the thermodynamic feasibility of biochemical reactions and molecular interactions using both theoretical knowledge and computational tools.
UNIT-IV	
Objective-4	To introduce the principles of nanochemistry and polymer chemistry, focusing on the structural properties, classifications, and pharmaceutical applications of nanomaterials and polymers in drug delivery systems.
Nano Chemistry and Polymer Chemistry: Nano Chemistry Definition, One-Dimensional, Two-Dimensional and Three-Dimensional nanomaterials, stability, properties(nanowire, nanorod and nanotube), self-assembly nanoparticles, Fundamentals of Drug Nanoparticles, combination of drugs with their controlled drug delivery system. **Polymer chemistry:** Basic concepts of polymers, classification: Natural, synthetic, linear, cross linked, network, plastics, elastomers and fibers. Biopolymers in Drug Delivery role and application example; cyclodextrin, Chitosan and Gelatin.	
Outcome-4	Be able to describe the types, properties, and applications of nanomaterials and pharmaceutical polymers, and explain their role in advanced drug delivery and biomedical applications.
UNIT-V	
Objective-5	To understand the structural and functional roles of metal-containing biomolecules and explore the chemical basis of drug action, classification, and mechanisms, including antibiotics and therapeutic agents.
Bioinorganic Chemistry and Medicinal Chemistry: Overview of structure and functions of heme proteins such as Hemoglobin, and Myoglobin. Structure and functions of electron transfer proteins such as Iron-Sulphur proteins (Ferredoxins, and Rubredoxin). **Medicinal Chemistry**: Introduction to Drugs-Definition, Sources and classification of drugs, Drug action in human body, Chemistry of antibiotics and related drugs with their mode of action and side effects (Benzathine penicillin, Ampicillin, cis-platin, Chloroquine and Amodiaquine).	
Outcome-5	Be able to explain the biological roles of heme and electron transfer proteins, and analyze the chemistry, mode of action, and side effects of key pharmaceutical drugs.

Suggested Readings:

Gowariker, V. R., Viswanathan, N. V., Jayadev Sreedhar, N. V. (2008). Polymer Science.(1st Ed). New Age International Pvt. Ltd.

Gopalan, R. (2009). Inorganic Chemistry. Universities Press.Cammack, R. (1999). Iron-Sulfur Proteins. Academic Press.

Eldik, R. V. (2004). Advances in Inorganic Chemistry. Vol-55, Publisher-Elsevier.Ahuja, S., Jespersen, N. (2006). Modern Instrumental Analysis. Vol-47, Elsevier.

Agrawal, J. P., Hodgson, R. D. (2007). Organic Chemistry of Explosives. John Wiley & Sons Ltd.

McMurry, J. (2008). Organic Chemistry. (7th Ed,), Thomson Higher Education. Brechignac, C., Houdy P., Lahmani, M. (2008). Nanomaterials and Nanochemistry.Springer Science & Business Media.

Lewis, A. (2009). Drug-Device Combination Products: Delivery Technologies and Applications. Woodhead Publishing series in Biomaterials. Elsevier,

Thassu, D., Deleers, M., Pathak, Y. (2007). Nanoparticulate Drug Delivery Systems.Edition-Informa Healthcare USA, Inc.
Atul, S. (2010). The Pearson Guide to Objective Chemistry for the AIEEE. PearsonEducation India.
Watson, D. G. (2011). Pharmaceutical Chemistry E-Book. Publisher-Elsevier HealthSciences.
Bhattacharjee, M. K. (2016). Chemistry of Antibiotics and Related Drugs. Publisher-Springer
House, J. E. (2012). Inorganic Chemistry. (2nd Ed.) Publisher-Academic Press.
Clayden, J., Greeves, N., Warren, S. (2012). Organic Chemistry. (2nd Ed.). OUP Oxford.
Kaim, W. Schwederski, B. Klein, A. (2013). Bioinorganic Chemistry-Inorganic Elements in the Chemistry of Life: An Introduction and Guide. (2nd Ed.). John Wiley & Sons.

Online Resources:

1. https://www.geeksforgeeks.org/chemical-bonding/
2. https://www.scimagojr.com/journalsearch.php?q=25786&tip=sid&clean=0

Course Outcome	K1	K2	K3	K4	K5	K6
CO1	✓	✓	✓	✓	✓	
CO2	✓	✓	✓	✓	✓	
CO3	✓	✓	✓	✓	✓	
CO4	✓	✓	✓	✓	✓	
CO5	✓	✓	✓	✓	✓	

K1-Remember	*K2-Understand*	*K3-Apply*	*K4-Analyze*	*K5-Evaluate*	*K6-Create*

Course designed by: Dr. P. Boomi

Course Outcome VS Programme Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	2	3	2	3	3	2	3	3	3
CO2	3	3	3	2	3	2	1	3	2	2
CO3	2	2	2	2	2	3	3	2	1	2
CO4	3	2	1	2	1	3	2	1	2	3
CO5	2	1	1	1	2	3	1	2	1	1
W.AV	2.6	2	2	1.8	2.2	2.8	1.8	2.2	1.8	2.2

S –Strong (3), M-Medium (2), L- Low (1)

POs vs COs Interpretation

PO	Weighted Average	Interpretation
PO1	2.6	Moderately aligned.
PO2	2.0	Moderately aligned.
PO3	2.0	Moderately supported
PO4	1.8	Low alignment
PO5	2.2	Moderately supported
PO6	2.8	Moderately supported
PO7	1.8	Low alignment
PO8	2.2	Moderately supported
PO9	1.8	Low alignment
PO10	2.2	Moderately supported

Assignment & Seminar – General Chemistry

1. Write a brief note on aromaticity and anti-aromaticity.
2. Explain the detail about annulenes and fulvenes.
3. How to synthesis of primary and secondary alcohol.
4. Define the structure and application of pyrrole, and imidazole.
5. Give a detailed account on $SN1$ and $SN2$ reaction and mechanism.
6. Discus the Bimolecular reaction and mechanism.
7. Define neighboring group participation and leaving group.
8. Describe the Vander-Waals forces and Molecular orbital theory.
9. Types of chemical bonding.
10. Structure and uses of polymethacrylate, polyvinyl alcohol.

Student Choice and it may be conducted by parallel sections (DSE)

Major Electives- DSE-II

Food and Nutritional Biochemistry

Program: M.Sc.,	Semester : III (2025-2026 Onwards)
Course Title: **Food and Nutritional Biochemistry** Subject Code: 25MBC3E1	Class Time: As per the time table
Name of Course Teachers	Dr. M. Mamutha
Mobile: +91 91761 63179	E-mail: mamudha2014@gmail.com

Course Brief:

This course provides a comprehensive overview of the biochemical principles underlying food composition, nutrient metabolism, and their physiological roles in human health. It integrates knowledge of macro- and micronutrient functions, enzymatic roles in food systems, the molecular basis of nutrition-related diseases, and emerging concepts like functional foods, nutrigenomics, and food toxicology. The course also addresses current issues in food safety and regulation, equipping students with foundational and applied knowledge relevant to biochemistry, nutrition, and health sciences.

Teaching methods: The course will be based on the following teaching and learning activities:

- Lectures covering the theoretical part using PowerPoint presentations
- Case studies
- Review questions

Attendance: A student's academic performance and opportunity to gain knowledge largely depend on regular class attendance. According to university norms, maintaining at least 70–75% attendance is essential to be eligible to appear for the end-semester examinations.

Punctuality: Punctuality is one of the essential qualities that students must follow and maintain to achieve greater success. Students are required to arrive in class on time without any delay. Only important reasons such as personal or medical emergencies will be accepted as valid excuses. Otherwise, the student will be marked absent.

Class Participation: Classroom participation is important because learning is not just between the student and the teacher, but part of the whole classroom experience which involves questioning, inquiring and exchanging ideas. When students participate, they learn from each other and internalize the knowledge better.

Submission of Assignment: Assignments are an important part of the learning process, designed to help students apply the concepts and knowledge acquired during the course. Each student will receive two assignments that together cover the full syllabus. The course instructor will assign specific topics for each. Completing these assignments with proper effort and understanding will greatly benefit students in preparing for their final examinations.

Presentation of Seminar: Students are supposed to give an oral presentation during the class seminar hours in their assigned topic. Students will discuss on recent research finding related to the topic and participants are encouraged to ask valid questions. Seminars help the students to be updated in their course. In addition students will be able to learn their mistakes and can improve their communication skills during seminar

presentation.

Preparedness: Students are expected to have read and be able to discuss the assigned chapter before attending the lecture. In addition, students should be prepared to discuss homework problems.

Academic Dishonesty: Academic dishonesty includes giving, receiving, or using unconstitutional support on any academic work. This includes a person who has taken a test discussing what was on a test with a person who has not taken the test. A clear indication of academic dishonesty will result in a grade of "F" being assigned to that particular piece of work.

Subject to change clause: Depending upon the requirement of student's possibility, the course syllabus will be re-structured and updated accordingly at the discretion of the Professor(s) and Board of studies chairperson.

Important dates: Please note down the important dates and stick to the schedule.

CIA Test I	CIA Test II	Assignment	Seminar
As per Academic Calendar		After CIA Test-I	

Course Outline:

- Understanding the structure, function, digestion, and metabolism of carbohydrates, proteins, lipids, vitamins, and minerals essential for human nutrition.
- Study of enzymatic reactions, food emulsification, gelation, browning mechanisms, and the role of functional foods and nutraceuticals.
- Exploration of hormone-mediated metabolic regulation and gene–diet interactions through nutrigenomics and epigenetics.
- Investigating the relationship between diet and chronic diseases (CVD, diabetes, cancer), the gut microbiome, and dietary antioxidants.
- Examination of foodborne toxins, contaminants, allergens, risk assessment protocols (HACCP), and the safety of GMOs.

Semester – III					
DSE-II	**Course Code 25MBC3E1**	**Food and Nutritional Biochemistry (K1-K5)**	**T**	**Credits:3**	**Hours:3**
Unit-I					
Objective-I	To understand the chemical composition of food and the biochemical principles governing food structure and stability.				

Fundamentals of Food Biochemistry: Composition of food- Macronutrients (carbohydrates, proteins, lipids) and micronutrients (vitamins and minerals); Water activity, pH, and buffering in foods; Role of enzymes in food systems: endogenous and microbial; Basic food chemistry: emulsification, gelation, browning reactions (enzymatic and non-enzymatic); Functional foods and nutraceuticals: classification, health benefits, and regulatory aspects.	
Outcome-I	Students will be able to explain the roles of macronutrients, micronutrients, enzymes, and bioactive compounds in food systems.
Unit-II	
Objective-2	To study the sources, functions, and metabolic roles of essential vitamins and minerals in human nutrition.
Vitamins and Minerals: Minerals - sources, requirement, physiological function, deficiency and toxicity of calcium, sodium, potassium, iron, magnesium, chromium. Cobalt, copper, manganese, molybdenum, selenium, iodine and zinc. Vitamins - definition and types of vitamins, sources, requirement, biological functions, deficiency symptoms of thiamine, riboflavin, niacin, pyridoxine, panthothenic acid, folic acid, biotin, cyanocobalamine, vitamins C, A, D, E and K. Hypervitaminosis.	
Outcome-2	Learners will be able to identify deficiency symptoms and evaluate the biological importance and toxic effects of micronutrients.
Unit-III	
Objective-3	To examine the digestion, metabolism, and hormonal regulation of carbohydrates, proteins, and lipids.
Nutritional Biochemistry of Macronutrients: Digestion, absorption, and assimilation of carbohydrates, proteins, and fats; Hormonal regulation of metabolism (insulin, glucagon, leptin); Metabolic disorders: lactose intolerance, Glycemic index, insulin sensitivity, and energy balance; Dietary fiber and its metabolic effects; Thermogenesis and adaptive metabolism.	
Outcome-3	Students will analyze how macronutrient imbalances contribute to metabolic disorders and assess their nutritional impact.
Unit-IV	
Objective-4	To explore the link between diet, chronic disease risk, and the influence of bioactive compounds and nutrigenomics on health.
Food, Nutrition, and Health: Diet and chronic diseases: cardiovascular disease, type 2 diabetes, cancer; Nutritional genomics: gene-diet interactions, epigenetic influences; Bioactive compounds: carotenoids, glucosinolates, omega-3s, probiotics; Role of dietary antioxidants in disease prevention; Gut microbiome and its role in immunity, obesity, and inflammation; Nutrition across life stages: pregnancy, infancy, elderly.	
Outcome-4	Learners will evaluate how dietary components modulate gene expression, gut health, and disease prevention across life stages.
Unit-V	
Objective-5	To gain knowledge of foodborne toxins, contaminants, allergens, and regulatory practices in ensuring food safety.
Food Toxicology and Safety Biochemistry: Natural toxins in food: mycotoxins, alkaloids, glycoalkaloids; Chemical food contaminants: heavy metals, pesticide residues, processing-induced toxins (acrylamide, nitrosamines); Food allergens and intolerance: biochemical mechanisms and	

detection; Risk assessment, toxicokinetics, and hazard control (HACCP, Codex guidelines); Genetically Modified Foods (GMOs): safety evaluation and regulation.	
Outcome-5	Students will assess the biochemical basis of food toxicity, interpret risk assessment protocols, and understand GMO safety.

Suggested Readings

Gibney, M. J., Lanham-New, S. A., Cassidy, A., & Vorster, H. H. Introduction to Human Nutrition Wiley-Blackwell, 2nd/3rd Edition Nelson, D. L. & Cox, M. M.

Lehninger Principles of Biochemistry, W.H. Freeman, 8th Edition

Wardlaw, G. M., & Smith, A. M. Contemporary Nutrition, McGraw-Hill Education, Latest Edition

Mahan, L. K., & Raymond, J. L. Krause's Food & the Nutrition Care Process. Elsevier, 15th Edition

Fennema, O. R., Damodaran, S., & Parkin, K. L. Fennema's Food Chemistry CRC Press, 5th Edition

Wildman, R. E. C. Handbook of Nutraceuticals and Functional Foods. CRC Press, 2nd Edition

Franz, C. M. A. P., & Huch, M. Food Safety for Food Processors. Springer

Gurr, M. I., Harwood, J. L., & Frayn, K. N. Lipid Biochemistry. Wiley-Blackwell, 5th Edition

Reference Journals & Online Resources

The Journal of Nutrition

Nutrition Reviews

Critical Reviews in Food Science and Nutrition

NCBI Bookshelf – https://www.ncbi.nlm.nih.gov/books/

Food and Agriculture Organization (FAO) – https://www.fao.org/nutrition

EFSA (European Food Safety Authority) – https://www.efsa.europa.eu/

USDA FoodData Central – https://fdc.nal.usda.gov/

Course Outcome	K1	K2	K3	K4	K5	K6
CO1	✓	✓	✓	✓	✓	-
CO2	✓	✓	✓	✓	✓	-
CO3	✓	✓	✓	✓	✓	-
CO4	✓	✓	✓	✓	✓	-
CO5	✓	✓	✓	✓	✓	-

K1-Remember	*K2-Understand*	*K3- Apply*	*K4-Analyze*	*K5-Evaluate*	*K6-Create*

Course designed by: Dr. M. Mamutha

Course outcome Vs Programme outcome

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	3	3	3	3	2	3	1	1	1
CO2	3	3	3	3	3	2	3	3	2	2
CO3	3	3	3	3	3	3	3	2	3	2
CO4	3	3	3	3	3	3	2	2	3	3
CO5	3	3	3	3	3	3	3	2	3	2
W.AV	3	3	3	3	3	2.6	2.8	2	2.4	2

S-Strong (3) M-Medium (2) L-Low (1)

POs vs COs Interpretation

PO	Weighted Average	Interpretation
PO1	3.0	Strongly aligned with all COs
PO2	3.0	Strongly aligned with all COs
PO3	3.0	Strongly aligned with all COs
PO4	3.0	Strongly aligned with all COs
PO5	3.0	Strongly aligned with all COs
PO6	2.6	Moderately supported
PO7	2.8	Strongly aligned with all COs
PO8	2.0	Moderately supported
PO9	2.4	Moderately supported
PO10	2.0	Moderately supported

Assignment Topics

- Prepare a comparative chart showing RDA, sources, and deficiency symptoms of all essential vitamins and minerals.
- Analyze a diet plan for a pregnant woman and suggest modifications based on micronutrient needs.
- Write a report on how functional foods like omega-3 fatty acids or probiotics contribute to heart and gut health.
- Explain the molecular mechanism of lactose intolerance and phenylketonuria with clinical significance.
- Design a flowchart describing hormonal regulation of glucose metabolism and its implication in diabetes.
- Critically review a research article from *The Journal of Nutrition* on the impact of antioxidants in cancer prevention.
- Prepare a case study evaluating the food safety incident involving aflatoxin contamination.
- Compare and contrast enzymatic vs. non-enzymatic browning in food and their implications in processing.
- Discuss the significance of nutrigenomics and how gene-diet interactions can inform personalized nutrition.
- Survey local or packaged foods for labeling of GMOs, allergens, and nutraceutical claims; critically assess compliance.

Student Choice and it may be conducted by parallel sections (DSE)
Major Electives-DSE-II
Plant Biochemistry

Program: M.Sc.,	Semester : III (2025-2026 Onwards)
Course Title: Plant Biochemistry Subject Code: 25MBC3E2	Class Time: As per the time table
Name of Course Teachers	Dr. M. Jeyakumar & Dr. M. Mamutha
Mobile: +91 96559 07058 & +91 91761 63179	E-mail:biotechjeya@gmail.com mamudha2014@gmail.com

Course Brief:

This course introduces the biochemical foundations of plant systems, focusing on the structure, properties, and metabolic functions of biomolecules. Students will gain a solid understanding of bioenergetics, enzymology, macromolecular chemistry (carbohydrates, lipids, proteins, nucleic acids), membranes, plant cell walls, and secondary metabolites. Emphasis is placed on integrating biochemical concepts with plant-specific processes relevant to agriculture and biotechnology. The course blends theory with computational databases (CSDB, LIPID MAPS, NCBI, EMBL) to enhance analytical skills.

Teaching methods: The course will be based on the following teaching and learning activities:

- Lectures covering the theoretical part using PowerPoint presentations
- Case studies
- Review questions

Attendance: A student's academic performance and opportunity to gain knowledge largely depend on regular class attendance. According to university norms, maintaining at least 70–75% attendance is essential to be eligible to appear for the end-semester examinations.

Punctuality: Punctuality is one of the essential qualities that students must follow and maintain to achieve greater success. Students are required to arrive in class on time without any delay. Only important reasons such as personal or medical emergencies will be accepted as valid excuses. Otherwise, the student will be marked absent.

Class Participation: Classroom participation is important because learning is not just between the student and the teacher, but part of the whole classroom experience which involves questioning, inquiring and exchanging ideas. When students participate, they learn from each other and internalize the knowledge better.

Submission of Assignment: Assignments are an important part of the learning process, designed to help

students apply the concepts and knowledge acquired during the course. Each student will receive two assignments that together cover the full syllabus. The course instructor will assign specific topics for each. Completing these assignments with proper effort and understanding will greatly benefit students in preparing for their final examinations.

Presentation of Seminar: Students are supposed to give an oral presentation during the class seminar hours in their assigned topic. Students will discuss on recent research finding related to the topic and participants are encouraged to ask valid questions. Seminars help the students to be updated in their course. In addition students will be able to learn their mistakes and can improve their communication skills during seminar presentation.

Preparedness: Students are expected to have read and be able to discuss the assigned chapter before attending the lecture. In addition, students should be prepared to discuss homework problems.

Academic Dishonesty: Academic dishonesty includes giving, receiving, or using unconstitutional support on any academic work. This includes a person who has taken a test discussing what was on a test with a person who has not taken the test. A clear indication of academic dishonesty will result in a grade of "F" being assigned to that particular piece of work.

Subject to change clause: Depending upon the requirement of student's possibility, the course syllabus will be re-structured and updated accordingly at the discretion of the Professor(s) and Board of studies chairperson.

Important dates: Please note down the important dates and stick to the schedule.

CIA Test I	CIA Test II	Assignment	Seminar
As per Academic Calendar		After CIA Test-I	

Course outline:

- The course introduces the fundamentals of plant biochemistry, including atomic structure, molecular interactions, pH, buffers, and their agricultural relevance.
- It explains the principles of bioenergetics and enzymology, covering thermodynamics, energy currencies, enzyme kinetics, and regulation.
- It describes the structure, classification, and metabolism of carbohydrates and lipids, supported by databases like CSDB and LIPID MAPS.
- It analyzes amino acids, proteins, and nucleic acids, focusing on their structure, biosynthesis, and related biological databases.
- It evaluates the biochemistry of plant membranes, cell walls, and secondary metabolites, highlighting their structural and functional significance.

Semester-III					
DSE-II	**Course Code 25MBC3E2**	**Plant Biochemistry (K1-K5)**	**T**	**Credits: 3**	**Hours :3**

UNIT - I	
Objective -1	To understand the basic concepts of biochemistry.
Basic Biochemistry: Structure of atom, molecules, forces stabilizing macromolecules, weak bonds and covalent bonds, buffers, pKa values, Ph, hydrogen bonding, hydrophobic, electrostatic and Van der Waals forces. Scope and importance of biochemistry in agriculture.	
Outcome -1	Remember the fundamentals and significance of Plant Biochemistry.
UNIT – II	
Objective -2	Strengthens the knowledge for the understanding of the bioenergetics of plants.
Bioenergetics: Principles of thermodynamics, Conservation of energy, Entropy and disorder, Gibbs free energy, Water biochemistry, Chemical reactions and equilibrium constants, Redox potential, energy currencies (ATP, NAD, NADP), ATP structure and reactions. Enzymes: Discovery and nomenclature, Properties of enzymes, Co-factors, Isozymes, enzyme kinetics, Michaelis – Menten equation, mechanism of enzyme action, regulation of enzyme action.	
Outcome - 2	Understanding on the structure and properties of carbohydrates and lipids.
UNIT – III	
Objective -3	To understand the structure and properties of carbohydrates and lipids.
Carbohydrates: Classification, structure and function of carbohydrates a) monosaccharides b) oligosaccharides c) polysaccharides, storage polysaccharides and structural polysaccharides. CSDB (Carbohydrate Structure Database). Lipids: Classification of lipids – simple lipids, compound lipids, sterols and terpenoids, biosynthesis of fatty acids, polyunsaturated fatty acids, lipoproteins, oxidation of fats, αoxidation, β-oxidation, glyoxylate cycle, gluconeogenesis. LIPID MAPS.	
Outcome -3	Explain fundamental thermodynamic properties and laws.
UNIT – IV	
Objective -4	Learn amino acid and protein structural hierarchy and relate structure to function.
Amino acids: a) General properties b) Classification and characteristics c) non protein amino acids d) peptide bonds e) Biosynthesis of amino acids with reference to GS and GOGAT. Proteins: a) Classification of proteins, b) Structure of proteins and Ramachandran plot. Nucleic acids: a) Structure of DNA and types – B, A and Z forms of DNA b) Structure of RNA – m-RNA, t-RNA and r-RNA. Biosynthesis and degradation of purines and pyrimidines. NCBI and EMBL database.	
Outcome -4	Analyze the structure, function and synthesis of amino acids, proteins and Nucleic acids.
UNIT-V	
Objective -5	The course will aid the students in understanding the biochemistry of plant cells.
Structure and function of membranes: a) Chemical composition b) Membrane models c) Functions of Membranes d) Membrane proteins e) Membrane lipids. Biochemistry of plant cell wall: cellulose, hemicelluloses, lignin, pectin, suberin and cutin. Cellulose synthase (s), structure, active sites, transmembrane domains, assembly, recognition of distinct CesA proteins in primary and secondary cell walls. The lignin biosynthesis pathway; control points and effects of mutations on lignin production. Assembly and synthesis of pectin. Secondary metabolites: introduction, classification, distribution and functions (flavonoids, alkaloids and steroids).	
Outcome -5	Evaluate the secondary metabolites in plant system.

Suggested readings:-

Goodwin, T. W., Mercer, E. I. (1996). Introduction to plant Biochemistry. CBS Publishers, New Delhi. Heldt, H. W. and Piechulla, B. (2010). Plant Biochemistry. Academic Press. 4th edition. Voet, D., Voet, J. G. (2010). Plant Biochemistry International. 4th edition.

Nelson, D. L., Cox, M. M. (2017). Lehninger principles of biochemistry. (7th Ed.). Bej, S., Lodha, T. D. (2019). Plant Biochemistry Scitus. Scitus Academics.

Online Resources:

1. https://www.pdfdrive.com/plant-biochemistry-4pdf-d39618886.html
https://agrimoon.com/fundamentals-of-biochemistry-pdf-book/
2. https://agri-bsc.kkwagh.edu.in/uploads/department_course/Biochemistry_notes.pdf
https://uou.ac.in/sites/default/files/slm/MSCBOT-601.pdf
https://sist.sathyabama.ac.in/sist_coursematerial/uploads/SBC3201.pdf

Course Outcome	K1	K2	K3	K4	K5	K6
CO1	✓	✓	✓	✓	✓	
CO2	✓	✓	✓	✓	✓	
CO3	✓	✓	✓	✓	✓	
CO4	✓	✓	✓	✓	✓	
CO5	✓	✓	✓	✓	✓	

K1-Remember	*K2-Understand*	*K3-Apply*	*K4-Analyze*	*K5-Evaluate*	*K6-Create*

Course designed by: Dr. M. Jeyakumar & Dr. M. Mamutha

Course Outcome VS Programme Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	2	2	-	1	2	2	-	1	-	3
CO2	2	2	1	1	2	2	-	1	-	2
CO3	3	2	2	1	2	2	1	-	-	1
CO4	2	2	2	2	2	3	1	1	-	1
CO5	2	2	1	2	3	3	2	1	2	2
W.AV	2.2	2	1.2	1.4	2.2	2.4	0.8	0.8	0.4	1.8

S –Strong (3), M-Medium (2), L- Low (1)

POs vs COs Interpretation

PO	Weighted Average	Interpretation
PO1	2.2	Moderately aligned.
PO2	2.0	Moderately aligned.
PO3	1.2	Low alignment
PO4	1.4	Low alignment
PO5	2.2	Moderately aligned.
PO6	2.4	Moderately aligned.

PO7	0.8	Low alignment
PO8	0.8	Low alignment
PO9	0.4	Low alignment
PO10	1.8	Low alignment

Assignment Topics:

- Role of weak interactions (H-bonds, hydrophobic forces, Van der Waals) in stabilizing plant macromolecules.
- Application of bioenergetics in photosynthesis and respiration: Gibbs free energy perspective.
- Comparative study of Michaelis–Menten enzyme kinetics in plant enzymes (with examples).
- Database-based assignment: Use of CSDB and LIPID MAPS for analyzing carbohydrate and lipid structures.
- Role of glyoxylate cycle in seed germination and its agricultural importance.
- Structure-function analysis of amino acids in relation to GS/GOGAT pathway in nitrogen assimilation.
- Ramachandran plot analysis of plant proteins: significance in structural biology.
- Comparative structures of B-DNA, A-DNA, and Z-DNA: their biological relevance in plants.
- Biochemistry of cellulose synthase: mechanism and role in primary vs secondary cell wall formation.
- Phytochemical importance of secondary metabolites (flavonoids, alkaloids, steroids) in plant defense and medicine.

Student Choice and it may be conducted by parallel sections (DSE)
Major Electives-DSE-II
Medical Biochemistry

Program: M.Sc.,	Semester : III (2025-2026 Onwards)
Course Title: **Medical Biochemistry** Subject Code: 25MBC3E3	Class Time: As per the time table
Name of Course Teachers	Dr. M. Jeyakumar & Dr. M. Mamutha
Mobile: +91 96559 07058 & +91 91761 63179	E-mail:biotechjeya@gmail.com mamudha2014@gmail.com

Course Brief:

This course provides an in-depth understanding of the biochemical basis of human health and disease, with emphasis on the metabolic pathways of carbohydrates, lipids, proteins, nucleic acids, and their associated disorders. It highlights the biochemical basis of inborn errors of metabolism, enzymopathies, and immunological disorders while connecting theoretical principles with clinical manifestations. The course equips students with knowledge of diagnostic biochemical parameters, pathological conditions, and the role

of biomolecules in maintaining homeostasis.

Teaching methods: The course will be based on the following teaching and learning activities:

- Lectures covering the theoretical part using PowerPoint presentations
- Case studies
- Review questions

Attendance: A student's academic performance and opportunity to gain knowledge largely depend on regular class attendance. According to university norms, maintaining at least 70–75% attendance is essential to be eligible to appear for the end-semester examinations.

Punctuality: Punctuality is one of the essential qualities that students must follow and maintain to achieve greater success. Students are required to arrive in class on time without any delay. Only important reasons such as personal or medical emergencies will be accepted as valid excuses. Otherwise, the student will be marked absent.

Class Participation: Classroom participation is important because learning is not just between the student and the teacher, but part of the whole classroom experience which involves questioning, inquiring and exchanging ideas. When students participate, they learn from each other and internalize the knowledge better.

Submission of Assignment: Assignments are an important part of the learning process, designed to help students apply the concepts and knowledge acquired during the course. Each student will receive two assignments that together cover the full syllabus. The course instructor will assign specific topics for each. Completing these assignments with proper effort and understanding will greatly benefit students in preparing for their final examinations.

Presentation of Seminar: Students are supposed to give an oral presentation during the class seminar hours in their assigned topic. Students will discuss on recent research finding related to the topic and participants are encouraged to ask valid questions. Seminars help the students to be updated in their course. In addition students will be able to learn their mistakes and can improve their communication skills during seminar presentation.

Preparedness: Students are expected to have read and be able to discuss the assigned chapter before attending the lecture. In addition, students should be prepared to discuss homework problems.

Academic Dishonesty: Academic dishonesty includes giving, receiving, or using unconstitutional support on any academic work. This includes a person who has taken a test discussing what was on a test with a person who has not taken the test. A clear indication of academic dishonesty will result in a grade of “F”

being assigned to that particular piece of work.

Subject to change clause: Depending upon the requirement of student's possibility, the course syllabus will be re-structured and updated accordingly at the discretion of the Professor(s) and Board of studies chairperson.

Important dates: Please note down the important dates and stick to the schedule.

CIA Test I	CIA Test II	Assignment	Seminar
As per Academic Calendar		After CIA Test-I	

Course Outline:

- **Carbohydrate Metabolism Disorders** – Overview of carbohydrate metabolism, hypo- and hyperglycemia, renal threshold, glycosuria, obesity, galactosemia, glucose tolerance test, diabetes mellitus, and inborn errors of carbohydrate metabolism.
- **Lipid Metabolism Disorders** – Lipid metabolism overview, hypo- and hyperlipoproteinemias, disorders of triglycerides, phospholipids, and cholesterol metabolism, steatorrhea, and inborn errors of lipid metabolism.
- **Amino Acid and Protein Metabolism Disorders** – Overview of amino acid and protein metabolism, starvation metabolism, γ-globulinemia, proteinuria, urea, uric acid, creatinine, ammonia metabolism, disorders like uremia, urecemia, porphyria, and mineral metabolism abnormalities (anemia, Cushing's syndrome).
- **Nucleic Acid Metabolism Disorders** – Purine and pyrimidine metabolism, gout, Lesch-Nyhan syndrome, orotic aciduria, xanthinuria, and biosynthesis of nucleotides.
- **Immunological Disorders** – Disorders of immunoglobulin synthesis, allergy and hypersensitivity, autoimmune diseases including SLE, rheumatoid arthritis, psoriasis, and multiple sclerosis.

Semester-III					
DSE-II	**Course Code 25MBC3E3**	**Medical Biochemistry (K1-K5)**	**T**	**Credits: 3**	**Hours :3**
UNIT - I					
Objective -1	Understand the structure, nomenclature, functions and importance of Biomolecules				
Disorders of carbohydrate metabolism-overview of carbohydrate metabolism, Sugar level in normal blood – Hypo and Hyperglycemia, Renal threshold, Glycosuria, Obesity and Galactosemia, Glucose tolerance test. Diabetes mellitus. Inborn errors of carbohydrate metabolism.					
Outcome -1	Acquire knowledge on the biomolecules and their importance in normal functioning of living organisms.				
UNIT – II					
Objective -2	Learn the elements of enzyme structure that explains their substrate specificity and catalytic activity.				

Disorders of lipid metabolism, overview of lipid metabolism, Hypo and Hyper lipoproteniemias, disorders of triglycerides, Phospholipids and Cholesterol metabolism. Steatorrhea. Inborn errors of lipid metabolism.	
Outcome - 2	Gain information the metabolic pathways linked with pathological Conditions.
UNIT – III	
Objective -3	Outline the sequence of reactions in anaerobic metabolism.
Disorders of amino acid and protein metabolism-overview of amino acids and protein metabolism, Amino acid metabolism in starvation, Disorders of plasma protein – γ-globulinemia, proteinuria. urea, uric acid, creatinine, ammonia. Uremia, Urecemia and Porphyria. Inborn errors of amino acid metabolism. Mineral metabolism-anaemia, cushings syndrome	
Outcome -3	Get comprehensive and concise overview of the metabolic disorders
UNIT – IV	
Objective -4	Describe the regulatory role of hormones and basis of innate and adoptive immune response.
Disorders of nucleic acid metabolism, overview of purine and pyrimidine metabolism, Gout, Lesch-Nhyan syndrome, orotic aciduria and xanthinuria. Biosynthesis of nucleotides	
Outcome -4	Understand the role of platelets in hemostasis and thrombosis and basis of immune response.
UNIT-V	
Objective -5	Acquire knowledge on the allergic reactions and causes for allergy.
Immunological disorders-disorders of immunoglobulin synthesis, allergy and hypersensitivity, autoimmune diseases-SLE, rheumatoid arthritis, psoriasis, multiple sclerosis.	
Outcome -5	Learn the auto immune diseases
Suggested Readings: Baynes, J.W. & Dominiczak, M.H. (2019). Medical Biochemistry (5th ed.). Harvey, R. A., & Ferrier, D. R. (2011). Lippincott's illustrated reviews: Biochemistry (7th ed.). Wolters Kluwer India Pvt. Ltd. Voet, D., & Voet, J. G. (2011). Biochemistry, 4-th Edition. NewYork: John Wiley& SonsInc, 492. Denise R Ferrier (2017). Lippincott's Illustrated Reviews Biochemistry (7th ed.). Robert K. Murray and Daryl K. Granner and Peter A. Mayes and Victor W. Rodwell. (2000). Harper‟s biochemistry , 25th edition Donald Voet and Judith G. Voet. (2008). Biochemistry 3rd edition David L. Nelson and Michael M. Cox, W.H. Freeman, (2004). Lehninger principles of biochemistry 5th edition.	
Online resources Biochemistry Books, Ebooks And Journals- https://www.us.elsevierhealth.com/medicine/biochemistry Medical Biochemistry - An Essential Textbook- https://www.thieme.in/Biochemistry-Medical-Biochemistry-An-Essential-Textbook-Panini Textbook of Medical Biochemistry- https://books.google.co.in/books/about/Textbook_of_Medical_Biochemistry.html?id=BVpDI7n2M9gC& redir_esc=y	

Course Outcome	K1	K2	K3	K4	K5	K6
CO1	✓	✓	✓	✓	✓	-
CO2	✓	✓	✓	✓	✓	-
CO3	✓	✓	✓	✓	✓	-
CO4	✓	✓	✓	✓	✓	-
CO5	✓	✓	✓	✓	✓	-
K1-Remember	*K2-Understand*	*K3-Apply*	*K4-Analyze*	*K5-Evaluate*	*K6-Create*	
Course designed by: Dr. M. Jeyakumar & Dr. M. Mamutha						

Course Outcome VS Programme Outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	2	2	3	1	-	3	-	3	3	3
CO2	2	3	3	1	1	3	1	3	3	3
CO3	2	3	3	2	-	3	-	3	3	3
CO4	2	3	3	2	1	3	1	3	3	3
CO5	2	3	3	2	2	3	1	3	3	3
W.AV	2	2.8	3	1.6	0.8	3	0.6	3	3	3

POs vs COs Interpretation

PO	Weighted Average	Interpretation
PO1	2.0	Moderately aligned.
PO2	2.8	Moderately aligned.
PO3	3.0	Strongly aligned with all COs
PO4	1.6	Low alignment
PO5	0.8	Low alignment
PO6	3.0	Strongly aligned with all COs
PO7	0.6	Low alignment
PO8	3.0	Strongly aligned with all COs
PO9	3.0	Strongly aligned with all COs
PO10	3.0	Strongly aligned with all COs

Assignment topics:

1. Comparative analysis of hypo- and hyperglycemia: biochemical and clinical perspectives.
2. The role of glucose tolerance test in the diagnosis of diabetes mellitus.
3. Inborn errors of carbohydrate metabolism with case study examples.
4. Hyperlipoproteinemias: biochemical basis and clinical classification.
5. Steatorrhea: causes, biochemical abnormalities, and diagnostic tests.

6. Uremia and urecemia: metabolic dysfunctions and clinical implications.
7. Porphyrias: classification, biochemical basis, and symptoms.
8. Gout and Lesch-Nyhan syndrome: purine metabolism defects and clinical outcomes.
9. Immunoglobulin synthesis disorders and their role in immunodeficiency.
10. Autoimmune diseases (SLE, rheumatoid arthritis, psoriasis, multiple sclerosis): biochemical basis and pathological mechanisms.

Student Choice and it may be conducted by parallel sections (DSE)

Major Electives-DSE-II

Nanotechnology and Advanced drug delivery system

Program: M.Sc.,	Semester: III (2025-2026 Onwards)
Course Title: **Nanotechnology andAdvanced drug delivery system** Subject Code: 25MBC3E4	Class Time: As per Time Table
Name of the Course Teacher	Dr. P. Boomi
Mobile: +91 – 9486031423	Email: boomip@alagappauniversity.ac.in

Course Brief:

Nanomedicine deals with the development and application of materials and devices to study biological processes and to treat disease at the level of single molecules and atoms. This exciting new field of nanotechnology and medicine is offering unique capabilities in disease diagnosis and management. This course also offers a survey of timely concepts in the rapidly emerging nanomedicine. The vision of combining diagnostics and therapeutics,now being referred to as theranostics is the area of recent research. Currently, the main use of nanoparticle medicinal products (NMP) is their conjugation or/and encapsulation with several active biomolecules for therapeutic or/and diagnostic purposes, since theycan be used as drug carriers for chemotherapeutics to deliver medication directly to the tumor while sparing healthy tissue. This course will emphasize emerging nanotechnologies and biomedical applications including nanomaterials, nanoengineering and nanotechnology based drug delivery systems, nano-based imaging and diagnostic systems, nanotoxicology and translating nanomedicines into clinical investigation.

Teaching Methods: The course will be based on the following teaching and learning activities:

- Lectures covering the theoretical part using PowerPoint presentations
- Case studies
- Review questions

Attendance: Regular attendance is necessary for gaining academic success; hence the students are expected to attend all the classes. As per University norms, the students are qualified to write their end-semester examinations only if they have a minimum attendance of 75% in all the courses.

Punctuality: Punctuality is an important quality for the students to achieve success. Students arriving late to the class by 10 minutes without any valid reason will be markedabsent in the attendance record. Excuse will be provided for personal or medical emergency with prior approval by the Head of the Department

Class Participation: Classroom participation is important because learning is not just between the student and the teacher, but part of the whole classroom experience which involves questioning, inquiring and exchanging ideas. When students participate, they learn from each other and internalize the knowledge better.

Submission of Assignment: Assignments will help the students to apply the concepts which results in deeper understanding of the subject. Hence each student will be allocated two assignments for the course, covering the entire topic. Students will be provided deadline by the course instructor to submit the assignment. Proper preparation of assignment will help the students for final exams

Presentation of Seminar: Students are supposed to give an oral presentation during theclass seminar hours in their assigned topic. Students will discuss on recent research finding related to the topic and participants are encouraged to ask valid questions. Seminars help the students to be updated in their course. In addition students will be able to learn their mistakes and can improve their communication skills during seminar presentation

Preparedness: Prior to attending the class the students are expected to collect information regarding the topic given in advance, so that they will be able to discuss during the lecture.

Academic Dishonesty: Since the students are not aware of academic integrity, students must be clearly explained about plagiarism and the consequences of violation of copyright laws, so that academic dishonesty may be avoided.

Subject to change clause: Depending upon the requirement of student, the course syllabus and course schedule are subjective to minor changes, which will be informed to students

Important dates: Scheduled dates for the various activities related to the course

CIA Test I	**CIA Test II**	**Assignment**	**Seminar**
As per Academic Calendar		After CIA Test-I	

Course Outline: Nanotechnology and Advanced drug delivery system

1. Properties and technological advantages of nanomaterials.
2. Top down and Bottom up approaches for the synthesis of nanomaterials.
3. Characterization of the synthesized nanomaterials by spectroscopic analysis and microscopic observations.

4. Types of nanocarriers used in drug delivery and its physicochemical properties.
5. Targeted and Non-targeted drug delivery using nanocarriers.
6. Various strategies of surface modification of Nanoparticles to enhancebiocompatibility.
7. Role of Nanoparticles in diagnosis and imaging.
8. Fabrication of DNA and Protein based biosensor and its diagnostic application.
9. Theranostics nanomedicine for the treatment of cancer.
10. Nanotechnology application in the treatment of neurology, cardiology andopthamology.

More books for Reading and Referencing

Kewal K. Jain, "The Handbook of Nanomedicine", (2008), Publisher-Springer Science & Business Media, **ISBN: 1603273190, 9781603273190**
V. P. Torchilin, "Nano Particulates As Drugcarriers", (2006), Publisher-Imperial College Press, **ISBN: 186094907X, 9781860949074**
Ram B. Gupta and Uday B. Kompella "Nanoparticle Technology for Drug Delivery", (2006), Publisher-CRC Press, **ISBN: 0849374553, 9780849374555**
R. Khare, "Nanomedicine and Future drugs", (2015), **ISBN:9384568643, 9789384568641**
T. Pradeep, "A Textbook of Nanoscience and Nanotechnology", (2003), Publisher-Tata McGraw-Hill Education, **ISBN: 1259007324, 9781259007323**
Mansoor M. Amiji, "Nanotechnology for cancer therapy", (2006), Pubisher-CRC Press, **ISBN: 1420006630, 9781420006636**
Jeff W.M. Bulte and Michel M.J. Modo, "Nanoparticles in Biomedical ImagingEmerging Technologies and Applications", (2007), Publisher- Springer Science & Business Media, **ISBN: 0387720278, 9780387720272**

Semester-III					
DSE-II	**Course Code: 25MBC3E4**	**Nanotechnology and advanceddrug delivery system (K1-K5)**	**T**	**Credits:3**	**Hours:3**
UNIT – I					
Objective - 1	Provide students broad overview of the application of nanotechnology to medicine				
Basic concepts of Nano-science and technology: Properties and technological advantages of Nanomaterials -Quantum wire, Quantum well, Quantum dots and Carbon nanotubes: Synthesis – Top down and bottom up approaches; Characterization - Spectroscopic techniques and Microscopic observations.					
Outcome - 1	Comprehend the principles behind nanomedicine.				
UNIT – II					
Objective - 2	Impart knowledge on the role of biological and synthetic nanocarriers in drug delivery.				

Fundamentals and types of Nanocarriers: Types - Viral nanocarrriers, Polymeric nanocarrier, lipidnanocarrier, carbon nanostructures, dendrimers, silica nanoparticles, Microbes and antibody based nanocarriers; Physicochemical properties - Size, Surface, Magnetic and Optical Properties.	
Outcome - 2	Gain a broad understanding of concepts and applications ofnanomedicine.
UNIT – III	
Objective - 3	Understand the regulatory and ethical aspects on use of nanotechnology in clinical practice
Nanotechnology for Drug Targeting Drug targeting – Targeted (Microneedles, Micropumps, microvalves, Implantable microchips), non-targeted delivery, controlled drug release; Nanoparticle surface modification – bioconjugation, peglyation, antibodies cell- surface targeting; nanostructures for use as antibiotics, diseased tissue destruction using nanoparticles, drug encapsulation strategies.	
Outcome - 3	Impart the knowledge to apply these nano-drug delivery systems forthe diagnosis and therapy
UNIT – IV	
Objective - 4	Convey knowledge about drug delivery systems.
Nanotechnology for Imaging and Detection Fluorophores and Quantum dots - Labeling and functionalization, Image analysis, Imaging facilitating surgical approaches; Nanoparticles for bioanalytical applications – Biosensors - DNA and Protein based biosensors – materials for biosensor applications- fabrication of biosensors, BioMEMs; Use of nanoparticles for MRI, X Ray, Ultrasonography Drug Delivery; Nano devices.	
Outcome - 4	Understand the concepts of nanomedicine to a focused clinical area oftheir choice
UNIT-V	
Objective - 5	To acquire basic understanding of nanoparticles in Cancer Therapy
Nanomedicine: Nanotechnology in Cancer Therapy - Passive and Active Targeting Strategies in Cancer with a Focus on Nanotechnology Applications, Multifunctional Nanoparticles for Cancer Therapy - Neutron Capture Therapy of Cancer, nanoparticles and High Molecular Weight Boron Delivery Agents; Nanoneurology – Nanocardiology - Nano-Orthopedics - Nano-Ophthalmology.	
Outcome - 5	Understand the applications of nanosystems as platforms foradvanced Cancer Therapy

Suggested Readings:

Vo-Dinh Tuan (2015) "Nanotechnology in biology and medicine methods, devices and Applications"Second edition, CRC press, San Fransico.

V. Mishra, P. Kesharwani, M.C.I.M. Amin, A. Iyer (2017) "Nanotechnology-Based Approaches for Targetingand Delivery of Drugs and Genes" Academic Press, London.

D.P. Nikolelis, G.P. Nikoleli (2018) "Nanotechnology and Biosensors" Elseiver, Amsterdam.

S.S. Mohapatra, S. Ranjan, N. Dasgupta, R.K. Mishra (2019) "Nanocarriers for drug delivery, Nanoscienceand Nanotechnology in drug delivery", Elseiver, Amsterdam.

M. Slevin, (2012) "Current Advances in the medical application of nanotechnology", Manchester metropolitan university, Manchester, UK.

Applications of Nanomaterials", Atlantic Publishers & Distributors

W.M. Jeff Bulte, and Michel M.J. Modo, (2016) "Design and Applications of Nanoparticles in Biomedical Imaging", Springer.

P. Kumar, R. Srivastava, (2016) "Nanomedicine for Cancer Therapy: From Chemotherapeutic to Hyperthermia-Based Therapy", Springer.

B. Malhotra, Md. A. Ali, (2017), "Nanomaterials for Biosensors- Fundamentals and Applications", 1st Edition, Elsevier.

Online Recourse

1. http://www.nanomedicinecenter.com
2. https://nptel.ac.in/courses/118107015/module4/lecture7/lecture7.pdf
3. https://nptel.ac.in/courses/102107058/

Course Outcome	K1	K2	K3	K4	K5	K6
CO1	✓	✓	✓	✓	✓	
CO2	✓	✓	✓	✓	✓	
CO3	✓	✓	✓	✓	✓	
CO4	✓	✓	✓	✓	✓	
CO5	✓	✓	✓	✓	✓	

K1-Remember	*K2-Understand*	*K3-Apply*	*K4-Analyze*	*K5-Evaluate*	*K6-Create*

Course designed by: Dr.P. Boomi

Course Outcome VS Programme Outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	2	-	1	1	-	1	-	1	1	1
CO2	1	-	1	1	-	2	1	1	1	1
CO3	1	1	1	1	1	1	1	1	1	1
CO4	1	1	-	1	-	1	-	1	1	1
CO5	1	1	-	1	-	1	1	1	1	1
W.AV	1.2	0.6	0.6	1	0.2	1.2	0.6	1	1	1

S –Strong (3), M-Medium (2), L- Low (1)

POs vs COs Interpretation

PO	Weighted Average	Interpretation
PO1	1.2	Low alignment
PO2	0.6	Low alignment
PO3	0.6	Low alignment
PO4	1.0	Low alignment
PO5	0.2	Low alignment
PO6	1.2	Low alignment
PO7	0.6	Low alignment
PO8	1.0	Low alignment
PO9	1.0	Low alignment
PO10	1.0	Low alignment

Assignment I Nanotechnology and Advanced drug delivery system

1. Discuss in detail the top down and Bottom up approach of synthesis ofNanomaterials.
2. Give an account on synthesis, properties and biomedical application of quantumdots.
3. Explain in detail the various spectroscopic techniques used for thecharacterization of metal nanoparticles with suitable example.
4. Elaborate in detail the sample preparation and working principle behind thecharacterization of nanoparticles using TEM with a neat sketch.
5. Describe in detail principle and instrumentation of XRD technique and its application in the characterization of metal and metal oxide nanoparticles.
6. Elaborate in detail the types and application of polymeric nanocarriers intargeted drug delivery.
7. Explain in detail about viral nanocarriers and its application.
8. Discuss in detail the about functionalization and pharmacological application ofcarbon nanotubes.
9. Give an account on microbial nanocarriers and its application in the treatment ofcancer.
10. Discuss in detail the various methods of surface modification of mesoporoussilica nanoparticles for cancer therapy.

Assignment II Nanotechnology and Advanced drug delivery system

1. Discuss in detail about physiochemical properties of drug molecule influencing the design and performance of sustained release drug delivery system.
2. Explain with examples biodegradable and non-biodegradable polymers used forcontrolled drug delivery system.
3. Give an account of approaches and applications of implantable drug deliverysystems.
4. Describe in detail the active and passive targeting in drug delivery.
5. Elaborate in detail the surface modification techniques to enhance thebiocompatibility of drug.
6. Discuss in detail about liposomal drug delivery system in drug targeting to aspecific site.
7. Discuss in detail the role of Quantum dots in live cell imaging and diagnostics.
8. Describe in detail the principle and application of DNA and Protein basedbiosensors.

9. Discuss about the theragnostic application and targeted drug delivery ofnanoparticle for the treatment of cancer.
10. Elaborate in detail the role of nanomaterials in the field of orthopedics as boneimplants and for the treatment of joint injuries involving cartilage.

Student Choice and it may be conducted by parallel sections (DSE)

Major Electives-DSE-III

Pharmaceutical Biochemistry

Program: M.Sc.,	Semester : IV (2025-2026 Onwards)
Course Title: **Pharmaceutical Biochemistry** Subject Code: 25MBC4E1	Class Time: As per the time table
Name of Course Teachers	Dr. M. Jeyakumar & Dr. M. Mamutha
Mobile: +91 96559 07058 & +91 91761 63179	E-mail:biotechjeya@gmail.com mamudha2014@gmail.com

Course Brief:

This course provides a foundational and advanced understanding of pharmacological principles, including drug action, metabolism, and pharmacokinetics. It delves into chemical structures and therapeutic mechanisms of various drug classes, the science of rational drug design through computational tools, and explores the growing field of biopharmaceuticals and nanomedicine. Emphasis is placed on integrating biochemistry with drug discovery and delivery to support the design and evaluation of effective therapeutic agents.

Teaching methods: The teaching includes lectures, discussions, demonstrations, concept maps and models, self-study and question times and an integrating project work. The project work is in-depth studies in groups with an emphasis on own work and literature studies. The course is completed with a written final examination.

Attendance: A student's academic performance and opportunity to gain knowledge largely depend on regular class attendance. According to university norms, maintaining at least 70–75% attendance is essential to be eligible to appear for the end-semester examinations.

Punctuality: Being punctual is a key habit that helps students reach important goals in their academic journey. Students must arrive on time for every class without unnecessary delays. Absences will only be excused for valid reasons such as personal or medical emergencies. In all other cases, late arrivals will be marked as absent.

Class Participation: Class participation and interaction helps to form a complete educational experience. However, class participation and interaction is to be relevant to course content and context. Deviant behavior may lead to dismissal or suspension.

Submission of Assignment: Assignments are given to the students to help them to apply the concepts and knowledge gained by the course. Each students will be assigned two assignments for the course, covering entire syllabus. Topic of assignments for each assignments will be assigned by the course instructor. Good preparation of assignment will help the students for their final exams.

Presentation of Seminar: Beyond regular assignments, students are expected to deliver an oral presentation during seminar sessions on a topic assigned by the instructor. These seminars aim to improve students' public speaking and communication skills. Active participation from classmates through relevant questions will be encouraged to foster engagement and build confidence. This interactive setting also helps students broaden their understanding and stay current with key concepts in the course.

Preparedness: Prior to attending the class the students are expected to collect information regarding the topic given in advance, so that they will be able to discuss during the lecture.

Academic Dishonesty: Academic dishonesty is a serious violation of ethical conduct and is not tolerated under any circumstances. To promote academic integrity, faculty members proactively educate students about common forms of misconduct such as plagiarism, copyright infringement, and unauthorized use of patented material. By understanding these issues and their consequences, students are better equipped to act responsibly and uphold honesty throughout their academic journey.

Subject to change clause: Depending upon the requirement of student's possibility, the course syllabus will be re-structured and updated accordingly at the discretion of the Professor(s) and Board of studies chairperson.

Important dates: Please note down the important dates and stick to the schedule

CIA Test I	**CIA Test II**	**Assignment**	**Seminar**
As per Academic Calendar		After CIA Test-I	

Course Outline:

- Learn sources, classification, and routes of drug administration along with receptor interactions, ED50, LD50, and drug response curves.
- Understand the ADME process, first-pass metabolism, and factors affecting drug stability and bioavailability, including enzyme interactions.

- Explore the chemistry and mechanism of antibiotics, antivirals, anticancer, CNS, and cardiovascular drugs.
- Analyze structure-based drug design, molecular docking, QSAR, high-throughput screening, and CADD tools in pharmaceutical research.
- Study the development of monoclonal antibodies, gene/RNA therapies, and nanocarrier-based drug delivery systems like liposomes and polymers

IV- Semester					
DSE-3	**Course Code : 25MBC4E1**	**Pharmaceutical Biochemistry (K1-K5)**	**T**	**Credits: 3**	**Hours: 3**
UNIT-I					
Objective -1	To introduce the foundational concepts of pharmacology, drug classifications, routes of administration, mechanisms of action, and dose-response relationships.				
General Pharmacology: Introduction to pharmacology, sources of drugs, Classification of drugs based on sources, dosage forms, route of administration, site of action of drugs. Mechanism of action, concept of receptors, combined effect of drugs, factors modifying drug action. Dose response curve- ED50 and LD50.					
Outcome - 1	Students will recall drug classifications, identify pharmacological terms, and interpret dose-response data (ED50, LD50).				
UNIT-II					
Objective - 2	To analyze the pharmacokinetics of drug absorption, metabolism, and bioavailability, including enzyme interactions and first-pass metabolism.				
Drug Action and Pharmacokinetics: Mechanisms of drug action, drug absorption, distribution, metabolism, and excretion (ADME), enzyme inhibition and activation, factors affecting drug metabolism, first-pass metabolism, and bioavailability. Discussion on prodrugs and drug stability.					
Outcome - 2	Students will analyze ADME processes and predict factors affecting drug metabolism and therapeutic efficiency.				
UNIT-III					
Objective - 3	To examine the chemical structure, mechanism, and therapeutic applications of various drug classes, including antibiotics, antivirals, and CNS agents.				
Chemistry of Therapeutic Agents: Chemical properties, synthesis, and mechanism of action of major classes of drugs, including antibiotics (penicillins, cephalosporins, macrolides), anticancer agents, antiviral drugs, cardiovascular drugs (beta-blockers, calcium channel blockers), and central nervous system (CNS) drugs (sedatives, anesthetics, antidepressants).					
Outcome - 3	Students will explain the mode of action and structural features of key therapeutic drugs across major disease categories.				
UNIT-IV					
Objective - 4	To understand modern drug design principles using computational and combinatorial approaches for discovering new therapeutics.				
Drug Design and Development: Principles of rational drug design, structure-based drug design, combinatorial chemistry in drug discovery, computer-aided drug design (CADD), role of bioinformatics in drug discovery, high-throughput screening, and molecular docking studies.					

Outcome - 4	Students will evaluate drug discovery tools including molecular docking, QSAR, and CADD strategies for rational drug design
UNIT-V	
Objective - 5	To explore the role of biotechnology and nanotechnology in advanced drug delivery systems and RNA/gene-based therapies.

Biopharmaceuticals and Nanomedicine: Introduction to biopharmaceuticals, peptide and protein drugs, monoclonal antibodies, vaccines, gene therapy, and RNA-based therapeutics. Applications of nanotechnology in drug delivery, nanocarriers, liposomes, and polymer-based drug delivery systems.

Outcome - 5	Students will assess biopharmaceutical innovations and propose nanocarrier models for efficient drug delivery.

Suggested Readings

Reference Books

Foye, W. O., Lemke, T. L., & Williams, D. A. (2013). Foye's Principles of Medicinal Chemistry. Lippincott Williams & Wilkins.

Patrick, G. L. (2017). An Introduction to Medicinal Chemistry. Oxford University Press.

Silverman, R. B. (2012). The Organic Chemistry of Drug Design and Drug Action. Academic Press.

Thomas, G. (2003). Fundamentals of Medicinal Chemistry. Wiley-Blackwell.

Brahmachari, G. (2013). Chemistry and Pharmacology of Naturally Occurring Bioactive Compounds. CRC Press.

Textbooks

Wilson, C. O., & Gisvold, O. (2011). Textbook of Organic Medicinal and Pharmaceutical Chemistry. Lippincott Williams & Wilkins.

Katzung, B. G. (2021). Basic & Clinical Pharmacology. McGraw-Hill.

Online Resources

DrugBank (https://www.drugbank.ca/).

PubChem (https://pubchem.ncbi.nlm.nih.gov/).

FDA Drug Development and Approval Process (https://www.fda.gov/).

European Medicines Agency (https://www.ema.europa.eu/).

Molecular Modeling and Drug Design Resources (https://www.rcsb.org/).

Course Outcome	K1	K2	K3	K4	K5	K6
CO1	✓	✓	✓	✓	✓	-
CO2	✓	✓	✓	✓	✓	-
CO3	✓	✓	✓	✓	✓	-
CO4	✓	✓	✓	✓	✓	-
CO5	✓	✓	✓	✓	✓	-

K1-Remember	*K2-Understand*	*K3- Apply*	*K4-Analyze*	*K5-Evaluate*	*K6-Create*

Course designed by: Dr. M. Jeyakumar & Dr. M. Mamutha

Course outcome Vs Programme outcome

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	3	3	3	3	2	2	2	3	2
CO2	3	3	3	3	3	2	2	1	3	2
CO3	3	3	3	3	3	2	2	2	2	2
CO4	3	3	3	3	3	3	2	2	2	2
CO5	3	3	3	3	3	2	2	3	1	2
W.AV	3	3	3	3	3	2.2	2	2	2.2	2

S-Strong (3) M-Medium (2) L-Low (1)

POs vs COs Interpretation

PO	Weighted Average	Interpretation
PO1	3.0	Strongly aligned with all COs
PO2	3.0	Strongly aligned with all COs
PO3	3.0	Strongly aligned with all COs
PO4	3.0	Strongly aligned with all COs
PO5	3.0	Strongly aligned with all COs
PO6	2.2	Moderately supported
PO7	2.0	Moderately supported
PO8	2	Moderately supported
PO9	2.2	Moderately supported
PO10	2.0	Moderately supported

Assignment topics:

- Explain the concept of ED50 and LD50 with dose-response curve interpretation.
- Discuss the ADME process with examples of drugs influenced by first-pass metabolism.
- Describe the mechanisms of action and clinical uses of penicillins and cephalosporins.
- Compare beta-blockers and calcium channel blockers in cardiovascular therapy.
- Review the role of enzyme inhibition in drug metabolism and therapeutic applications.
- Write a report on molecular docking and its application in identifying drug candidates.
- Discuss the principles and strategies of structure-based drug design (SBDD).
- Evaluate RNA-based therapeutics and their role in personalized medicine.
- Illustrate the use of nanotechnology in drug delivery systems with recent examples.
- Critically analyze the role of gene therapy in treating genetic disorders.

Student Choice and it may be conducted by parallel sections (DSE)

Major Electives-DSE-III

Genomics and Proteomics

Program: M.Sc.,	Semester: IV (2025-2026 Onwards)
Course Title: **Genomics and Proteomics** Subject Code: 25MBC4E2	Class Time: As per Time Table
Name of Course Teachers	Dr. M. Jeyakumar & Dr. M. Mamutha
Mobile: +91 96559 07058 & +91 91761 63179	E-mail:biotechjeya@gmail.com mamudha2014@gmail.com

Course Brief:

This course offers an in-depth understanding of **genomics** and **proteomics**, the two most rapidly advancing disciplines in modern biology. It explores the structure and organization of genomes and proteomes, the technologies used to analyze them, and the powerful computational and bioinformatics tools enabling their interpretation. The course bridges biological sciences with information technologies to interpret biological function, evolution, and disease mechanisms at the molecular level.

Teaching Methods: The mode of teaching of delivering the courses are as followsthrough these below mentioned methodologies:

- Delivering the lectures in the form of presentation using advanced technologiesdevices such as smart board.
- Video-conferencing for lectures that will be sought from experts belonging tooverseas reputed institutions
- Case-studies and Review questions

Attendance: Having good attendance record marks, the student's sincerity and has an overall positive impact on his/her personality trait development. The students are asked to attend the classes on a regular note and those having a minimum scale of 70-75% attendance are eligible to take up the end-semester examinations as per the University norms.

Punctuality: It is the most important attribute to be followed and maintained by the student throughout his/her life which for sure will lead to the path of success. Students who arrive late by 10mins after the attendance has been taken will be marked absent unless there is a valid reason (medical/ personal emergency) at the discretion of the Head of the Department.

Class Participation: A student's overall growth and personality development is based on his/her involvement in the class not just by mere presence but rather being interactive through questioning that will lead to propagation of ideas, initiation of thought-provoking process and much more that will provide a wholesome enriched classroom experience. Therefore, students are advised to be more attentive so that they learn from one another and develop quality-based knowledge.

Submission of Assignment: Assignments are given to students with just one motive toget more quantitative and qualitative knowledge insights into the assigned topic/chapter that will lead to

preparation and completion of the assignment in a constructive manner here just the knowledge provided is not merely counted but also completion prior to proposed deadline will also have a check on the student's serious consideration of the assignments.

Presentation of Seminar: Apart from the assignments the concerned instructors also allocate the students with a topic or based on their interests to present seminar that will aid them built their confidence levels, command over English language to communicate with precision and fluently. In addition, the fellow students are encouraged to pose questions that will instigate interest and provide update in that particular topic besidesthe information presented helping them to prepare for their examinations that can be taken as added advantage for the students.

Preparedness: At the end of every class, the concerned instructor tells the students what will be taken in the next class using these details the students should be aware of the topics that will be covered in the upcoming lectures which actually enhance the student's capability to grasp the knowledge and concepts provided much efficiently.

Academic Dishonesty: This is an important aspect that every student should be aware of.Thus, the respective faculty members educate the students of possible means of academic malpractices (plagiarism, violation of copyrights and stealing the patented knowledge) and the following consequences that will make them more vigilant in their academiccareer.

Subject to change clause: Based on the requirement of student's feasibility and meetingthe competitive demands of the discipline the syllabus courses will be re-structured and updated accordingly at the discretion of the Professor(s) and Board of studies chairman.

Important dates: Please note down the important dates and stick to the schedule

CIA Test I	II CIA Test	Assignment	Seminar
As per Academic Calendar		After CIA Test-I	

Course Outline: Core: Genomics and Proteomics

- Understand the fundamental concepts of genomics and proteomics, including genome organization, gene structure, protein classification, and how these are applied to gain insights in biology, medicine, and healthcare. Concepts and Analysis of Genomics and Proteomics.
- Analyze the principles of comparative and functional genomics such as gene editing, gene duplication, mutations, genome evolution, gene expression profiling, and the role of major genome projects in medical research. Fundamental concepts of techniques used in the proteomics and genomics.
- Recall and describe basic and advanced proteomics methods including protein extraction, post-translational modifications, protein separation techniques, and protein sequence annotation.
- Apply genomic and proteomic techniques such as PCR, electrophoresis, sequencing, western blotting, and spectroscopy for the analysis of nucleic acids and proteins.
- Utilize bioinformatics tools and databases in translational research to interpret genomic and proteomic data for applications such as gene therapy, molecular medicine, and protein interaction networks.

Semester - IV					
DSC-III	**Course Code 25MBC4E2**	**Genomics and Proteomics (K1-K5)**	**T**	**Credits: 3**	**Hours: 3**

Unit - I	
Objective -1	To understand concepts of how genomic data are being used to provide new insights throughout biology and medicine To learn the fundamental concepts of proteomics and its applications
Introduction to Genomics and Proteomics: Introduction – Organization and structure of genomes, Genome size, Sequence complexity, Introns and Exons, Genome structure in viruses and prokaryotes, Eukaryotes, Isolation of Chromosomes, chromosome micro dissection, Retrofitting. Introduction to Proteomics- Protein Geometry - Amino Acid Classification & Properties, Protein sequence information, Composition and Properties, Physiochemical properties based on sequence, Sequence comparison , Protein Structure Classification, Structural conformation of proteins, Mining proteomes	
Outcome - 1	Understand the basic concepts of genomics and proteomics, and how they are applied to gain insights in biology, medicine, and healthcare.
Unit - II	
Objective-2	To understand the key concept of comparative and functional genomics
Concepts and Analysis of Genomics: Orthologs & Paralogs, Molecular Clock, Horizontal Gene Transfer, Gene and genome duplication, Gene Loss, Gene editing and gene therapy Gene interaction, Suppressor and enhancer, Gene Ontology, Gene silencing, Gene expression profiling, SNPs, Mutations, Human genome project and its applications, 1000 genome project, Hapmap project, Evolution of genome, Gene and Annotations, Genome Mapping	
Outcome - 2	To gain knowledge about the fundamental genomic concepts
Unit - III	
Objective - 3	To understand the concept of various methods protein
Concepts and Analysis of Proteomics: Protein Extraction, Physical & Chemical Methods, Isoelectric Focusing, Protein sequence annotations – Post translational modification (PTMs), Protein Characterization- Centrifugation, Chromatography & Electrophoresis - Principle, Instrumentation	
Outcome - 3	Gain an insight of the basic and advanced concepts and applications of proteomics
Unit - IV	
Objective - 4	Apply functional genomics techniques to analyze proteome and genomics.
Techniques of Genomics and Proteomics: Polymerase Chain Reaction (PCR), Gel Electrophoresis, Sanger Sequencing, Next generation Sequencing (NGS) -DNA &RNA, Types & Application PAGE & SDS PAGE, Western Blot, Mass Spectroscopy, X- Ray Diffraction, NMR - Electron Microscopy, Atomic Force Microscopy, Principle, Instrumentation, Types & Application Single-cell omics (Single-cell genomics, Single-cell transcriptomics, Single-cell epigenomics, Single-cell proteomics, Single-cell metabolomics)	
Outcome - 4	To understand and able to apply techniques of proteomic and genomic
Unit - V	

Objective - 5	To impart knowledge on the bioinformatics driven applications of genomics and proteomics.

Translational genomics & proteomics: Bioinformatics applications, Molecular medicine: Antisense therapy, Peptide vaccines, Gene Therapy, Stem cell Therapy, Sequence databases: GeneBank, EMBL Nucleotide sequence databank, DNA Data Bank of Japan (DDBJ), dbSNP, Clinvar, SNPs- Polypen-2, Panther, Protein arrays: bioinformatics-based tools for analysis of proteomics data (Tools available at ExPASy Proteomics server); databases (such as InterPro) and analysis tools. Protein-protein interactions: databases such as DIP, string server and tools for analysis of protein-protein interactions, Pathway and network analysis

Outcome - 5	Summarize the details about applications of the genomics and proteomics softwares.

Suggested Readings:

S. B. Primrose and R.M. Twyman - Principles of Genome Analysis and Genomics, 7 th Edition, Blackwell Publishing, 2006.

Principles of Genome Analysis & Genomics, S. B. Primrose & R.M. Twyman, 3rd edition, 2003, Blackwell Publishing.

Genomes, T. A. Brown, 5th Edition,(2023) CRC Press.

Analysis of Genes & Genomes by Richard J. Reece John Wiley & Sons (2nd Ed)(2023)

Introduction to Genomics, Arthur M. Lesk, 2017, Oxford University Press

Introduction to Proteomics – Tools for the new biology (1st Ed.) by Liebler, D.C., Humana Press Inc., New Jersey, USA. 2002

Bioinformatics and Functional Genomics by Pevsner, J., John Wiley and Sons, New Jersey, USA. (3rd Ed.), 2015

Principles of Proteomics. R.M Twyman (2nd Ed)(2013). (BIOS Scientific publishers). ISBN-978-0-8153-4472

Discovering Genomics, Proteomics and Bioinformatics, 2nd Edition. Campbell AM & Heyer LJ, Benjamin Cummings 2007; CSH Press, NY. ISBN-10: 8131715590

Proteomics in Practice: A Guide to Successful Experimental Design, 2nd, Completely Revised Edition - Reiner Westermeier, Tom Naven, H, Hans-rudolf Pker (2008).

Mount, D. (2004) "Bioinformatics: Sequence and Genome Analysis"; Cold Spring Harbor Laboratory Press, New York.

Baxevanis, A.D. and Francis Ouellellette, B.F., (2009). "Bioinformatics- a Practical Guide to the Analysis of Genes and Proteins" 4th Edition, Wiley India.

Online Resources:

1. https://shop.elsevier.com/books/horizontal-gene-transfer/syvanen/978-0-12-409511-3

Course Outcome	K1	K2	K3	K4	K5	K6
CO1	✓	✓	✓	✓	✓	
CO2	✓	✓	✓	✓	✓	
CO3	✓	✓	✓	✓	✓	
CO4	✓	✓	✓	✓	✓	
CO5	✓	✓	✓	✓	✓	

K1-Remember	*K2-Understand*	*K3-Apply*	*K4-Analyze*	*K5-Evaluate*	*K6-Create*

Course designed by:Dr. M. Jeyakuar & Dr. M. Mamutha

Course Outcome VS Programme Outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	3	3	-	1	-	-	3	1	1
CO2	3	3	2	3	3	3	3	3	1	3
CO3	3	3	3	2	3	3	1	-	1	2
CO4	3	3	3	3	2	3	2	3	1	3
CO5	3	3	3	3	2	3	3	3	1	3
W.AV	3	3	2.8	2.2	2.2	2.4	1.8	2.4	1	2.4

S-Strong (3), M-Medium (2), L-Low (1)

POs vs COs Interpretation

PO	Weighted Average	Interpretation
PO1	3.0	Strongly aligned with all COs
PO2	3.0	Strongly aligned with all COs
PO3	2.8	Moderately supported
PO4	2.2	Moderately supported
PO5	2.2	Moderately supported
PO6	2.4	Moderately supported
PO7	1.8	Low alignment
PO8	2.4	Moderately supported
PO9	1.0	Low alignment
PO10	2.4	Moderately supported

Assignment & Seminar

1. Comparative Analysis of Genome Structure across Viruses, Prokaryotes, and Eukaryotes
2. Functional Genomics and the Role of Gene Expression Profiling in Disease Diagnosis
3. Genome Editing Technologies: CRISPR-Cas Systems and Their Applications in Therapeutics
4. Mining Proteomes: Tools and Techniques for Protein Structure and Function Analysis
5. Human Genome Project and 1000 Genomes Project: Achievements and Implications
6. Comparative Proteomics: Techniques and Applications in Biomedical Research
7. Single-Cell Omics: A New Frontier in Personalized Medicine.
8. Horizontal Gene Transfer and Its Evolutionary Significance.
9. Post-Translational Modifications (PTMs) and Their Role in Protein Function.
10. Bioinformatics Applications in Genomics and Proteomics: Current Tools and Future Trends.

Student Choice and it may be conducted by parallel sections (DSE)
Major Electives-DSE-III
Cell Communication and Cell Signaling

Program: M.Sc.,	Semester: IV (2025-2026 Onwards)
Course Title and Code: **Cell Communication and Cell Signaling** Subject Code: 25MBC4E3	Class Time: As per Time Table
Name of Course Teachers	Dr. M. Jeyakumar & Dr. M. Mamutha
Mobile: +91 96559 07058 & +91 91761 63179	E-mail:biotechjeya@gmail.com mamudha2014@gmail.com

Course Brief:

Cell communication and cell biology course deals with the molecular biology of cell signaling. The students will gain an insight into the fundamental processes of the cell to cell communication and signaling uptake of molecules by membrane receptors, including membrane-protein and protein-protein interactions, and their associated effectors. Students will learn about Morphogenesis and organogenesis. The second half of lectures will deal with cell cycle signaling system and cell death.

Teaching Methods: The mode of teaching of delivering the courses are as followsthrough these below mentioned methodologies:

- Delivering the lectures in the form of presentation using advanced technologies devices such as smart board.
- Video-conferencing for lectures that will be sought from experts belonging to overseas reputed institutions

Attendance: Having good attendance record marks the student's sincerity and has an overall positive impact on his/her personality trait development. The students are asked

to attend the classes on a regular note and those having a minimum scale of 70-75% attendance are eligible to take up the end-semester examinations as per the University norms.

Punctuality: It is the most important attribute to be followed and maintained by the student throughout his/her life which for sure will lead to the path of success. Students who arrive late by 10mins after the attendance has been taken will be marked absent unless there is a valid reason (medical/ personal emergency) at the discretion of the Head of the Department.

Class Participation: A student's overall growth and personality development is based on his/her involvement in the class not just by mere presence but rather being interactive through questioning that will lead to propagation of ideas, initiation of thought-provoking process and much more that will provide a wholesome enriched classroom experience. Therefore, students are advised to be more attentive so that they learn from one another and develop quality-based knowledge.

Submission of Assignment: Assignments are given to students with just one motive to get more quantitative and qualitative knowledge insights into the assigned topic/chapter that will lead to preparation and completion of the assignment in a constructive manner here just the knowledge provided is not merely counted but also completion prior to proposed deadline will also have a check on the student's serious consideration of the assignments.

Presentation of Seminar: Apart from the assignments the concerned instructors also allocate the students with a topic or based on their interests to present seminar that will aid them built their confidence levels, command over English language to communicate with precision and fluently. In addition, the fellow students are encouraged to pose questions that will instigate interest and provide update in that particular topic besidesthe information presented helping them to prepare for their examinations that can be taken as added advantage for the students.

Preparedness: At the end of every class, the concerned instructor tells the students what will be taken in the next class using these details the students should be aware of the topics that will be covered in the upcoming lectures which actually enhance the student's capability to grasp the knowledge and concepts provided much efficiently.

Academic Dishonesty: This is an important aspect that every student should be aware of. Thus, the respective faculty members educate the students of possible means of academic malpractices (plagiarism, violation of copyrights and stealing the patented knowledge) and the following consequences that will make them more vigilant in their academiccareer.

Subject to change clause: Based on the requirement of student's feasibility and meetingthe competitive demands of the discipline the syllabus courses will be re-structured and updated accordingly at the discretion of the Professor(s) and Board of studies chairman.

Important dates: Please note down the important dates and stick to the schedule

CIA Test I	**II CIA Test**	**Assignment**	**Seminar**
As per Academic Calendar		After CIA Test-I	

Course Outline: Core: Cell Communication and Cell Signaling

- Basic concepts about the Host parasitic interactions – understanding the entry processof different pathogens.
- Exploring the virus-induced cell transformation and pathogen induced diseases in animals and plants.
- Cell-Cell fusion method in both normal and abnormal cells.
- Cell signaling mechanism in cells, hormones and their receptors.
- Signaling through G-protein coupled receptor.
- Principles of cellular communication and regulation of hematopoiesis.
- Cell adhesion and role of different adhesion molecules.
- Genetic rearrangements in progenitor cells, oncogenes, tumor suppressor genes.

- Programmed cell death, aging and senescence.
- Morphogenesis and organogenesis in animals and plants.

More books for Reading and Referencing

Molecular Cell Biology (Fourth Edition) by Harvey Lodish, Arnold Berk, David Baltimore; 1999, **ISBN-13: 978-0716737063, ISBN-10: 071673706X**
Handbook of Cell Signaling by Edward A. Dennis; 2009, **ISBN: 9780123741455**
Handbook of Cell Signaling (Second Edition) by Ralph A. Bradshaw and Edward A. Dennis; 2015; **ISBN: 978-0-8153- 4244**
Cell Signaling: principles and mechanisms by Wendell Lim, Bruce Mayer, Tony Pawson
Cell Communication: Understanding how Information is Stored and Used in Cells by Michael Friedman, Brett Friedman, 2005; **ISBN 10:1404203192, ISBN 13: 9781404203198**
Cell-to-Cell Communication by Walmor C. De Mello; 2012; **ISBN 13:978-1-4612- 9006-7**

Semester-IV					
DSE-III	**Course Code: 25MBC4E3**	**Cell Communication and Cell Signaling (K1-K5)**	**T**	**Credits:3**	**Hours: 3**
UNIT - I					
Objective - 1	To study the cellular morphology, function and to develop an understandingof genome organization.				
Host parasite interaction: Recognition and entry processes of different pathogens like bacteria, viruses into animal and plant host cells, alteration of host cell behavior by pathogens, virus-induced cell transformation, pathogen-induced diseases in animals and plants, cell-cell fusion in both normal and abnormal cells.					
Outcome - 1	Students will learn about Morphogenesis and organogenesis to describe how cells exploit signaling components to assemble the specific signaling pathways.				
UNIT – II					
Objective - 2	To underpin the more advanced concept those are covered experimental basis of current understandings, new experimental methodologies in molecular cell biology techniques.				
Cell signaling: Hormones and their receptors, cell surface receptor, signaling through G-protein coupled receptors, signal transduction pathways, second messengers, regulation of signaling pathways, bacterial and plant two-component systems, light signaling in plants, bacterial chemo taxis and quorum sensing.					
Outcome - 2	Student will be able to learn components and properties of major cell signaling pathways in control of gene expression and cellular metabolism.				
UNIT – III					
Objective - 3	To provide the student with a strong foundation for principles of cellcommunication				
Cellular communication: General principles of cell communication, cell adhesion and roles of different adhesion molecules, gap junctions, extracellular matrix, integrins, neurotransmission and its regulation and Regulation of hematopoiesis.					

Outcome - 3	Recognize and discuss the main types of cell communication,including the signal molecules.
UNIT – IV	
Objective - 4	To make the students to understand the genetic rearrangement
Cellular and genetic alterations: Genetic rearrangements in progenitor cells, oncogenes, tumor suppressor genes, cancer and the cell cycle, virus-induced cancer, metastasis, interaction of cancer cells with normal cells, apoptosis, therapeutic interventions of uncontrolled cell growth. Pr med cell death, aging and senescence.	
Outcome - 4	To understand the importance of genetic alteration
UNIT-V	
Objective - 5	To find out the methods for analyzing the cell morphogenesis and organogenesis
Morphogenesis and organogenesis in animals: Cell aggregation and differentiation in *Dictyostelium*; axes and pattern formation in *Drosophila*, amphibia and chick; organogenesis – vulva formation in *Caenorhabditis elegans*, eye lens induction, limb development and regeneration in vertebrates; differentiation of neurons, post embryonic development- larval formation, metamorphosis; environmental regulation of normal development; sex determination. **Morphogenesis and organogenesis in plants:** Organization of shoot and root apical meristem; shoot and root development; leaf development and phyllotaxy; transition to flowering, floral meristems and floral development in *Arabidopsis* and *Antirrhinum.*	
Outcome - 5	Analyze the general cellular morphogenesis and organogenesis for animal and plant.

Suggested Readings:

Pfeffer U (2013) Cancer Genomics; Springer.

Scott F. Gilbert (2013) Developmental Biology; Tenth Edition; Sinauer Associates, Inc., Sunderland, USA.

Henry C. Pitot (2002) Fundamentals of Oncology; Fourth Edition, Revised and Expanded; Marcel Dekker, Inc., New York, USA.

Wolfgang Arthur Schulz (2005) Molecular Biology of Human Cancers; An Advanced Student's Textbook; Springer, USA.

Raymond W. Ruddon, Daniel D. Loeb (2007) Cancer Biology; Fourth Edition; OXFORD University Press, New York, USA.

Bunz F (2016) Principles of Cancer Genetics; Springer.

Online Resources:

1. https://elifesciences.org/articles/55793
2. https://academic.oup.com/jb/article/159/6/553/1750854

Course Outcome	**K1**	**K2**	**K3**	**K4**	**K5**	**K6**
CO1	✓	✓	✓	✓	✓	
CO2	✓	✓	✓	✓	✓	
CO3	✓	✓	✓	✓	✓	
CO4	✓	✓	✓	✓	✓	
CO5	✓	✓	✓	✓	✓	

K1-Remember	***K2-Understand***	***K3-Apply***	***K4-Analyze***	***K5-Evaluate***	***K6-Create***

Course designed by:Dr. M. Jeyakumar & Dr. M. Mamutha

Course Outcome VS Programme Outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	2	2	2	2	1	2	2	2	2	2
CO2	2	2	3	2	2	2	2	2	1	2
CO3	2	1	1	1	2	2	1	1	2	1
CO4	1	1	2	2	1	2	1	2	1	1
CO5	2	1	2	1	1	2	2	1	2	2
W.AV	1.9	1.4	2	1.4	1.4	2	1.8	1.8	1.8	1.8

S –Strong (3), M-Medium (2), L- Low (1)

POs vs COs Interpretation

PO	Weighted Average	Interpretation
PO1	1.9	Low alignment
PO2	1.4	Low alignment
PO3	2.0	Moderately supported
PO4	1.4	Low alignment
PO5	1.4	Low alignment
PO6	2.0	Moderately supported
PO7	1.8	Low alignment
PO8	1.8	Low alignment
PO9	1.8	Low alignment
PO10	1.8	Low alignment

Assignment & Seminar: Cell Communication and Cell Signaling

1. Describe signal transduction pathways.
2. Discuss about the cell signaling pathways.
3. What are bacterial chemotaxis and quorum sensing?
4. Describe virus-induced cell transformation
5. Write about G-protein coupled receptors
6. Explain the pathogen-induced diseases in animals and plants.
7. Define Regulation of hematopoiesis and its regulation.
8. Discuss about the neurotransmission.
9. Give an account on cell adhesion and roles of different adhesion molecules.
10. Define bacterial and plant two-component systems?

Student Choice and it may be conducted by parallel sections (DSE)
Major Electives-DSE
IPR, Bio-safety and Bioethics

Program: M.Sc., Bioinformatics	Semester : IV (2025-2026 Onwards)
Course Title: IPR, Biosafety and Bioethics Subject Code: 25MBC4E4	Class Time: As per Time Table
Name of Course Teachers	Dr. M. Jeyakumar & Dr. M. Mamutha
Mobile: +91 96559 07058 & +91 91761 63179	E-mail:biotechjeya@gmail.com mamudha2014@gmail.com

Course Brief:

The course introduces students to Intellectual Property (IP) Law in general and its two common categories: Industrial Property (mostly patents) and Copyright. Intellectual Property is undoubtedly perceived as one of the core fields in the emerging area of law, the need specialized professionals. The course provides an overview of the

main principles and legal rules of IP Law, focusing specifically on the theoretical connections between IP and academic/scientific works/studies and on the IP issueswith which the students are likely to come into contact in their different areas of knowledge. The course on Intellectual Property Rights, Biosafety and Bioethics covers all aspects of creations of the intellect (Images, inventions, literary works, artistic worksetc.), Patent application, rules essential for patents, genetically modified crops and plants with their impacts, general ethical issues in handling transgenic plants, animals and microorganisms at laboratory etc. It also deals with new and upcoming areas like ethical issues associated with embryonic stem cells, genetic testing and regulatory approval to conduct human clinical trials. This course has been designed to give the students a holistic understanding of the subject. The concept of IP, its creation and how it should be protected are the major key points which will be discussed during this course.

Teaching Methods: The mode of teaching is based on the following learning activities:

- Lectures covering the theoretical part will be delivered using PowerPointpresentations.
- A new set of problems and issues that are worthy of exploration related to thiscourse will be conversed.
- Case studies and questions.

Attendance: The students are expected to attend the classes regularly, since regular attendance is essential to gain academic achievement. As per the University norms, the students having a minimum scale of 70-75% attendance are only qualified to write their end-semester examinations.

Punctuality: Punctuality is the most important quality for the student to be followed andmaintained to achieve success. Students who arrive late by 10 mins to the class without any vital reason will be marked absent in the attendance register. On the other hand, valid excuse including personal or medical emergency is acceptable, with prior consent by the Head of the Department.

Class Participation: A student's overall growth and personality development is based on his/her involvement in the class not just by mere presence but rather being interactive through questioning that will lead to propagation of ideas, initiation of thought-provoking practice and much more that will provide

a wholesome enriched classroom experience. When students participate, they learn from one another and gain their knowledge better.

Submission of Assignment: Assignments are given to students in order to apply the concepts for deeper understanding of the subject. Therefore, each student will be allocated two assignments for the course, covering the entire topic. Students will be given deadline to submit the assignment by the course instructor and good preparationof assignment will help the students for their final exams.

Presentation of Seminar: Apart from the assignments, students are supposed to give anoral presentation during the class seminar hours in their assigned topic. The concerned instructor will encourage the participants to ask valid questions during seminar presentation in order to put up their confidence levels and communication skills. In addition, students will be able to gain information and can be updated in their course.

Preparedness: At the end of every class, the concerned instructor conveys the students about the details that will be handled in the next class to increase the student's awareness related to the topics.

Academic Dishonesty: This is an important aspect that every student should be aware of. Thus, the respective faculty members educate the students of possible means ofacademic malpractices (plagiarism, violation of copyrights and stealing the patentedknowledge) and the following consequences that will make them more vigilant in their academic career.

Subject to change clause: Depending upon the requirement of student's possibility, the course syllabus will be re-structured and updated accordingly at the discretion of the Professor(s) and Board of studies chairman.

Important dates: Scheduled dates for the various activities related to the course

CIA Test I	**CIA Test II**	**Assignment**	**Seminar**
As per Academic Calendar		After CIA Test I	

Course Outline: Elective: IPR, Bio-safety and Bioethics

- An outline of Intellectual property rights- World Trade Organization (WTO) - WTO Agreements- General Agreement on Tariffs and Trade (GATT) - General Provisions and Basic Principles- Protection of different types of plant variety.
- Types of Intellectual property rights-TRIPs -Trademarks and copyrights-act and law. Procedures for GMOs intended for direct use-risk assessment-risk management- handling, transport, packaging and identification of GMOs.
- Patenting and the Procedures Involved in the Application for Grading of a Patent -Steps to a Patent - Compulsory Licenses - Patent Cooperation Treaty (PCT)- Some case studies-Beneficial role of Transgenic plants and animals.

- Rules for the manufacture, use/import/export and storage of hazardous microorganisms/genetically engineered organisms or cell.
- An Overview of the Legal and Socio-economic Impacts of Biotechnology - Biosafety Regulations-Good laboratory practices-Different types of containment.
- Bioethics introduction-Various ethical issues related to genetic studies, human genome project-stem cell applications and ethical issues in stem cell research- cloning- instrumentality.

More books for Reading and Referencing

An Introduction to Intellectual Property Rights-**Manju Pathak** Publisher: New India Publishing Agency, 2013. **(ISBN: 978-93-833-0512-4)**
Intellectual Property Rights- **Neeraj Pandey, Khushdeep Dharni** Publisher: PHI Learning Pvt. Ltd-New Delhi, 2014. **(ISBN: 978-81-203-4989-6)**
WIPO Intellectual Property Handbook- **Wipo Publication** Publisher: WIPO 2004, Second Edition. **(ISBN: 978-92-805-1291-5)**
Bioethics and Biosafety- **M. K. Sateesh** Publisher: I. K. International Pvt Ltd, 2008. **(ISBN: 978-81-906-7570-3)**
Bioethics and Biosafety in Biotechnology-**V. Sree Krishnan** Publisher: New Age International (P) Limited, New Delhi, 2007. **(ISBN: 978-81-224-2248-1)**
IPR, Biosafety and Bioethics- **Deepa Goel, Shomini Parashar** Publisher: Pearson Publication, First edition, 2013. **(ISBN: 978-93-325-1424-9)**
Patent law - **P Narayanan** Publisher: Eastern Law House; 3rd edition, 1998. **(ISBN: 978-81-717-7090-8)**
Introduction to Bioethics- John A. Bryant, Linda Baggott la Velle, John F. Searle Publisher: Wiley publications, 2005. **(ISBN: 978-0-470-02198-9)**

Semester-IV					
DSE-III	**Course Code 25MBC4E4**	**IPR, Bio-safety and Bioethics (K1-K5)**	**T**	**Credits: 3**	**Hours :3**
UNIT - I					
Objective -1	To describe the role of international institutions like WTO, WIPO, and IBSCin relation to intellectual property rights. To understand agreements like TRIPS and acts like the Plant Variety and Farmers' Rights Act.				
Concept and Role of International Institutions: Introduction of IPR, General Agreement on Trade and Tariff (GATT) and World Trade Organizations. Establishment and functions of GATT,World Trade Organization (WTO) and World International Property Organization (WIPO). WTO Summits, Role of					

Integrated Business Solution Center (IBSC) and Review Committee on Genetic Manipulation (RCGM), Production of Plant variety and formers right act	
Outcome -1	Explain the concepts and roles of international institutions, such as GATT, WTO, and WIPO, in the context of IPR and biosafety**.**
UNIT – II	
Objective -2	To define different types of intellectual property rights like patents,trademarks, copyrights, and trade secrets.
Patent and Copyright: TRIPS, Different types of intellectual property rights (IPR), Patents, Trade mark, Trade secret copy right, Geographical distribution on biological diversity, Obligations, Production of Traditional Knowledge, Impact of GM Crops and GM Foods.	
Outcome - 2	Understand different types of intellectual property rights and their implications on biological diversity and traditional knowledge.
UNIT – III	
Objective -3	To explain Indian patent law and discuss case studies of patents on biological resources. To understand the benefits of transgenic plants and animals.
Patent Law: Patent application, Rules governing patents, Licensing - Flavr Savr™ tomato as a model case. Case studies on patents (Basmati rice, Turmeric, Neem, etc.). Indian Patent Act, 1970. Benefits of transgenic plants and animals.	
Outcome -3	Analyze patent applications, rules governing patents, and case studies on patents, such as Basmati rice, Turmeric, and Neem.
UNIT – IV	
Objective -4	To describe different levels of biosafety and containment. To understand national biosafety policies, GLP, and GMP in relation to biotechnology intellectual property.
Intellectual property in Biotechnology: Introduction and different levels of biosafety, Microorganism according to pathogenicity, rDNA research in India, General guidelines forresearch in transgenic plants, Good Laboratory Practices (GLP). Containments- Types, National biosafety policies and law, Germplasm conservation and Cross border movement. Introduction to GMP (Good Manufacturing Practices).	
Outcome -4	Know the application facts about biosafety guidelines, good laboratory practices (GLP), and good manufacturing practices (GMP) in biotechnology research andproduction.
UNIT-V	
Objective -5	To discuss about general ethical issues related to the release of transgenic organisms and the use of technologies like stem cells, genetic testing, and human clinical trials from a bioethics perspective.
Bioethics: Introduction of bioethics, General ethical issues related to environmental release of transgenic plants, animals and microorganisms, Ethical issues related to embryonic stem cells, Genetic testing and screening, human clinical trials and drug testing.	
Outcome -5	Evaluate the ethical implications of biotechnology research, including environmental release of transgenic organisms, embryonic stem cells, and human clinical trials.

Suggested Readings:

Iltis, A.S. and MacKay, D. (2024) *The Oxford Handbook of Research ethics*. New York, NY: Oxford University Press.

Ganguli, P. (2022). *Intellectual Property Rights: Unleashing the Knowledge Economy* (4th ed.). Tata McGraw Hill. (India).

Schüklenk, U. and Singer, P. (2022) *Bioethics: An anthology*. Hoboken, NJ: John Wiley & Sons, Inc.

Tsioumani, E. (2021) *Biosafety: Ensuring the safe use of modern biotechnologies*. International Institute for Sustainable Development.

Dutfield, G. and Suthersanen, U. (2020) *Dutfield and Suthersanen on global intellectual property law*. Cheltenham, UK: Edward Elgar Publishing.

Beauchamp, T.L. and Childress, J.F. (2019) *Principles of Biomedical Ethics*. New York, NY: Oxford University Press.

Matthews, D. and Zech, H. (2017) *Research handbook on intellectual property and the Life Sciences*. Cheltenham, UK: Edward Elgar Publishing Limited.

Campbell, A.V. (2017) *Bioethics: The basics*. London: Routledge, Taylor & Francis Group.

Ahuja, V.K. (2016) *Law relating to intellectual property rights*. Gurgaon, Haryana, India: LexisNexis.

Sherlock, R. and Morrey, J.D. (2005) *Ethical issues in biotechnology edited by Richard Sherlock and John D. Morrey*. Enskede: TPB.

Recombinant DNA safety guidelines, (1990), Department of Biotechnology, Ministry of Science & Technology, Government of India, New Delhi.

Deepa Goel; Shomini Parashar, (2015) IPR, Biosafety and Bioethics, Pearson India, ISBN: 9789332514249.

Revised guidelines for research in transgenic plants, (1998), Department of Biotechnology, Ministry of Science & Technology, Government of India, New Delhi.

Subbaram, N. (2007) "Patent Law Practices and Procedures" Pharma Book Syndicate, Hyderabad, 2nd Edition.

M. K. Sateesh, (2008) Bioethics and Biosafety, K. International Pvt Ltd.

Online Resources:

3. ttps://www.taylorfrancis.com/books/edit/10.1201/9781003179177/biosafety-bioethics - biotechnology

https://www.google.com/search?q=IPR%2C+Biosafety+and+Bioethics&sca

Course Outcome	K1	K2	K3	K4	K5	K6
CO1	✓	✓	✓	✓	✓	
CO2	✓	✓	✓	✓	✓	
CO3	✓	✓	✓	✓	✓	
CO4	✓	✓	✓	✓	✓	
CO5	✓	✓	✓	✓	✓	

K1-Remember	***K2-Understand***	***K3-Apply***	***K4-Analyze***	***K5-Evaluate***	***K6-Create***

Course designed by: Dr. M. Jeyakumar & Dr. M. Mamutha

Course Outcome VS Programme Outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	2	2	3	1	-	3	-	3	3	3
CO2	2	3	3	1	1	3	1	3	3	3
CO3	2	3	3	2	-	3	-	3	3	3
CO4	2	3	3	2	1	3	1	3	3	3
CO5	2	3	3	2	2	3	1	3	3	3
W.AV	2	2.8	3	1.6	0.8	3	0.6	3	3	3

S –Strong (3), M-Medium (2), L- Low (1)

POs vs COs Interpretation

PO	Weighted Average	Interpretation
PO1	2.0	Moderately aligned.
PO2	2.8	Moderately aligned.
PO3	3.0	Strongly aligned with all COs
PO4	1.6	Low alignment
PO5	0.8	Low alignment
PO6	3.0	Strongly aligned with all COs
PO7	0.6	Low alignment
PO8	3.0	Strongly aligned with all COs
PO9	3.0	Strongly aligned with all COs
PO10	3.0	Strongly aligned with all COs

Assignment & Seminar Elective:

1. Establishment and functions of GATT, WTO and WIPO.
2. Explain transgenic plants and its beneficiary role.
3. Write short notes on Biosafety and its different levels.
4. Derive the government patent rules.
5. Give an account on FLAVA SAVR^{tm} turmeric as model case.
6. Explain WTO summit and WTO agreements.
7. Write a short note on environmental impact of genetically modified plants.
8. Explain the ethical issues related to research in embryonic stem cell cloning.
9. Impact of GM crops in agriculture.
10. Discuss about GATT's principle of reciprocal tariff liberalization.

Minutes of the Ad-hoc Board of Studies meeting for M.Sc Biochemistry Programme held on 09-07-2025 in the Department of Bioinformatics, Alagappa University, Karaikudi

Members present:

1.	**Dr. J. JEYAKANTHAN** Senior Professor and Head Department of Bioinformatics	**Chairperson**
2.	**Dr. SURESH KUMAR RAYALA** Professor Department of Biotechnology IIT Madras, Chennai	**Subject Expert**
3.	**Dr. S. SUJA** Professor and Head Department of Biochemistry Bharathiar University, Coimbatore	**Subject Expert (ONLINE)**
4.	**Dr. N. SUGANTHY** Assistant Professor Department of Nanoscience and Technology Alagappa University, Karaikudi	**Member**
5.	**Dr. P. KUMAR** Department of Animal Health and Management Alagappa University, Karaikudi	**Member**
6.	**Dr. SANJEEV KUMAR SINGH** Professor Department of Bioinformatics	**Internal Expert**
7.	**Dr. RM. VIDHYAVATHI** Assistant Professor Department of Bioinformatics	**Internal Expert**
8.	**Dr. J. JOSEPH SAHAYARAYAN** Assistant Professor Department of Bioinformatics	**Internal Expert**
9.	**Dr. P. BOOMI** Assistant Professor Department of Bioinformatics	**Internal Expert & Programme Co-ordinator**
10.	**Dr. V. SIVAKUMAR** Director Curriculum Design & Development Cell	**Ex-Officio Member**

The Ad-hoc Board of Studies was held on 09-07-2025 at 11.30 a.m. in the Department of Bioinformatics, Alagappa University to frame the Structure and M.Sc. Syllabus.

Dr. J. Jeyakanthan. Chairperson, Senior Professor and Head, Department of Bioinformatics formally welcomed the Experts and Department Faculties. He introduced the newly created M.Sc. Biochemistry program, highlighting the academic rationale, objectives, and relevance in the current scientific and industrial landscape.

Prof. Suresh Kumar Rayala, IIT-M (Subject Expert), DBI faculty members (Prof. Sanjeev Kumar Singh, Dr. RM. Vidhyavathi, Dr. J. Joseph Sahayarayan, Dr. P. Boomi-Programme Co-ordinator), Dr. N. Suganthy, Assistant Professor, Department of Nanoscience and Technology, Alagappa University, Dr. P. Kumar, Department of Animal Health and Management, Alagappa University, Dr. V. Sivakumar, Director - CD & DC and Dr. N.M. Prabhu, Deputy Director – CD &DC (Special Invitee) has attended the Ad-hoc BOS meeting in the 4th Floor Sir C.V. Raman Conference Hall, Department of Bioinformatics, Alagappa University, Karaikudi. Prof. Dr. S. Suja, Professor and Head, Department of Biochemistry, Bharathiyar University, Coimbatore has joined the meeting through online mode (https://meet.google.com/xgh-fbfr-eio).

The experts are very impressed with the diversity, depth and the magnitude of the structure and syllabus that is being taught to M.Sc. Biochemistry students at the Alagappa University, Karaikudi. They compared the curriculum of M.Sc. Biochemistry with similar programs in abroad Institutions, Indian Premier Institutes and as per the needs of the industry requirement. This programme is a multidisciplinary field integral to addressing challenges in healthcare, agriculture, and environmental sustainability. It bridges biology and chemistry, providing molecular level insights into biological processes vital for advancements in life sciences. This program is designed to prepare students for careers in academic research, diagnostics, pharmaceutical industries, and biotechnology sectors, and to pursue doctoral studies (Ph.D.) or related professional qualifications.

During the meeting, the Subject Expert and Members are suggested the drafted programme structure and syllabus. In this, Core theory (12), Core Practical (4), Core Project (1), Discipline Student Choice-Elective (3), Skill Enhancement Course (2), Non Major Elective (2) and Self Learning

Course (2) have discussed to include in the programme structure along with credits as per the CD&DC guidelines. The experts have also suggested adding the bioinformatics course, extra-curricular activities (Yoga), skill-based learning (Journal club) and industry-relevant skills in the drafted structure.

Based on the detailed discussions held during the Ad-hoc Board of Studies meeting, the following suggestions and course inclusions were made in the M.Sc. Biochemistry programme structure and syllabus:

The first semester introduces essential course such as Chemistry of Biomolecules, Cell and Molecular Biology, Enzymology, Lab – I: Biomolecules, Cellular, Enzymology Lab, Major Elective-I: Microbial Biochemistry, and Introduction to Bioinformatics.

The second semester covers with Intermediary Metabolism and Regulation, Molecular Basis of Development, Immunology and Immunotechnology, Clinical and Medical Biochemistry, Lab – II: Metabolism, Developmental, Immunology & Clinical Biochemistry Lab, Molecular Modelling and Drug Design, Non Major Elective and Self-Learning Course.

The third semester introduces the Genetics, rDNA Technology, Analytical and Instrumentation Techniques, Lab – III: Genetics, rDNA Technology and Advanced Biochemistry Lab, Food and Nutritional Biochemistry, Non Major Elective and Self-Learning Course.

In the fourth semester, the curriculum includes Computational and Structural Biology, Industrial and Environmental Biochemistry, Lab – IV: Industrial, Environmental, and Structural Biology Lab, Project Work & Viva-Voce and Major Elective-I Pharmaceutical Biochemistry.

The detailed courses content for all semesters are thoroughly discussed and incorporated into the final draft of the syllabus, with emphasis on integrating fundamental knowledge and advanced applications in biochemistry.

Internships: It is also proposed that the University should establish partnerships with pharmaceutical and biotech industries to facilitate short-term internships or training programs (2–3 weeks) for students of the M.Sc. Biochemistry program. Such hands-on experiences will greatly enhance students' practical skills and career readiness in the biochemistry field.

In view of the above, the committee members endorsed the chairman to incorporate all the valuable comments suggested by the committee members during the Ad-hoc Board of studies meeting. It was agreed that the structure and syllabus will be implemented from the academic year 2025–2026. The meeting ended with a vote of thanks by Professor Sanjeev Kumar Singh, appreciating the contributions of all members.

Dr. J. Jeyakanthan

Dr. Suresh Kumar Rayala

Dr. S. Suja

Dr. Sanjeev Kumar Singh

Dr. N. Suganthy

Dr. P. Kumar

Dr. RM. Vidhyavathi

Dr. J. Joseph Sahayarayan

Dr. P. Boomi

Dr. V. Sivakumar

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