# AVS

# COLLEGE OF ARTS & SCIENCE

# (AUTONOMOUS)

**Attur Main Road, Ramalingapuram, Salem - 106.**

**(Recognized under section 2(f) & 12(B) of UGC Act 1956 and**

**Accredited by NAAC with 'A' Grade)**

**(Co - Educational Institution | Affiliated to Periyar University, Salem**

**ISO 9001 : 2015 Certified Institution)**

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**Syllabus for**

## M.Sc. BIOTECHNOLOGY

**CHOICE BASED CREDIT SYSTEM –**

**LEARNING OUTCOMES BASED CURRICULUM FRAMEWORK**

**(CBCS – LOCF)**

**(Applicable to the Candidates admitted from 2023-24 onwards)**

## VISION

- To attain excellence in the field of education by creating competent scholars with a touch of human values.

## MISSION

- To accomplish eminence in the academic domain.
- To provide updated infrastructure.
- To educate value based education.
- To impart skills through efficient training programs.
- To cultivate culture and tradition with discipline and determination.

## REGULATIONS

**1. Eligibility for Admission:**

MSc Biotechnology eligibility is to have a bachelor's degree in science with a Specialization in any biological sciences. Graduates from BAMS, BHMS, BPT, and B Pharm Are also eligible for admission. At least 50% must have been scored in aggregate at the **Undergraduate level.**

**2. Duration:**

The course of Master of Science shall consist of 2 academic years divided into 4 semesters

**3. Eligibility for award of degree:**

Students those who are all complete all the 4 semester with minimum 50 % mark in university examination

**4. Course of Study:**

M.Sc. in Biotechnology is a two-year long postgraduate course in the field of Science. The course covers subjects like Immunology, Environmental Biotechnology, Advanced Biological Chemistry, Molecular Biology, Animal Biotechnology.

**5. Scheme of Examination:**

Regular class tests will be held in all subjects in the month of November.

Mid–term Examination will be held in all subjects in the month of November.

The Test Examination of Part – I candidates will be held in the month of March.

Students must appear and qualify Test/Selection Examination, failing that they would not be allowed to appear in the University Examination.

For students of the second and third year the same scheme of evolution will be followed.

**6. Passing Rules:**

Any student who has earned his/her undergraduate degree in BSc in any specialization with a Minimum of 50% marks passed examinations.

**i) Theory**

Internal- Minimum -13

External- Minimum – 38

**ii) Practical**

Internal- Minimum – 20

External- Minimum – 30

| **Programme Outcomes (POs)**<br>On successful completion of the **M.Sc. BIOTECHNOLOGY** | |
|---|---|
| **PO1** | **Problem Solving Skill**<br>Apply knowledge of Management theories and Human Resource practices to solve business problems through research in Global context. |
| **PO2** | **Decision Making Skill**<br>Foster analytical and critical thinking abilities for data-based decision-making. |
| **PO3** | **Ethical Value**<br>Ability to incorporate quality, ethical and legal value-based perspectives to all organizational activities. |
| **PO4** | **Communication Skill**<br>Ability to develop communication, managerial and interpersonal skills. |
| **PO5** | **Individual and Team Leadership Skill**<br>Capability to lead themselves and the team to achieve organizational goals. |
| **PO6** | **Employability Skill**<br>Inculcate contemporary business practices to enhance employability skills in the competitive environment. |
| **PO7** | **Entrepreneurial Skill**<br>Equip with skills and competencies to become an entrepreneur. |
| **PO8** | **Contribution to Society**<br>Succeed in career endeavors and contribute significantly to society. |
| **PO9** | **Multicultural competence**<br>Possess knowledge of the values and beliefs of multiple cultures and a global perspective. |
| **PO10** | **Moral and ethical awareness/reasoning**<br>Ability to embrace moral/ethical values in conducting one's life. |

| **Program Specific Outcomes (PSOs)**<br>After the successful completion of **M.Sc. BIOTECHNOLOGY** programme the students are expected to | |
|---|---|
| **PSO1** | **Placement**<br>To prepare the students who will demonstrate respectful engagement with others' ideas, behaviors, and beliefs and apply diverse frames of reference to decisions and actions. |
| **PSO2** | **Entrepreneur**<br>To create effective entrepreneurs by enhancing their critical thinking, problem Solving, decision making and leadership skill that will facilitate startups and high potential organizations. |
| **PSO3** | **Research and Development**<br>Design and implement HR systems and practices grounded in research that comply with employment laws, leading the organization towards growth and development. |
| **PSO4** | **Contribution to Business World**<br>To produce employable, ethical and innovative professionals to sustain in the dynamic business world. |
| **PSO5** | **Contribution to the Society**<br>To contribute to the development of the society by collaborating with stakeholders for mutual benefit. |

| **Programme Educational Objectives of M.Sc. BIOTECHNOLOGY** programme describe accomplishments that graduates are expected to attain within five to seven years after graduation. | |
|---|---|
| **PEO1** | Explain in-depth and up to-date knowledge in basic and advanced biotechnological elements |
| **PEO2** | Evaluate information relevant to concepts and issues of contemporary biotechnology |
| **PEO3** | Analyze and solve both theoretical and applied biotechnological problems related to research and technical aspects of the industry |
| **PEO4** | To understand and apply basic science, perform technical skills, learn written and oral communication skills, develop critical thinking, understand societal and environmental impact of life sciences, and realize practical perspectives of biotechnology |
| **PEO5** | To introduce the students with emerging field of functional genomics and genomics |

## CREDIT DISTRIBUTION FOR 2 YEARS M.Sc. BIOTECHNOLOGY PROGRAMME

| Part | Course Type | Credits per Course | No. of Papers | Total Credits |
|---|---|---|---|---|
| Part I | Core Courses- Theory | 4 | 6 | 24 |
| | | 5 | 5 | 25 |
| | Core Courses- Practical | 3 | 4 | 12 |
| | | 7 | 1 | 7 |
| | Major Elective Courses- Theory | 2 | 4 | 8 |
| | | 3 | 2 | 6 |
| | Major Elective Courses- Practical | - | - | - |
| | Generic Discipline Specific/ Allied Courses - Theory | | | |
| | | | **Total** | **82** |
| Part II | Non Major Elective Courses | 2 | 4 | 7 |
| | Common paper | 1 | 1 | 1 |
| | Internship | 2 | 1 | 2 |
| | | | **Total** | **10** |
| | | | **Total Credits** | **92** |

## CONSOLIDATED SEMESTER WISE AND COMPONENT WISE CREDIT DISTRIBUTION FOR 2 YEARS M.Sc. BIOTECHNOLOGY PROGRAMME

| Parts | Semester I | Semester II | Semester III | Semester IV | Total Credits |
|---|---|---|---|---|---|
| **Part I** | **20** | **20** | **22** | **20** | **82** |
| **Part II** | **-** | **3** | **4** | **3** | **10** |
| **Total** | **20** | **23** | **26** | **23** | **92** |

*Part I, II and Part III components will be separately taken into account for CGPA calculation and classification for the under graduate programmes and the other components IV and V have to completed during the duration of the programmes as per the norms, to be eligible for obtaining the PG degree.

## METHOD OF EVALUATION

| Evaluation | Components | | Marks |
|---|---|---|---|
| Internal Evaluation | Continuous Internal Assessment Test | 15 | 25 Marks |
| | Assignments | 3 | |
| | Class Participation | 2 | |
| | Distribution of marks for Attendance (in percentage)<br>96 – 100: 5 Marks<br>91 – 95: 4 Marks<br>86 – 90: 3 Marks<br>81 – 85: 2 Marks | 5 | |
| External Evaluation | End Semester Examination | | 75 Marks |
| **Total** | | | **100 Marks** |

**Note:** 1.PG Programmes- A candidate must score minimum 13 marks in Internal and 38 marks in External Evaluation.

## CONTINUOUS INTERNAL ASSESSMENT

Categorizing Outcome Assessment Levels Using Bloom's Taxonomy

| Level | Cognitive Domain | Description |
|---|---|---|
| K1 | Remember | It is the ability to remember the previously learned concepts or ideas. |
| K2 | Understand | The learner explains concepts or ideas. |
| K3 | Apply | The learner uses existing knowledge in new contexts. |
| K4 | Analyze | The learner is expected to draw relations among ideas and to compare and contrast. |
| K5 | Evaluate | The learner makes judgments based on sound analysis. |
| K6 | Create | The learner creates something unique or original. |

## Question Paper Blue Print for Continuous Internal Assessment - I & II

| Duration: 2 Hours | | | | | | | Maximum: 50 marks |
|---|---|---|---|---|---|---|---|
| Section | K level | | | | | | Marks |
| | K1 | K2 | K3 | K4 | K5 | K6 | |
| A (no choice) | 10 | | | | | | 10 X 1 =10 |
| B (no choice) | | 1 | 1 | | | | 2 X 5 =10 |
| C (either or choice) | | | | 3 | | | 3 x 10 = 30 |
| Total | | | | | | | 50 marks |

*Note: K4 and K5 levels will be assessed in the Model Examination whereas K5 and K6 Levels will be assessed in the End Semester Examinations.*

**Question Paper Blue Print for Continuous Internal Assessment - I**

Time: 2 Hours Total Marks: 50 Marks Minimum Pass: 20 Marks

| Unit | Section – A | Section - B | Section - C |
|---|---|---|---|
| I | Q.N. 1, 2, 3, 4, 5 | Q.N. 11 | Q.N. 13 A, 13 B |
| I or II | - | - | Q.N. 14 A, 14 B |
| II | Q.N. 6, 7, 8, 9, 10 | Q.N. 12 | Q.N. 15 A, 15 B |

**SECTION – A (10 X 1 = 10 Marks)**

ANSWER ALL THE QUESTIONS

**SECTION – B (2 X 5 = 10 Marks)**

ANSWER ALL THE QUESTIONS

**SECTION – C (3 X 10 = 30 Marks)**

ANSWER ALL THE QUESTIONS (Either or Choice)

**Question Paper Blue Print for Continuous Internal Assessment - II**

Time: 2 Hours Total Marks: 50 Marks Minimum Pass: 20 Marks

| Unit | Section – A | Section - B | Section - C |
|---|---|---|---|
| III | Q.N. 1, 2, 3, 4, 5 | Q.N. 11 | Q.N. 13 A, 13 B |
| III or IV | - | - | Q.N. 14 A, 14 B |
| IV | Q.N. 6, 7, 8, 9, 10 | Q.N. 12 | Q.N. 15 A, 15 B |

**SECTION – A (10 X 1 = 10 Marks)**

ANSWER ALL THE QUESTIONS

**SECTION – B (2 X 5 = 10 Marks)**

ANSWER ALL THE QUESTIONS

**SECTION – C (3 X 10 = 30 Marks)**

ANSWER ALL THE QUESTIONS (Either or Choice)

## Question Paper Blue Print for Model Examination & End Semester Examination

| Duration: 3 Hours | | | | | | | | Maximum: 75 marks |
|---|---|---|---|---|---|---|---|---|
| Section | | K level | | | | | | Marks |
| | | K1 | K2 | K3 | K4 | K5 | K6 | |
| A (no choice, three questions from each unit) | | 15 | | | | | | 15 X 1 =15 |
| B (choice, one question from each unit) | | | 1 | 1 | | | | 2 X 5 =10 |
| C (either or choice & two questions from each unit) | *Courses with K4 as the highest cognitive level* | | | | 4 | 1 | | 5 x 10 = 50 |
| | *Course with K5 as the highest cognitive level wherein three K4 questions and two K5 questions are compulsory.* | | | | 3 | 2 | | |
| | *Course with K6 as the highest cognitive level wherein two questions each on K4, K5 and one question on K6 are compulsory.* | | | | 2 | 2 | 1 | |
| Total | | | | | | | | 75 marks |

**Question Paper Blue Print for Model Examination & End Semester Examination**

Time: 2 Hours Total Marks: 75 Marks Minimum Pass: 30 Marks

| Unit | Section – A | Section - B | Section - C |
|---|---|---|---|
| I | Q.N. 1, 2, 3 | Q.N. 16 | Q.N. 21 A, 21 B |
| II | Q.N. 4, 5, 6 | Q.N. 17 | Q.N. 22 A, 22 B |
| III | Q.N. 7, 8, 9 | Q.N. 18 | Q.N. 23 A, 23 B |
| IV | Q.N. 10, 11, 12 | Q.N. 19 | Q.N. 24 A, 24 B |
| V | Q.N. 13, 14, 15 | Q.N. 20 | Q.N. 25 A, 25 B |

**SECTION – A (15 X 1 = 15 Marks)**

ANSWER ALL THE QUESTIONS

**SECTION – B (2 X 5 = 10 Marks)**

ANSWER ANY TWO QUESTIONS

**SECTION – C (5 X 10 = 50 Marks)**

ANSWER ALL THE QUESTIONS (Either or Choice)

**Question Paper Blue Print for Model Practical Examination & End Semester Examination (Practical)**

Time: 3 Hours Total Marks: 60 Marks Minimum Pass: 24 Marks

| Practical Marks | Maximum Mark | Minimum Mark |
|---|---|---|
| Internal | 40 | 20 |
| External | 60 | 30 |
| Total | 100 | 50 |

**Evaluation for End Semester Examinations (Practical)**

| | |
|---|---|
| Record | 10 marks |
| Formula with expansion | 05 marks |
| Observation with data | 20 marks |
| Viva-voce | 05 marks |
| Calculation | 15 marks |
| Result with units | 05 marks |
| **TOTAL** | **60 MARKS** |

*Submission of record with due certification is a must for external practical examinations.

**A student should complete all requires experiments to get 10 marks for the record.

# Scheme of Examination for M.Sc. Biotechnology

## First Year – Semester - I

| Part | Course Code | Course Title | Ins. Hrs | Credit | CIA | ESE | Total |
|---|---|---|---|---|---|---|---|
| I | 23PBTCT01 | Core - I Biochemistry | 5 | 4 | 25 | 75 | 100 |
| I | 23PBTCT02 | Core - II Molecular Genetics | 4 | 4 | 25 | 75 | 100 |
| I | 23PBTCT03 | Core - III Molecular Cell Biology | 4 | 4 | 25 | 75 | 100 |
| I | 23PBTCP01 | Core Practical – I<br>(A) Biochemistry<br>(B) Molecular Genetics<br>(C) Molecular Cell biology | 6 | 4 | 40 | 60 | 100 |
| I | 23PBTMEA1 | Elective - I Bioinstrumentation | 3 | 2 | 25 | 75 | 100 |
| I | 23PBTMEB2 | Elective - II Food technology | 3 | 2 | 25 | 75 | 100 |
| **Total** | | | **25** | **20** | | | |

## First Year – Semester - II

| Part | Course Code | Course Title | Ins. Hrs | Credit | CIA | ESE | Total |
|---|---|---|---|---|---|---|---|
| I | 23PBTCT04 | Core - IV Microbiology | 4 | 4 | 25 | 75 | 100 |
| I | 23PBTCT05 | Core - V Plant and Animal Biotechnology | 4 | 4 | 25 | 75 | 100 |
| I | 23PBTCT06 | Core - VI Genetic Engineering | 4 | 4 | 25 | 75 | 100 |
| I | 23PBTCP02 | Core Practical – II<br>(A) Microbiology<br>(B) Plant & Animal Biotechnology<br>(C) Genetic Engineering | 6 | 4 | 40 | 60 | 100 |
| I | 23PBTMEB3 | Elective - III Pharmaceutical Biotechnology | 2 | 2 | 25 | 75 | 100 |
| I | 23PBTMEB4 | Elective - IV Marine Biotechnology | 2 | 2 | 25 | 75 | 100 |
| I | 23PSOCCC01 | Fundamentals of Human Rights | 1 | 1 | 25 | 75 | 100 |
| II | 23PBCNE05 | Non Major Elective Course - Nutritional Biochemistry | 2 | 2 | 25 | 75 | 100 |
| **Total** | | | **25** | **23** | | | |

## Second Year – Semester - III

| Part | Course Code | Course Title | Ins. Hrs | Credit | CIA | ESE | Total |
|---|---|---|---|---|---|---|---|
| I | 23PBTCT07 | Core - VII Bioinformatics | 5 | 5 | 25 | 75 | 100 |
| I | 23PBTCT08 | Core - VIII Immunology | 4 | 5 | 25 | 75 | 100 |
| I | 23PBTCT09 | Core - IX Bioprocess Technology | 4 | 5 | 25 | 75 | 100 |
| I | 23PBTCP03 | Core Practical – III<br>(A) Bioinformatics<br>(B) Immunology<br>(C) Bioprocess Technology | 6 | 4 | 40 | 60 | 100 |
| I | 23PBTMEA5 | Elective -V Nano Biotechnology / Molecular Developmental Biology | 3 | 3 | 25 | 75 | 100 |
| II | | NME II | 3 | 2 | 25 | 75 | 100 |
| II | 23PBTI01 | Internship in Industries to Biotechnology Field (food / clinical trial/ dairy/ aqua sciences, pharmaceutical)CSIR/DBT/DST research laboratories | - | 2 | 25 | 75 | 100 |
| **Total** | | | **25** | **26** | | | |

## Second Year – Semester - IV

| Part | Course Code | Course Title | Ins. Hrs | Credit | CIA | ESE | Total |
|---|---|---|---|---|---|---|---|
| I | 23PBTCT10 | Core - X Research Methodology | 6 | 5 | 25 | 75 | 100 |
| I | 23PBTCT11 | Core - XI Biostatistics | 5 | 5 | 25 | 75 | 100 |
| I | 23PBTPR01 | Project Work- Dissertation | 10 | 7 | 40 | 60 | 100 |
| I | 23PBTMEA6 | Elective - VI Stem Cell Biology/ Bioethics, Biosafety, Clinical Trials, Ipr & Enterpreneurship | 2 | 3 | 25 | 75 | 100 |
| II | NME | Non Major Elective Course from other Department | 2 | 2 | 25 | 75 | 100 |
| | | Extension Activity | - | 1 | 25 | 75 | 100 |
| **Total** | | | **25** | **23** | | | |

****Ins. Hrs** – Instructional Hours**, CIA-** Continuous Internal Assessment**, ESE-** End Semester Examination

| Semester: I | Course Code: 23PBTCT01 | Hours/Week: 5 | Credit: 4 |
|---|---|---|---|
| COURSE TITLE: CORE - I BIOCHEMISTRY | | | |

**Course Overview:**

1. The paper imparts a thorough knowledge on the basics of all the Biochemical concepts, Metabolic reactions and its regulation.
2. The student will get to understand the core concepts of metabolism and physiological processes of the body in both healthy and disease state.

**Learning Objectives:**

1. To understand the basics of pH and related principles and carbohydrate metabolism.
2. To provide basic knowledge about lipid metabolism and related significance.
3. To enlighten the students on Bio-energetics and Biological oxidation pathways.
4. To update the knowledge on Amino acids and Protein.
5. To assess and appraise the role of Nucleic acids.

| Unit - I | pH, pK | 10 Hours |
|---|---|---|

Acid, base. Buffers- Henderson- Haselbach equation, biological buffer system –Phosphate buffer system, protein buffer system, bicarbonate buffer system, amino acid buffer system and Hb buffer system. Carbohydrates: Nomenclature, classification, structure, chemical and physical properties of carbohydrates. Metabolisms: glycogenesis, glycogenolysis, gluconeogenesis, pentose phosphate pathway, glycolysis, citric acid cycle, cori's cycle, glyoxalate pathway

| Unit - II | Lipids | 10 Hours |
|---|---|---|

Lipids: Nomenclature, classification, structure, chemical and physical properties of fatty acids. Metabolisms: biosynthesis of fatty acids, triglycerols, phospholipids, glycol lipids. Cholesterol biosynthesis, bile acids and salt formation. Oxidation of fatty acids, ß-oxidation, alpha and gamma oxidation.

| Unit III | Bioenergetics | 10 Hours |
|---|---|---|

Concept of energy, Principle of thermodynamics. Laws of thermodynamics, Biological oxidation: Electron transport chain, oxidative phosphorylation. Photosynthesis (Oxygenic and An oxygenic), Hormonal regulation of fatty acids and carbohydrates metabolisms.

| Unit - IV | Amino acids and Protein | 10 Hours |
|---|---|---|

Nomenclature, Classification, structure, chemical and physical properties. Metabolisms: Biosynthesis of amino acids. Degradation of proteins, nitrogen metabolisms and carbon skeleton of amino acids, Urea cycle. Over all in born errors of metabolisms.

| Unit - V | Nucleic acids | 10 Hours |
|---|---|---|

Nomenclature, Classification, structure, chemical and physical properties. De novo and salvage synthesis of purine and pyrimidine bases, nucleosides and nucleotides. Catabolism of purine and pyrimidine bases. Synthetic analogues of nitrogenous bases

**Text Book(s):**


- Philip Kuchel, Simon Easterbrook-Smith, Vanessa Gysbers, Jacqui M. Matthews, 2011. Schism's Outline of Biochemistry, Third Edition (Schism's Outline Series), McGraw-Hill.
- Sathyanarayana.U and U.Chakrapani, 2011. Biochemistry. Books and Allied private limited, Kolkata.
- Jeremy M. Berg, John L. Tymoczko, Lubert Stryer, 2010. Biochemistry, Seventh Edition, W. H. Freeman.


**Reference Books:**


- Michael M. Cox, 2008. Lehninger Principles of Biochemistry, Fifth Edition, W. H. Freeman publishers.
- Albert Lehninger, David L. NelsonVoet Donald, Judith G.Voet and Charlotte W.Pratt., 2008. Principles of Biochemistry. John Wiley and sons, Inc., New Jersey.


**Web Resources:**

- mcdb-webarchive.mcdb.ucsb.edu/.../biochemistry/.../website-tourf.htm
- www.biochemweb.org/
- http://golgi.harvard.edu/biopages.html
- webarchive.mcdb.ucsb.edu/sears/biochemistry/info/website-

**Teaching Methodology**: Videos, Audios, PPT, Role Play, Quiz, Field Visit, Seminar, Chalk & Talk, Lecturing, Case Study, Demonstration, Problem Solving, Group Discussion, Flipped Learning

**Learning Outcomes:**

Upon successful completion of this course, the student will be able to:

| COs | Statements | Bloom's Level |
|---|---|---|
| CO1 | To understand the basics of pH and related principles and carbohydrate metabolism. | K2 |
| CO2 | To provide basic knowledge about lipid metabolism and related significance. | K2 |
| CO3 | To enlighten the students on Bio-energetics and Biological oxidation pathways. | K3 |
| CO4 | To update the knowledge on Amino acids and Protein. | K4 |
| CO5 | To assess and appraise the role of Nucleic acids. | K5 |

K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

**Mapping (COs vs POs)**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 |
|---|---|---|---|---|---|---|---|---|---|
| **CO1** | S | S | M | S | M | S | S | S | S |
| **CO2** | S | M | S | S | M | S | S | S | S |
| **CO3** | S | M | M | S | M | S | S | S | M |
| **CO4** | S | S | M | S | M | S | S | S | S |
| **CO5** | S | S | S | S | M | S | S | S | S |

**S - Strong, M – Medium, L – Low**

| Semester: I | Course Code: 23PBTCT02 | Hours/Week: 4 | Credit: 4 |
|---|---|---|---|

## COURSE TITLE: CORE - II MOLECULAR GENETICS

**Course Overview:**

1. The paper imparts a thorough knowledge on the basics of all the Genetics concepts, molecules and its regulation.
2. The student will get to understand the core concepts of molecules and genetics.

**Learning Objectives:**

1. To understand the basics of pH and related principles and carbohydrate metabolism.
2. To provide basic knowledge about lipid metabolism and related significance.
3. To enlighten the students on Bio-energetics and Biological oxidation pathways.
4. To update the knowledge on Amino acids and Protein.
5. To assess and appraise the role of Nucleic acids.

| Unit – I | Genes and chromosomes | 10 Hours |
|---|---|---|

Genes and chromosomes, Co-linearity of Genes and Proteins, Genetic code. Identification of DNA as the genetic material. The complexity of eukaryotic genome (introns, exons, repetitive DNA sequence, gene duplication and pseudo genes).

| Unit – II | Gene expression and regulation | 10 Hours |
|---|---|---|

Gene expression and regulation in prokaryotes and eukaryotes. Mutation: Spontaneous and virus induced mutation, Radiation induced mutation. Chromosomal Abnormalities and associated genetic diseases, Techniques in the study of chromosomes and their applications, Recombination – models

| Unit III | DNA Damage and Repair | 10 Hours |
|---|---|---|

DNA Damage and Repair-Internal and external agents causing DNA damages, Mechanisms of DNA damage (transition, trans version, frame shift, nonsense mutations), Repair mechanisms (Photo reactivation, excision repair, mismatch repair, post replication repair, SOS repair), Transposons and its mechanisms, control consequences and application by simple and complex elements.

| Unit - IV | Allele and genotype | 10 Hours |
|---|---|---|

Allele and genotype frequencies, Random mating population, Hardy-Weinberg principle, complications of dominance, special cases of random mating – multiple alleles, autosomal and X-linked frequencies. Inbreeding, genetics and evolution, random genetic drift, Karyotyping and usefulness of chromosomes in understanding Genetic variation, Genetics of eukaryotes gene linkage and chromosome mapping.

| Unit - V | Extra chromosomal heredity | 10 Hours |
|---|---|---|

Extra chromosomal heredity: Biology of Plasmids, their discovery, structure and types. Replication and partitioning, Incompatibility and copy number control-natural and artificial plasmid transfer and their applications- Genomics and Modern methodologies in understanding genome -Human Genome Project, DNA markers -VNTR, STR, microsatellite, SNP and their detection techniques.

**Text Book(s):**


- Principles of Genetics- 8th Edition, Gardner, Simmons and Snustad, 2002.
- The Cell- A Molecular Approach. 3rd Edition. Geoffrey M. Cooper, Robert E. Hausman, 2003.
- Genetics- Kavitha B. Ahluwalia, New Age International Pvt Ltd and Publishers, New Delhi, 2010
- Genetics – P.S Verma and A.K Agarwal (Rack 3, Central Library)
- Robert Brooker.2011. Genetics- Analysis and Principles. 4th edition. McGraw Hill.


**Reference Books:**


- Leland Hartwell, Leroy Hood, Michael Goldberg, Ann Reynolds, and Lee Silver, 2010.Genetics: From Genes to Genomes, 4th Edition, and McGraw Hill.
- Rastogi Smite and Neel am Pathak, 2010. Genetic Engineering, Oxford University Press, New Delhi. (Rack 3, Central Library)
- Watson, Hopkins, Roberts, Steitz, Weiner, 2004. Molecular Biology of Genes, 4th Edition.
- DNA markers Protocols, applications and overviews Anolles G. C. & Gressh off P. M. Wiley-Liss


**Web Resources:**

- mcdb-webarchive.mcdb.ucsb.edu/.../biochemistry/.../website-tourf.htm
- www.biochemweb.org/
- http://golgi.harvard.edu/biopages.html
- webarchive.mcdb.ucsb.edu/sears/biochemistry/info/website-

**Teaching Methodology**: Videos, Audios, PPT, Role Play, Quiz, Field Visit, Seminar, Chalk & Talk, Lecturing, Case Study, Demonstration, Problem Solving, Group Discussion, Flipped Learning

**Learning Outcomes:**

Upon successful completion of this course, the student will be able to:

| COs | Statements | Bloom's Level |
|---|---|---|
| CO1 | To understand the basics of pH and related principles and carbohydrate metabolism. | K2 |
| CO2 | To provide basic knowledge about lipid metabolism and related significance. | K2 |
| CO3 | To enlighten the students on Bio-energetics and Biological oxidation pathways. | K3 |
| CO4 | To update the knowledge on Amino acids and Protein. | K4 |
| CO5 | To assess and appraise the role of Nucleic acids. | K5 |

K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

**Mapping (COs vs POs)**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 |
|---|---|---|---|---|---|---|---|---|---|
| **CO1** | S | S | M | S | M | S | S | S | S |
| **CO2** | S | M | S | S | M | S | S | S | S |
| **CO3** | S | M | M | S | M | S | S | S | M |
| **CO4** | S | S | M | S | M | S | S | S | S |
| **CO5** | S | S | S | S | M | S | S | S | S |

**S - Strong, M – Medium, L – Low**

| Semester: I | Course Code: 23PBTCT03 | Hours/Week: 4 | Credit: 4 |
|---|---|---|---|

## COURSE TITLE: CORE - III MOLECULAR CELL BIOLOGY

**Course Overview:**

1. The paper imparts a thorough knowledge on the basics of all the Cell biology concepts, molecules and its regulation.
2. The student will get to understand the core concepts of molecules and cell biology.

**Learning Objectives:**

1. To understanding of the molecular machinery of living cells and the principles that govern the structures of macromolecules and their participation in molecular recognition.
2. Identify the structures and purposes of basic components in prokaryotic and eukaryotic cells and their molecular mechanism
3. Demonstrate knowledge and understanding of the principles and basic mechanisms of nuclear envelope and its functions.
4. Understand the metabolic pathways and the process of transmission of extracellular signals
5. Demonstrate the operation of various microscopes and microtome in the laboratory

| Unit – I | Introduction to cell Biology | 10 Hours |
|---|---|---|

Basic properties of cells-Cellular dimension-Size of cells and their composition-Cell origin and Evolution (Endosymbiosis theory)–Microscopy types and its Application in cell biology, Organelles of the eukaryotic cell and its functions; Bio membranes - structural organization and the transport systems (Passive, Active and Bulk transport), Cell-Cell adhesion- Cell junctions, Extra cellular matrix components and its role.

| Unit – II | Genome organization in Eukaryotes | 10 Hours |
|---|---|---|

DNA Replication, Transcription, and Translation and post translational Modification. Synthesis, sorting and trafficking of proteins: site of synthesis of organelle and membrane proteins – transport of secretary and membrane proteins across ER – post-translational modification, protein glycosylation – mechanism and regulation of vesicular transport – Golgi and post-Golgi sorting and processing – receptor mediated endocytosis; Synthesis of membrane lipids.

| Unit III | Nucleus | 10 Hours |
|---|---|---|

Nuclear envelope – Nuclear pore complexes-nuclear matrix – organization of chromatin – supercoiling, linking number, twist - nucleosome and high order of folding and organization of chromosome(Solenoid and Zigzag model)-Global structure of chromosome –(Lamp brush and polygenes chromosomes).

| Unit - IV | Eukaryotic cell cycle | 10 Hours |
|---|---|---|

Molecular basis of eukaryotic cell cycle, Regulation and cell cycle check points; Programmed cell death (Apoptosis); Cell-Cell signaling-signaling molecules, types of signaling, signal transduction pathways (GPCR-cAMP, IP3, RTK, MAP Kinase, JAK-STAT, Wnt Pathway).

| Unit - V | Cancer Biology | 10 Hours |
|---|---|---|

Multistage cancer development Mitogens, carcinogens, oncogenes and proto-oncogenes, tumor suppressor genes-Rb, p 53, Apoptosis and significance of apoptosis.

**Text Book(s):**


- Karp, G., 2009, Cell and Molecular Biology, Sixth edition, John Wiley & Sons, New York.
- David E.Sadva., 2009. Cell biology organelles structure and function, CBS publishers and distributors, New Delhi.
- Prakash S. Lohar, 2009. Cell and Molecular Biology.
- Bruce Alberts, Alexander Johnson, Julian Lewis, Martin Raff, 2007. Molecular Biology of the Cell, Fifth edition. Garland Science.


**Reference Books:**


- Lodish, H., Berk, A., Zipursky, S.L., Matsudaira, P., Kaiser, A., Krieger, Scott and Darnell, J. 2007. Molecular Cell Biology. Media Connected, sixth edition. W.H.Freeman and Company
- Geoffrey.M.Cooper, Robert.E.Hausman.2007.The Cell-A Molecular Approach, Fourth edition. Sinauer Associates. •
- Luiz Carlos Uchoa, Janqueira, Jose, Carneiro. 2005. Basic Histology Text and Atlas. McGraw-Hill Professional.
- Paul A, 2001, Text Book Of Cell And Molecular Biology 2edition Niyogi Books •
- T.Fleming. 2002. Cell interactions: A practical approach Second edition.


**Web Resources:**

- www.biochemweb.org/
- http://golgi.harvard.edu/biopages.html

**Teaching Methodology**: Videos, Audios, PPT, Role Play, Quiz, Field Visit, Seminar, Chalk & Talk, Lecturing, Case Study, Demonstration, Problem Solving, Group Discussion, Flipped Learning

**Learning Outcomes:**

Upon successful completion of this course, the student will be able to:

| COs | Statements | Bloom's Level |
|---|---|---|
| CO1 | To understanding of the molecular machinery of living cells and the principles that govern the structures of macromolecules and their participation in molecular recognition. | K2 |
| CO2 | Identify the structures and purposes of basic components in prokaryotic and eukaryotic cells and their molecular mechanism | K2 |
| CO3 | Demonstrate knowledge and understanding of the principles and basic mechanisms of nuclear envelope and its functions. | K2 |
| CO4 | Understand the metabolic pathways and the process of transmission of extracellular signals | K2 |
| CO5 | Demonstrate the operation of various microscopes and microtomy in the laboratory | K5 |

K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

**Mapping (COs vs POs)**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 |
|---|---|---|---|---|---|---|---|---|---|
| **CO1** | S | S | M | S | M | S | S | S | S |
| **CO2** | S | M | S | S | M | S | S | S | S |
| **CO3** | S | M | M | S | M | S | S | S | M |
| **CO4** | S | S | M | S | M | S | S | S | S |
| **CO5** | S | S | S | S | M | S | S | S | S |

**S - Strong, M – Medium, L – Low**

| Semester: I | Course Code: 23PBTCP01 | Hours/Week: 6 | Credit: 4 |
|---|---|---|---|

## COURSE TITLE: CORE PRACTICAL - I (BIOCHEMISTRY, MOLECULAR GENETICS & MOLECULAR CELL BIOLOGY)

**Course Overview:**

1. The practical will establish basic study skills on the subject and will improve the student's ability to calculate and improve their practical skill and knowledge.

**Learning Objectives:**

1. Illustrate basic biochemistry procedures
2. Study the methods of estimation of biomolecules
3. Isolate & Analyze DNA, RNA & protein
4. Critically analyze the isolated biomolecules
5. Evaluate the quality and purity of DNA, RNA & Protein

| Unit – I | (A) Biochemistry – Practical | 15 Hours |
|---|---|---|

**Major**

1. Extraction of Proteins from biological materials
2. Protein separation methods:-Ammonium sulphate Precipitation,
3. SDS PAGE
4. Estimation of Proteins by Lowry's method
5. Estimation of RNA by orcinol method
6. Estimation of DNA by diphenylamine method
7. Estimation of Carbohydrate by Anthrone method

**Minor Experiments**

1. Preparation of biological buffer - phosphate buffer
2. Separation of amino acids by Paper Chromatography
3. Separation of sugars by Thin layer Chromatography

**Demo Experiments**

1. Gel permeation chromatography,
2. Affinity chromatography,
3. Ion. Exchange chromatography
4. Western blotting
5. PCR

| Unit – II | (B) Molecular Genetics – Practical | 15 Hours |
|---|---|---|

1. Agarose gel electrophoresis of DNA
2. Isolation of RNA
3. Restriction digestion of DNA
4. Giant chromosome studies in Chironomous larvae
5. Cell counting and cell viability;
6. Meiotic study in flower bud sand cockroach or grasshopper.
7. Preparation of single cell suspension from spleen and thymus.

**Minor**

1. Isolation of DNA from bacteria.
2. Isolation of DNA from plants.
3. Plasmid DNA isolation.
4. Preparation of metaphase chromosomes from blood.

9. Histochemical staining to localize carbohydrates

11. Histochemical staining to localize lipids.

| Unit – III | (C) Molecular Cell Biology – Practical | 15 Hours |
|---|---|---|

**Demo Experiments**

1. Introduction to Microtome and types
2. Microtome-Fixation of tissue
3. Microtome -Embedding
4. Microtome-Sectioning of tissue
5. H&E Staining of tissues
6. Preparation of tissue culture medium and membrane filtration
7. Embryonic development and stem cells (*Scrupled polychaete*, *Hydroids elegant*/chick/ frog)

**Teaching Methodology**: Videos, Audios, PPT, Role Play, Quiz, Field Visit, Seminar, Chalk & Talk, Lecturing, Case Study, Demonstration, Problem Solving, Group Discussion, Flipped Learning

| **Learning Outcomes:** Upon successful completion of this course, the student will be able to: | | |
|---|---|---|
| **COs** | **Statements** | **Bloom's Level** |
| CO1 | Illustrate basic biochemistry procedures | K1 |
| CO2 | Study the methods of estimation of biomolecules | K2 |
| CO3 | Isolate & Analyze DNA, RNA & protein | K4 |
| CO4 | Critically analyze the isolated biomolecules | K4 |
| CO5 | Evaluate the quality and purity of DNA, RNA & Protein | K5 |
| K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create | | |

| **Mapping (COs vs POs)** | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** |
| **CO1** | **S** | **S** | **M** | **S** | **M** | **S** | **S** | **S** | **S** |
| **CO2** | **S** | **M** | **S** | **S** | **M** | **S** | **S** | **S** | **S** |
| **CO3** | **S** | **M** | **M** | **S** | **M** | **S** | **S** | **S** | **M** |
| **CO4** | **S** | **S** | **M** | **S** | **M** | **S** | **S** | **S** | **S** |
| **CO5** | **S** | **S** | **S** | **S** | **M** | **S** | **S** | **S** | **S** |

**S - Strong, M – Medium, L – Low**

| Semester: I | Course Code: 23PBTMEA1 | Hours/Week: 3 | Credit: 2 |
|---|---|---|---|

## COURSE TITLE: ELECTIVE - I BIOINSTRUMENTATION

**Course Overview:**

1. The paper imparts a thorough knowledge on the basics of all the instrumentation concepts, in biology.
2. The student will get to understand the core concepts of biological instruments and their principles.

**Learning Objectives:**

1. Introduction and various types of Microscopic techniques
2. Impart understanding on centrifugation instruments and techniques
3. Separation of Biomolecules
4. Analytical methods on Spectroscopic Analysis
5. Understand the application and Detection on Bioinstrumentation

| Unit – I | Microscopic Techniques | 07 Hours |
|---|---|---|

Principles and Applications: Compound, Light, Stereo, Phase Contrast, Fluorescent Microscopy, Scanning and Transmission Electron Microscopy, Scanning Electron Microscopy, Atomic Force Microscopy, Confocal Microscopy, FRET and Flow Cytometers.

| Unit – II | Centrifugation | 07 Hours |
|---|---|---|

Principle and Applications of various types of centrifuges, Chromatography Techniques: Principle and Application of Paper Chromatography, TLC, Gel Filtration Chromatography, Ion Exchange Chromatography, Affinity Chromatography, GC & HPLC.

| Unit III | Electrophoretic Techniques | 07 Hours |
|---|---|---|

Principle and Application of Agarose Gel Electrophoresis, 2D-gel Electrophoresis, PAGE- NATIVE & SDS PAGE, Iso-electric Focusing, High resolution Electrophoresis, Immune Electrophoresis (Immunofixation EP,), ELISA, RIA, Southern, Northern and Western Blotting. Electro blotting, PCR and RT-PCR, Microarray (DNA, Proteins)

| Unit - IV | Spectroscopic Techniques | 07 Hours |
|---|---|---|

Theory and Application of UV and Visible Spectroscopy, Fluorescence Spectroscopy, Mass Spectroscopy, IR Spectroscopy NMR, ESR, Atomic Absorption Spectroscopy, X- ray Spectroscopy.

| Unit - V | Radio-isotopic Techniques | 07 Hours |
|---|---|---|

Introduction to Radioisotopes, Uses and their Biological Applications, Principles and Applications of GM Counter, Solid and Liquid Scintillation Counter, Autoradiography, RIA, Radiation Dosimetry, Health effects of Radiations.

**Text Book(s):**

- M.H. Fulekar and Bhawana Pandey Bioinstrumentation, Wiley
- Keith Wilson, John Walker, 2010. Principles and Techniques of Biochemistry and Molecular Biology (7th Edition), Cambridge University Press •
- David L. Nelson, Michael M. Cox. Menninger (2008). Principles of Biochemistry, Fifth edition W. H. Freeman, New York. •
- Experiments in Biochemistry: A Hands-On Approach by Shawn O. Farrell, Ryan T. Ranallo, Paperback: 324 pages, Publisher: Brooks Cole. 20 •

**Reference Books:**

- Metzler D.E. 2001, the chemical reactions of living cells –Academic Press. 2nd edition.
- Stryer L, 1999, Biochemistry-W.H. Freeman & Company, New York. 1. • 4th edition
- L.Veerakumari (2006) Bioinstrumentation MJP Publisher Kindle edition
- Jefrey. M., Backer el al., 1996. Biotechnology- A Laboratory Course. Academic Press, New York.
- Holcapek, M., Byrdwell, Wm. C. 2017. Handbook of Advanced Chromatography /Mass Spectrometry Techniques, Elsevier

**Web Resources:**

- http://golgi.harvard.edu/biopages.html
- webarchive.mcdb.ucsb.edu/sears/biochemistry/info/website-

**Teaching Methodology**: Videos, Audios, PPT, Role Play, Quiz, Field Visit, Seminar, Chalk & Talk, Lecturing, Case Study, Demonstration, Problem Solving, Group Discussion, Flipped Learning

| **Learning Outcomes:** Upon successful completion of this course, the student will be able to: | | |
|---|---|---|
| **COs** | **Statements** | **Bloom's Level** |
| CO1 | Introduction and various types of Microscopic techniques | K1 |
| CO2 | Impart understanding on centrifugation instruments and techniques | K2 |
| CO3 | Separation of Biomolecules | K3 |
| CO4 | Analytical methods on Spectroscopic Analysis | K4 |
| CO5 | Understand the application and Detection on Bioinstrumentation | K2 |
| K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create | | |

| **Mapping (COs vs POs)** | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** |
| **CO1** | **S** | **S** | **M** | **S** | **M** | **S** | **S** | **S** | **S** |
| **CO2** | **S** | **M** | **S** | **S** | **M** | **S** | **S** | **S** | **S** |
| **CO3** | **S** | **M** | **M** | **S** | **M** | **S** | **S** | **S** | **M** |
| **CO4** | **S** | **S** | **M** | **S** | **M** | **S** | **S** | **S** | **S** |
| **CO5** | **S** | **S** | **S** | **S** | **M** | **S** | **S** | **S** | **S** |

**S - Strong, M – Medium, L – Low**

| Semester: I | Course Code: 23PBTMEB2 | Hours/Week: 3 | Credit: 2 |
|---|---|---|---|

## COURSE TITLE: ELECTIVE - II FOOD TECHNOLOGY

**Course Overview:**

1. The subject imparts knowledge on the fundamentals of food preservatives and additives.
2. The student will be provided with a basic knowledge and understanding about the functions of enzyme as well as the industrial application of enzymes.

**Learning Objectives:**

1. Explain the basics food preservative techniques
2. Classify and summarize the detailed methodologies of food preservative techniques
3. Examine the packing system of food and additives
4. Assess extraction and downstream processing of food
5. Compile the uses of food and design the packages for Industrial and public.

| Unit – I | Introduction, scope and important of food biotechnology | 07 Hours |
|---|---|---|

Microorganisms associated with food - bacteria, fungi & yeast. Enzymes in food preparation. Food contaminations. Food preservation & Food spoilage- types. Canning of foods.

| Unit – II | Food borne diseases | 07 Hours |
|---|---|---|

Food borne diseases and prevention – infection, in-toxification – Salmonellosis, poliomyelitis. Food colors (natural and artificial food colourants), Food flavoring agents.

| Unit III | Food engineering operations | 07 Hours |
|---|---|---|

Characteristics of food raw materials, preparative operations in food industry, cleaning of food raw materials, sorting of foods, grading of foods.

| Unit – IV | Spectroscopic Techniques | 07 Hours |
|---|---|---|

Theory and Application of UV and Visible Spectroscopy, Fluorescence Spectroscopy, Mass Spectroscopy, IR Spectroscopy NMR, ESR, Atomic Absorption Spectroscopy, X- ray Spectroscopy.

| Unit – V | Food quality | 07 Hours |
|---|---|---|

Sensory evaluation of food quality, quality factors for consumer safety, food safety standards. FSSA, HACCP and FDA. Processing plant - Cleaning and sanitation methods.

**Text Book(s):**

- Food Microbiology, William C.Frazier, Dennis C. West off, McGraw Hill Publications, 2017

**Reference Books:**

- Fundamentals of Food Microbiology, Bibek, Laramie & Bhunia, CRC Press 2004

**Web Resources:**

- https://en.wikipedia.org/wiki/Novel_food
- https://www.chemicalsafetyfacts.org/preservatives/

| |
|---|
| **Teaching Methodology**: Videos, Audios, PPT, Role Play, Quiz, Field Visit, Seminar, Chalk & Talk, Lecturing, Case Study, Demonstration, Problem Solving, Group Discussion, Flipped Learning |

**Learning Outcomes:**

Upon successful completion of this course, the student will be able to:

| COs | Statements | Bloom's Level |
|---|---|---|
| CO1 | Explain the basics food preservative techniques | K1 |
| CO2 | Classify and summarize the detailed methodologies of food preservative techniques | K2 |
| CO3 | Examine the packing system of food and additives | K3 |
| CO4 | Assess extraction and downstream processing of food | K4 |
| CO5 | Compile the uses of food and design the packages for Industrial and public. | K5 |

K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

**Mapping (COs vs POs)**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 |
|---|---|---|---|---|---|---|---|---|---|
| **CO1** | **S** | **S** | **M** | **S** | **M** | **S** | **S** | **S** | **S** |
| **CO2** | **S** | **M** | **S** | **S** | **M** | **S** | **S** | **S** | **S** |
| **CO3** | **S** | **M** | **M** | **S** | **M** | **S** | **S** | **S** | **M** |
| **CO4** | **S** | **S** | **M** | **S** | **M** | **S** | **S** | **S** | **S** |
| **CO5** | **S** | **S** | **S** | **S** | **M** | **S** | **S** | **S** | **S** |

**S - Strong, M – Medium, L – Low**

| Semester: II | Course Code: 23PBTCT04 | Hours/Week: 4 | Credit: 4 |
|---|---|---|---|

## COURSE TITLE : CORE - IV MICROBIOLOGY

**Course Overview:**

1. To provide a comprehensive knowledge on taxonomy and microbial diversity, growth, their harmful effects and beneficial role of microorganisms in agriculture and environment

**Learning Objectives:**

1. To understand the major discoveries of microbiology and describe microbial diversity, Microbial growth and metabolism.
2. To provide basic knowledge about microbial culture, identification of microbes, principle and working of microscopes and sterilization techniques
3. To enlighten the students on host microbe interaction and Epidemiology of microbial disease
4. To update the knowledge on epidemic and pandemic diseases.
5. To assess and appraise the role of novel microbes in environment and integrate them in specific innovative approaches.

| Unit – I | History and microbial taxonomy | 10 Hours |
|---|---|---|

Major discoveries related to the field of microbiology: Antony Von Leeuwenhoek, Louis Pasteur, Robert Koch and Edward Jenner. Microbial taxonomy: Bacteria, viruses, fungi, algae and protozoa, Microbial growth and metabolism: Microbial growth: Growth curve, factors affecting growth

| Unit – II | Microbial culture, identification, and control | 10 Hours |
|---|---|---|

Microbial culture, identification, and control: Nutritional requirements for growth - Growth media and types, Pure culture techniques: Serial dilution and plating methods, Staining methods - Principles and types of staining (simple and differential), Microscopy: principles and applications of Bright field, florescent and Scanning electron microscopes, Microbial growth control: Physical Methods – Heat, Low Temperatures, High Pressure, Osmotic Pressure, Radiation

| Unit III | Host microbe interaction and Epidemiology | 10 Hours |
|---|---|---|

Human micro biome; Skin, Gastrointestinal tract, Oral cavity, Lung. Microbial interaction: Symbiosis, Mutualism, Parasitism, Commensalism and endophyte. Epidemiology of microbes: causes, types and transmission of epidemic, endemic and pandemic diseases

| Unit - IV | Microbial Diseases | 10 Hours |
|---|---|---|

Microbial diseases - General characteristics, pathogenesis, laboratory diagnosis and control measures of Pandemic and Epidemic diseases: Cholera, COVID-19, AIDS,, Malaria.

| Unit - V | Agricultural Microbiology | 10 Hours |
|---|---|---|

Biological nitrogen fixation, free living, symbiotic nitrogen fixation, mechanism of Nitrogen, Bio fertilizers-types and applications; Rhizosphere, Rhizobium Azospirillum, Azolla, BGA

**Text Book(s):**


- Joanne Willey, Linda Sherwood, Christopher J. Woolverton, (2017). Prescott's Microbiology, (10th edition), McGraw-Hill Education, ISBN: 978-1259281594.
- Maheshwari D K, Dubey R C 2013. A Textbook of Microbiology.4th Edn S Chand Publishing India.
- Ananthanarayan and Paniker's (2017) Textbook of Microbiology, (10th edition), The Orient Blacks wan, ISBN: 978-9386235251.


**Reference Books:**


- Benson HJ. (1999). Microbiological Applications: A Laboratory manual in General Microbiology, 7th Edition, and McGraw Hill. 5
- Managing epidemics- Key facts about major deadly diseases, World Health Organization (WHO) 2018. 9. O'Flaherty, Vincent & Collins, Gavin & Mahony, Therese. (2010). Environmental Microbiology, Second Edition. 10.1002/9780470495117.ch11.
- Agriculture Microbiology, 2016. E-Course Developed By TNAU (ICAR)


**Web Resources:**

- https://www.who.int/emergencies/diseases/managing-epidemics-interactive.pdfISBN
- 978-92-4-156553-0. https://doi.org/10.3389/fmicb.2020.631736
- https://www.agrimoon.com/wp-content/uploads/AGRICULTURAL-Microbiology.pdf.

**Teaching Methodology**: Videos, Audios, PPT, Role Play, Quiz, Field Visit, Seminar, Chalk & Talk, Lecturing, Case Study, Demonstration, Problem Solving, Group Discussion, Flipped Learning

**Learning Outcomes:**

Upon successful completion of this course, the student will be able to:

| COs | Statements | Bloom's Level |
|---|---|---|
| CO1 | To understand the major discoveries of microbiology and describe microbial diversity, Microbial growth and metabolism. | K2 |
| CO2 | To provide basic knowledge about microbial culture, identification of microbes, principle and working of microscopes and sterilization techniques | K2 |
| CO3 | To enlighten the students on host microbe interaction and Epidemiology of microbial disease | K3 |
| CO4 | To update the knowledge on epidemic and pandemic diseases. | K4 |
| CO5 | To assess and appraise the role of novel microbes in environment and integrate them in specific innovative approaches. | K5 |

K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

**Mapping (COs vs POs)**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 |
|---|---|---|---|---|---|---|---|---|---|
| **CO1** | **S** | **S** | **M** | **S** | **M** | **S** | **S** | **S** | **S** |
| **CO2** | **S** | **M** | **S** | **S** | **M** | **S** | **S** | **S** | **S** |
| **CO3** | **S** | **M** | **M** | **S** | **M** | **S** | **S** | **S** | **M** |
| **CO4** | **S** | **S** | **M** | **S** | **M** | **S** | **S** | **S** | **S** |
| **CO5** | **S** | **S** | **S** | **S** | **M** | **S** | **S** | **S** | **S** |

**S - Strong, M – Medium, L – Low**

| Semester: II | Course Code: 23PBTCT05 | Hours/Week: 4 | Credit: 4 |
|---|---|---|---|

## COURSE TITLE : CORE - V PLANT AND ANIMAL BIOTECHNOLOGY

**Course Overview:**

1. The paper imparts a thorough knowledge on the basics of all the biotechnological application on plant and animals.
2. The student will get to understand the core concepts of biotechnology.

**Learning Objectives:**

1. To impart theoretical knowledge on various techniques of plant biotechnology like tissue culture, plant genetic transformation and their application in industries.
2. Importance of secondary metabolites and production in plants.
3. To develop concepts, principles and processes in animal biotechnology.
4. Concept and different types in Animal Cell Culture and animal cell lines.
5. Use of molecular biology techniques genetically engineers the animals to improve sustainability, productivity and suitability for pharmaceutical and industrial applications.

| Unit – I | Introduction of plant tissue culture | 10 Hours |
|---|---|---|

Introduction of plant tissue culture, composition of media, Micro propagation, somatic embryogenesis, haploid and triploid production, protoplast isolation and fusion, hybrid and cybrid, synthetic seed production.

| Unit – II | Plant Transformation – Electroporation | 10 Hours |
|---|---|---|

Plant Transformation Direct transformation by electroporation and particle gun bombardment. Agrobacterium, Ti plasmid vector. Theory and techniques for the development of new genetic traits, conferring resistance to biotic and abiotic. Plant engineering towards the development of enriched food products, plant growth regulators; Molecular Marker aided breeding: RFLP maps, RAPD markers, QTL, Map based cloning and Molecular marker assisted selection.

| Unit III | An Introduction about Animal Cell Culture | 10 Hours |
|---|---|---|

An Introduction about animal cell culture, Planning and Construction of Lab layout, Equipment - Laminar-flow hood, CO2 Incubators, Inverted microscope, Cry storage containers, Aseptic concepts and Cell culture vessel. Preparation of Media- defined media and supplements, Types of cell culture media; Physical and chemical property of Medium, Balanced salts, Antibiotics, growth supplements; Fetal bovine serum; Serum free media primary and established culture; organ culture; tissue culture

| Unit - IV | Cloning micromanipulation | 10 Hours |
|---|---|---|

Disaggregation of tissue and primary culture; cell separation, Slide and coverslip cultures, flask culture, test tube culture techniques, cell synchronization, cryo preservation. Scaling up of animal cell culture, cell line and cloning micromanipulation and cloning, somatic cell cloning. Karyotyping; measuring parameters for growth, measurement of cell death, apoptosis and its determination, cytotoxicity assays.

| Unit – V | Production of biologically important compounds | 10 Hours |
|---|---|---|

Culture Scale up and mass production of biologically important compounds. Harvesting of products, purification and assays. Transgenic animals: Production and application; transgenic animals in livestock improvement, transgenic animals as model for human diseases.

**Text Book(s):**

- Food Microbiology, William C.Frazier, Dennis C. Westhoff, McGraw Hill Publications, 2017

**Reference Books:**

- Fundamentals of Food Microbiology, Bibek, Laramie & Bhunia, CRC Press 2004

**Web Resources:**

- https://www.who.int/emergencies/diseases/managing-epidemics-interactive.pdfISBN

**Teaching Methodology**: Videos, Audios, PPT, Role Play, Quiz, Field Visit, Seminar, Chalk & Talk, Lecturing, Case Study, Demonstration, Problem Solving, Group Discussion, Flipped Learning

**Learning Outcomes:**

Upon successful completion of this course, the student will be able to:

| COs | Statements | Bloom's Level |
|---|---|---|
| CO1 | To impart theoretical knowledge on various techniques of plant biotechnology like tissue culture, plant genetic transformation and their application in industries. | K1 |
| CO2 | Importance of secondary metabolites and production in plants. | K2 |
| CO3 | To develop concepts, principles and processes in animal biotechnology. | K3 |
| CO4 | Concept and different types in Animal Cell Culture and animal cell lines. | K4 |
| CO5 | Use of molecular biology techniques genetically engineers the animals to improve sustainability, productivity and suitability for pharmaceutical and industrial applications. | K5 |

K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

**Mapping (COs vs POs)**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 |
|---|---|---|---|---|---|---|---|---|---|
| **CO1** | S | S | M | S | M | S | S | S | S |
| **CO2** | S | M | S | S | M | S | S | S | S |
| **CO3** | S | M | M | S | M | S | S | S | M |
| **CO4** | S | S | M | S | M | S | S | S | S |
| **CO5** | S | S | S | S | M | S | S | S | S |

**S - Strong, M – Medium, L – Low**

| Semester: II | Course Code: 23PBTCT06 | Hours/Week: 4 | Credit: 4 |
|---|---|---|---|

## COURSE TITLE: CORE - VI GENETIC ENGINEERING

**Course Overview:**

1. The paper imparts a thorough knowledge on the basics of all the biotechnological application on plant and animals.
2. The student will get to understand the core concepts of biotechnology.

**Learning Objectives:**

1. Understanding the basic steps of gene cloning and the role of enzymes and vectors responsible for gene manipulation, transformation and genetic engineering.
2. Getting detailed knowledge of gene transfer methods and identifying suitable hosts for cloning.
3. Acquiring theoretical knowledge in the techniques, tools, and application and safety measures of genetic engineering.
4. Describes the genome mapping and sequencing and methods for gene therapy.
5. Elucidate different techniques involved in genetic engineering

| Unit – I | Gene cloning | 10 Hours |
|---|---|---|

Genetic engineering tools. Nucleic acid manipulating enzymes. Promoters, Selectable markers and reporters used in rDNA technology. Restriction digestion, Ligation, Transformation.

| Unit – II | E.coli vectors | 10 Hours |
|---|---|---|

pBR322 and its derivatives; Cloning vectors for gram negative bacteria - ColE1, p15A, R1, IncPa, pSC101; Lambda bacteriophage vectors, filamentous phages, Cosmids, Phasmids, Phagemids. Cloning in gram-positive bacteria (Bacillus subtilis).

| Unit – III | Cloning in yeast Saccharomyces cerevisae | 10 Hours |
|---|---|---|

Cloning in yeast Saccharomyces cerevisae. Life cycle and types of vectors; Eukaryotic vectors. SV40 (molecular genetics and expression); Construction of gene libraries: Genomic and cDNA library, Specialized cloning vector for cDNA; Synthesis of specific RNA in vitro; Vectors for cloning promoters and terminators; vectors with adjustable copy number

| Unit – IV | Nucleic acid hybridization techniques | 10 Hours |
|---|---|---|

Molecular probes (Types of probes and its construction); probe labeling. Nick translation, End labeling and Random primer labeling. Polymerase chain reaction and its variants; DNA fingerprinting; DNA sequencing first generation sequencing method (Illumina sequencing). Second generation sequencing methods

| Unit – V | Site directed mutagenesis | 10 Hours |
|---|---|---|

DNA microarray, Molecular techniques in prenatal diagnosis gene therapy, Transgenic animals (knockout mice) and plants (Flavrsavr tomato), Pharmaceutical products (Vaccine, Humulin, etc.), Crop improvement. Pesticide resistance, herbicide resistance, transgenic animals and GM foods; Modern Concepts in Genetic Analysis.

**Text Book(s):**


- T.A. Brown, 2010. Gene cloning and DNA analysis: An introduction, 6th edition, Wiley-Blackwell.
- Sandy B.Primrose and Richard Twyman, 2006. Principles of Gene Manipulation and genomics, 7th edition, Wiley-Blackwell.
- Lewin, 2009. Genes X, 10th edition, Jones & Barlett Publishers
- Raymond Rodriguez and David T.Denhart 2003.Vectors, A survey of molecular cloning vectors and their uses


**Reference Books:**


- Errst-L. Winnacker 1987.From genes to clones. Introduction to Gene Technology,
- Ed. David V. Geoddel 2002.Gene Expression technologies. Methods in enzymology (Vol.185)
- William Wu, Michael J.Welsh, Peter B.Kaufrmar, Helen H.Zhang 2001. Methods in Gene Biotechnology.


**Web Resources:**

- http://library.nuft.edu.ua/ebook/file/Gad2007.pdf
- https://oasis.iik.ac.id:9443/library/repository/a932eb462c49885a2c72755977036b81.pdf

| |
|---|
| **Teaching Methodology**: Videos, Audios, PPT, Role Play, Quiz, Field Visit, Seminar, Chalk & Talk, Lecturing, Case Study, Demonstration, Problem Solving, Group Discussion, Flipped Learning |

**Learning Outcomes:**

Upon successful completion of this course, the student will be able to:

| COs | Statements | Bloom's Level |
|---|---|---|
| CO1 | Understanding the basic steps of gene cloning and the role of enzymes and vectors responsible for gene manipulation, transformation and genetic engineering. | K2 |
| CO2 | Getting detailed knowledge of gene transfer methods and identifying suitable hosts for cloning. | K2 |
| CO3 | Acquiring theoretical knowledge in the techniques, tools, and application and safety measures of genetic engineering. | K3 |
| CO4 | Describes the genome mapping and sequencing and methods for gene therapy. | K4 |
| CO5 | Elucidate different techniques involved in genetic engineering | K5 |

K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

**Mapping (COs vs POs)**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 |
|---|---|---|---|---|---|---|---|---|---|
| **CO1** | S | S | S | S | S | S | S | S | S |
| **CO2** | M | S | S | S | S | M | S | M | M |
| **CO3** | S | S | S | M | M | S | M | S | S |
| **CO4** | S | S | S | S | S | S | S | M | S |
| **CO5** | M | S | S | S | S | S | M | S | M |

**S - Strong, M – Medium, L – Low**

| Semester: II | Course Code: 23PBTCP02 | Hours/Week: 6 | Credit: 4 |
|---|---|---|---|

## COURSE TITLE: CORE PRACTICAL – II MICROBIOLOGY, PLANT & ANIMAL BIOTECHNOLOGY, GENETIC ENGINEERING

**Course Overview:**

1. The practical will establish a basic study skill on the subject and will improve the student's ability to have hands on experience on the above core subjects.

**Learning Objectives:**

1. Isolate and identify microbes from various sources.
2. Characterize microbes.
3. Examine Plant and Animal cells and their functions
4. Assess extracted DNA, RNA and protein for rDNA technology
5. To study cloning tools

| Unit – I | (A) Microbiology-Practical | 15 Hours |
|---|---|---|

1. Sterilization of glassware using dry heat- hot air oven
2. Sterilization of media.
3. Liquid media preparation – nutrient broth
4. Preparation of Agar slants
5. Streak plate method
6. Gram staining and morphological characterization of microbes.
7. IMViC test of enteric bacteria
8. Isolation of microbes from soil, water and air.
9. Isolation of pure culture of E.coli

| Unit – II | (B) Plant and Animal Biotechnology - Practical | 15 Hours |
|---|---|---|

1. Plant tissue culture media preparation
2. Callus induction.
3. Isolation of plant protoplast
4. Protoplast viability test.
5. Mass culture of Chlorella /Spirulina
6. Preparation of tissue culture media
7. Preparation of single cell suspension from chicken liver (Primary cell culture).
8. Trypsinization of established cell culture.
9. Cell counting and viability - staining of cells Vital Staining (Trypan blue)
10. 13. MTT Assay (Demo)

| Unit – III | (C) Genetic Engineering - Practical | 15 Hours |
|---|---|---|

1. Preparation of plasmid DNA by alkaline lysis method.
2. Elution of DNA from agarose gel.
3. Restriction enzyme digestion.
4. Ligation.
5. Competent cell preparation
6. Transformation and selection of recombinants by Insertional inactivation/Blue white screening.
7. RAPD (Demo)
8. Amplification of DNA – PCR (Demo)
9. Determination of molecular weight of DNA by electrophoresis.

**Learning Outcomes:**

Upon successful completion of this course, the student will be able to:

| COs | Statements | Bloom's Level |
|---|---|---|
| CO1 | Isolate and identify microbes from various sources. | K1 |
| CO2 | Characterize microbes. | K2 |
| CO3 | Examine Plant and Animal cells and their functions | K3 |
| CO4 | Assess extracted DNA, RNA and protein for rDNA technology | K4 |
| CO5 | To study cloning tools | K5 |

K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

**Mapping (COs vs POs)**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 |
|---|---|---|---|---|---|---|---|---|---|
| CO1 | S | S | S | S | S | S | S | S | S |
| CO2 | M | S | S | S | S | M | S | M | M |
| CO3 | S | S | S | M | M | S | M | S | S |
| CO4 | S | S | S | S | S | S | S | M | S |
| CO5 | M | S | S | S | S | S | M | S | M |

**S - Strong, M – Medium, L – Low**

| Semester: II | Course Code: 23PBTMEB3 | Hours/Week: 2 | Credit: 2 |
|---|---|---|---|

## COURSE TITLE: ELECTIVE - III PHARMACEUTICAL BIOTECHNOLOGY

**Course Overview:**

1. The subject imparts knowledge on the fundamentals of pharmaceutical biotechnology.
2. The student will be provided with a basic knowledge and understanding about the pharmaceutical products produced based on biotechnological methods and its biomedical applications.

**Learning Objectives:**

1. Explain the basic components of pharmaceutical and biotechnology industry and methods and applications of biosensor
2. Describe the Scientific, technical and economic aspects of vaccine & rDNA technology
3. Describe the basic concepts of protein Engineering, therapeutic proteins and enzyme immobilization techniques
4. Describe the concepts of hybridism technology, microbial biotransformation and microbial bio-transformed products
5. Explain the basic components of somatic gene therapy, Xeno-transplantation and fermenter and bio safety methods

| Unit - I | Introduction to concepts in pharmaceutical biotechnology | 07 Hours |
|---|---|---|

Introduction to concepts and technologies in pharmaceutical biotechnology and industrial applications, Biosensors- Working and applications of biosensors in pharmaceutical Industries; Pharmacology and Ethno pharmacology: Scope, applications and Importance.

| Unit - II | Scientific, technical and economic aspects of vaccine | 07 Hours |
|---|---|---|

Scientific, technical and economic aspects of vaccine research and development, Preparation of bacterial vaccines, toxoids, viral vaccine and antitoxins, Storage conditions and stability of vaccines, Recombinant DNA technology, Application of rDNA technology and genetic engineering in the production of: (i) Interferon (ii) Vaccines - hepatitis- B (iii) Hormones – Insulin, Brief introduction to Protein Engineering, Therapeutic proteins, Production of Enzymes- General consideration – Amylase, Catalase, Peroxidase, Lipase, Protease, Penicillinase, Methods of enzyme immobilization and applications

| Unit - III | Hybridoma technology | 07 Hours |
|---|---|---|

Production, Purification and Applications, Formulation of biotech products - Rituximab, Introduction to Microbial biotransformation and applications, Study of the production of – penicillin, citric acid, Vitamin B12, Glutamic acid and Griseofulvin Somatic gene therapy, Xenotransplantation in pharmaceutical biotechnology, Large scale production fermenter design and its various controls, Bio safety in pharmaceutical industry

| Unit - IV | Pharmacological activity of Plant drugs | 07 Hours |
|---|---|---|

Pharmacological activity of Plant drugs, Plant Chemicals in modern pharmacology; biochemistry and pharmacology of atropine, caffeine, ephedrine, opioids, taxol, vinca alkaloids, synthetic substitutes for therapeutically active plant constituents; drug improvement by structure modification and bio-transformation. Criteria for pharmacological evaluation of drugs.

| Unit - V | Clinical Pharmacology | 07 Hours |
|---|---|---|

Clinical Pharmacology, Drug therapy, therapeutic situation, benefits and risk of use of drugs, Mechanism of drug action, Therapeutic efficacy, Therapeutic index, tolerance, dosage forms and routes of drug action factors affecting drug action; Adverse Drug reactions and drug poisoning-classification and causes of ADR; principle clinical manifestations and treatment of ADR, General principles of management of drug poisoning; antidotes, classifications of drugs.

**Text Book(s):**


- Harbanslal, 2011. Pharmaceuticals biochemistry. CBS Publishers and distributors Pvt. Ltd, Chennai.
- Carlos A. Guzmán and Giora Z. Feuerstein, 2009. Pharmaceutical Biotechnology, 1st edition, Springer.
- Daniel Figeys (Ed.). 2005. Industrial Proteomics: Applications for Biotechnology and Pharmaceuticals. Wiley, John & Sons, Incorporated.
- Kayser, O and Muller R.H... 2004. Pharmaceutical Biotechnology Drug Discovery and Clinical Applications. WILEY-VCH


**Reference Books:**


- Leon Shargel, Andrew B. C. Yu, Susanna Wu-Pong, and Yu Andrew B. C. 2004. Applied Bio pharmaceutics & Pharmacokinetics. McGraw-Hill Companies
- Stefanie Spade, Gary Walsh. 2004. Directory of approved biopharmaceutical
- Gary Walsh. 2003. Biopharmaceutical, Biochemistry & Biotechnology.

- Heinrich Klefenz. 2002. Industrial pharmaceutical biotechnology.
- Thomas Lengauer (Ed.). 2002. Bioinformatics – from Genomes to Drugs. Volume I& II. Wiley-VCH.


**Web Resources:**

- https://tugasakhirsttifbogor.files.wordpress.com/2018/08/pharmaceutical-biotechnology.pdf
- http://library.nuft.edu.ua/ebook/file/Gad2007.pdf
- https://oasis.iik.ac.id:9443/library/repository/a932eb462c49885a2c72755977036b81.pdf

**Teaching Methodology**: Videos, Audios, PPT, Role Play, Quiz, Field Visit, Seminar, Chalk & Talk, Lecturing, Case Study, Demonstration, Problem Solving, Group Discussion, Flipped Learning

**Learning Outcomes:**

Upon successful completion of this course, the student will be able to:

| COs | Statements | Bloom's Level |
|---|---|---|
| CO1 | Explain the basic components of pharmaceutical and biotechnology industry and methods and applications of biosensor | K1 |
| CO2 | Describe the Scientific, technical and economic aspects of vaccine & rDNA technology | K2 |
| CO3 | Describe the basic concepts of protein Engineering, therapeutic proteins and enzyme immobilization techniques | K3 |
| CO4 | Describe the concepts of hybridoma technology, microbial biotransformation and microbial bio-transformed products | K4 |
| CO5 | Explain the basic components of somatic gene therapy, Xeno-transplantation and fermenter and bio safety methods | K5 |

K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

**Mapping (COs vs POs)**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 |
|---|---|---|---|---|---|---|---|---|---|
| CO1 | S | S | S | S | S | S | S | S | S |
| CO2 | M | S | S | S | S | M | S | M | M |
| CO3 | S | S | S | M | M | S | M | S | S |
| CO4 | S | S | S | S | S | S | S | M | S |
| CO5 | M | S | S | S | S | S | M | S | M |

**S - Strong, M – Medium, L – Low**

| Semester: II | Course Code: 23PBTMEB4 | Hours/Week: 2 | Credit: 2 |
|---|---|---|---|

## COURSE TITLE: ELECTIVE - IV MARINE BIOTECHNOLOGY

**Course Overview:**

1. The subject imparts knowledge on the fundamentals of ecology and pollution.
2. The student will be provided with a basic knowledge and understanding about the functions of ecosystem and reduction of pollution by biotechnological tools.

**Learning Objectives:**

1. To gain employment in state and federal marine laboratories as well as private marine companies and aquariums.
2. To understand the extensive underwater and field research abilities coupled with synergistic molecular bench skills.
3. To assess the benefits of marine biotechnology is its potential to produce novel pharmaceuticals.
4. To enlighten the marine organisms such as sponges, tunicates, and algae are a rich source of biologically active compounds, including anti-cancer, anti-inflammatory, and anti-viral agents.
5. To develop the new pharmaceutical drugs, chemical products, enzymes, and other products and processes

| Unit – I | Biotechnology in marine science | 07 Hours |
|---|---|---|

History of marine biotechnology application in aquaculture, pharmaceutical, environment remediation, bio fouling

| Unit – II | Developmental biotechnology | 07 Hours |
|---|---|---|

Developmental biotechnology induced breeding in-vitro fertilization cry preservation biotechnological tools - ELISA, FISH, PCR Gene probes, dot immune binding activity

| Unit – III | Bioactive marine natural products | 07 Hours |
|---|---|---|

Membrane receptors, anti-tumor compounds, anti-inflammatory / analgesic compounds, anti-viral agents, isolation and identification of marine bioactive compounds such as labile proteins, toxins, carotenoids bio terminator Commercial development of marine natural products- chitosan, chitin.

| Unit – IV | Algal biotechnology | 07 Hours |
|---|---|---|

Single cell protein, hydrocolloids, agarose, carrageen, alginates and other byproducts. Marine Enzymes sources and their applications Marine Lipids sources and their applications.

| Unit – V | Microbial biodegradation | 07 Hours |
|---|---|---|

Microbial biodegradation – natural and synthetic material in the marine environment-pesticide. Bioremediation of xenobiotic oil, heavy metals, pesticides, plastics, etc. Mining and metal biotechnology.

**Text Book(s):**


- Italy, E (Eds).1998, New Developments in Marine Biotechnology, Plenum Pub. Corp.
- Milton Finger man and Rachakonda Nagabhushanam, 1996, Molecular Genetics of Marine Organisms, Science Pub Inc.
- Y.Le Galn and H.O. Halvorson 1998, New Developments in Marine Biotechnology. Springer.


**Reference Books:**


- DavidH. Atta way, 2001. Marine Biotechnology, Volume1, Pharmaceutical and Bioactive Natural Products.
- RitaR.Colwell1984.BiotechnologyintheMarineSciences (Advances in Marine Science & Biotechnology) Wiley Inter science.
- Scheupr,P.J.(Ed.),1984.ChemistryofMarineNaturalProducts,,ChemicalandBiologicalPerspectives.Vol.I III, Academic Press, New York.


**Web Resources:**

- http://library.nuft.edu.ua/ebook/file/Gad2007.pdf
- https://oasis.iik.ac.id:9443/library/repository/a932eb462c49885a2c72755977036b81.pdf

**Teaching Methodology**: Videos, Audios, PPT, Role Play, Quiz, Field Visit, Seminar, Chalk & Talk, Lecturing, Case Study, Demonstration, Problem Solving, Group Discussion, Flipped Learning

**Learning Outcomes:**

Upon successful completion of this course, the student will be able to:

| COs | Statements | Bloom's Level |
|---|---|---|
| CO1 | To gain employment in state and federal marine laboratories as well as private marine companies and aquariums. | K1 |
| CO2 | To understand the extensive underwater and field research abilities coupled with synergistic molecular bench skills. | K2 |
| CO3 | To assess the benefits of marine biotechnology is its potential to produce novel pharmaceuticals. | K3 |
| CO4 | To enlighten the marine organisms such as sponges, tunicates, and algae are a rich source of biologically active compounds, including anti-cancer, anti-inflammatory, and anti-viral agents. | K4 |
| CO5 | To develop the new pharmaceutical drugs, chemical products, enzymes, and other products and processes | K5 |

K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

**Mapping (COs vs POs)**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 |
|---|---|---|---|---|---|---|---|---|---|
| **CO1** | **S** | **S** | **S** | **S** | **S** | **S** | **S** | **S** | **S** |
| **CO2** | **M** | **S** | **S** | **S** | **S** | **M** | **S** | **M** | **M** |
| **CO3** | **S** | **S** | **S** | **M** | **M** | **S** | **M** | **S** | **S** |
| **CO4** | **S** | **S** | **S** | **S** | **S** | **S** | **S** | **M** | **S** |
| **CO5** | **M** | **S** | **S** | **S** | **S** | **S** | **M** | **S** | **M** |

**S - Strong, M – Medium, L – Low**

| Semester: II | Course Code: 23PBCNE05 | Hours/Week: 2 | Credit: 2 |
|---|---|---|---|

## COURSE TITLE: NON MAJOR ELECTIVE COURSE - NUTRITIONAL BIOCHEMISTRY

**Course Overview:**

1. The subject imparts knowledge on the Nutritional biochemistry
2. Basic knowledge on food, nutrition & dietetics, and metabolism of nutrients.

**Learning Objectives:**

1. To understand basic concepts involved in growth , health, nutrition, physiology and metabolism
2. To discuss the concepts and applications of nutrition in correlation with biochemistry
3. To define nutritional needs in healthy individuals and modification of diet during illness.
4. To describe the biochemical, physiological and nutritional functions of macronutrients and their integrated role.

| Unit - I | Basic concepts | 07 Hours |
|---|---|---|

Basic concepts - Nutrition - Food groups and balanced diet. Novel Foods. Calorific value of foods: Direct and indirect calorimetry. Empty calories. Basal metabolic rate: Factors affecting BMR. SDA and physical activity. Calculation of day‘s energy requirement. Assessment of nutritional status. Lactose intolerance. Nutritional requirement and biochemical changes in different physiological states -infancy, childhood, pregnancy, lactation, and ageing. Sports nutrition.

| Unit - II | Elements of nutrition | 07 Hours |
|---|---|---|

Plant and animal sources of simple and complex carbohydrates, fats and proteins and their requirement. Biological significance, deficiency and toxicity of macronutrients and micronutrients. Role of dietary fiber. Protein sparing action of carbohydrates and fats. Essential amino acids. Essential fatty acids. Effects of naturally occurring food toxins, preservatives, additives, alcohol and tobacco on health

| Unit - III | Vitamins and Minerals | 07 Hours |
|---|---|---|

Dietary sources, classification, biochemical functions, requirements, absorption, metabolism and excretion. Vitamin B complex as coenzyme. Nutritional significance of dietary calcium,
Phosphorus, magnesium, iron, iodine, zinc and copper

| Unit - IV | Malnutrition | 07 Hours |
|---|---|---|

Diseases arising due to Protein - Calorie Malnutrition and under nutrition (Kwashiorkor and Marasmus), Prevention of malnutrition. Deficiency diseases associated with vitamin B complex, vitamin C and A, D, E & K vitamins - Mineral deficiency diseases - aetiology, sign and symptoms and dietary supplementation. Enrichment and fortification (vitamins and minerals)

| Unit - V | Nutrition in Diseases | 07 Hours |
|---|---|---|

A etiology, signs and symptoms , treatment and dietary management during fever(Typhoid and Malaria) and infectious diseases(COVID-19), Jaundice, hyper acidity (Ulcer), Atherosclerosis, Hypertension, kidney diseases and diabetes in adults. Starvation and Obesity. Inter-
50relationship of nutrition, infection, immunity and poverty

**Text Book(s):**

- Srilakshmi. E (2016) Nutrition Science, New Age International Publishers. Mahan, Kathleen L. (2004)
- Krause‘s Food, Nutrition and Diet Therapy, W.B. Saunder‘s 11th Edition Andreas M. Papas (1998).

**Reference Books:**

- Antioxidant Status, Diet, Nutrition, and Health (1st end) CRC Press. M. Swami Nathan (1995)
- Principles of Nutrition and Dietetics. Bappco Margaret Mc Williams (2012).
- Food Fundamentals (10th end) Prentice Hall Tom Brody (1998) Nutritional Biochemistry (2nd end). Academic Press, USA

**Web Resources:**

- https://en.wikipedia.org/wiki/Novel_food
- https://www.chemicalsafetyfacts.org/preservatives/
- https://www.sciencedirect.com/topics/agricultural-and-biologicalsciences/food-enrichment

**Teaching Methodology**: Videos, Audios, PPT, Role Play, Quiz, Field Visit, Seminar, Chalk & Talk, Lecturing, Case Study, Demonstration, Problem Solving, Group Discussion, Flipped Learning

| **Learning Outcomes:**<br>Upon successful completion of this course, the student will be able to: | | |
|---|---|---|
| **COs** | **Statements** | **Bloom's Level** |
| CO1 | To Plan a balanced diet based on an individual's energy requirement, Assess nutritional status of an individual. | K1 |
| CO2 | Understand the role played by ant nutritional factors. | K2 |
| CO3 | Evaluate the functions of vitamins and minerals ,and fluids and electrolyte balance in different physiological states and in sports persons | K3 |
| CO4 | Identify nutritional deficiency conditions , its prevention and dietary management | K4 |
| CO5 | Acquire knowledge about the importance of balanced diet and diet therapy Understand and the bases for Introduction to Nanotechnology | K5 |
| K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create | | |

| **Mapping (COs vs POs)** | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** |
| **CO1** | **S** | **S** | **S** | **S** | **S** | **S** | **S** | **S** | **S** |
| **CO2** | **S** | **S** | **S** | **S** | **S** | **S** | **S** | **M** | **M** |
| **CO3** | **S** | **S** | **S** | **S** | **S** | **S** | **S** | **S** | **S** |
| **CO4** | **S** | **S** | **S** | **S** | **S** | **S** | **S** | **M** | **S** |
| **CO5** | **S** | **S** | **S** | **S** | **S** | **S** | **S** | **S** | **M** |

**S - Strong, M – Medium, L – Low**

| Title of the paper | Common paper: HUMAN RIGHTS | | Subject code: 23PBTHR1 |
|---|---|---|---|
| Category of the course | Year | Semester | Credits |
| Core Paper | I | II | 1 |

| Semester: III | Course Code: 23PBTCT07 | Hours/Week: 5 | Credit: 5 |
|---|---|---|---|

## COURSE TITLE: CORE - VII BIOINFORMATIS

**Course Overview:**

1. The paper imparts a thorough knowledge of the basics of bioinformatics tools.
2. The student will get to understand the core concepts of in Silico biological research.

**Learning Objectives:**

1. To get introduced to the basic concepts of Bioinformatics and its significance in Biological data analysis.
2. Describe the history, scope and importance of Bioinformatics and role of internet in Bioinformatics.
3. Explain about the methods to characterize and manage the different types of Biological data.
4. Classify different types of Biological Databases.
5. Introduction to the basics of sequence alignment and analysis

| Unit – I | Database concepts | 10 Hours |
|---|---|---|

Introduction to internet and its application, Introduction to bioinformatics, Protein and nucleotide databases, Information retrieval from biological databases, Sequence alignment and database searching-similarity searches using BLAST and FASTA. DNA/RNA/protein sequence or structure data, gene expression data, protein-protein interaction (PPI) data, pathway data and gene ontology (GO) data

| Unit – II | Sequence alignment | 10 Hours |
|---|---|---|

Sequence alignment basics, match, mismatch, similarity, scoring an alignment, gap penalty, protein vs DNA alignments and pairwise alignment Global and local alignment algorithms, multiple sequence alignment-progressive alignment and Iterative alignment algorithms, consensus sequence, patterns and profiles. Multiple sequence alignment based database searching. PSI- Blast, PAM and Blosum matrices

| Unit – III | Genome Sequencing | 10 Hours |
|---|---|---|

Bioinformatics for genome sequencing, EST Clustering and analyses, Finding genes in prokaryotic and eukaryotic genomes, Bioinformatics for understanding Genome Variation. Protein databank and the PDB Sum- SCOP, CATH, DALI and HSSP

| Unit – IV | Molecular visualization tools | 10 Hours |
|---|---|---|

Rasmol, Chime and Sped viewer. Structure analysis tools. VAST and DALI, Structural biology-Homology modeling, Bioinformatics for microarray designing and transcriptional profiling, Bioinformatics for metabolic reconstruction, Bioinformatics for phylogenetic Analysis

| Unit – V | Medical application of Bioinformatics | 10 Hours |
|---|---|---|

Disease genes, Drug Discovery. History. Steps in drug discovery. Target Identification. Target Validation. QSAR. Lead Identification. Preclinical pharmacology and toxicology. ADME. Drug designing. Rational drug design. Computer aided drug design. Ligand based approach. Target based approach

**Text Book(s):**


- Das sanayake S. Ranil, Y.I.N.Silva Gunawardene, 2011. Genomic and Proteomic Techniques, Narosa Publishing House Pvt. Ltd, New Delhi.
- Thiagarajan B, Rajalakshmi.P.A. 2009. Computational Biology, MJP publishers, Chennai.
- Bosu Orpita, Simminder Kaur Thukral, 2007. Bioinformatics Databases, Tools and Algorithms, Oxford University press, New Delhi.


**Reference Books:**


- Rastogi.S.C, Mendiratta. N, Rastogi. P, 2004. Bioinformatics methods and applications, Prentice- Hall of India private limited, New Delhi.
- Lohars. Prakash, 2009. Bioinformatics, MJP Publishers, Chennai.
- Stephen misener and Stephen A. Krawetz., 2000. Bioinformatics methods and protocols, Human press Inc, New Jersey.
- Durbin. R, S. Eddy, A. Krogh and G. Mitchison, 1998. Biological sequence analysis, Cambridge university press, Cambridge.


**Web Resources:**

- webarchive.mcdb.ucsb.edu/sears/biochemistry/info/website-
- http://library.nuft.edu.ua/ebook/file/Gad2007.pdf

**Teaching Methodology**: Videos, Audios, PPT, Role Play, Quiz, Field Visit, Seminar, Chalk & Talk, Lecturing, Case Study, Demonstration, Problem Solving, Group Discussion, Flipped Learning

**Learning Outcomes:**

Upon successful completion of this course, the student will be able to:

| COs | Statements | Bloom's Level |
|---|---|---|
| CO1 | To get introduced to the basic concepts of Bioinformatics and its significance in Biological data analysis. | K1 |
| CO2 | Describe the history, scope and importance of Bioinformatics and role of internet in Bioinformatics. | K2 |
| CO3 | Explain about the methods to characterize and manage the different types of Biological data. | K3 |
| CO4 | Classify different types of Biological Databases. | K4 |
| CO5 | Introduction to the basics of sequence alignment and analysis | K4 |

K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

**Mapping (COs vs POs)**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 |
|---|---|---|---|---|---|---|---|---|---|
| CO1 | S | S | S | S | S | S | S | S | S |
| CO2 | M | S | S | S | S | M | S | M | M |
| CO3 | S | S | S | M | M | S | M | S | S |
| CO4 | S | S | S | S | S | S | S | M | S |
| CO5 | M | S | S | S | S | S | M | S | M |

**S - Strong, M – Medium, L – Low**

| Semester: III | Course Code: 23PBTCT08 | Hours/Week: 4 | Credit: 5 |
|---|---|---|---|

## COURSE TITLE: CORE - VIII IMMUNOLOGY

**Course Overview:**

1. The paper imparts a thorough knowledge on the basics of immunology.
2. The student will get to understand the core concepts of immune systems and their non-specific and specific mechanisms, vaccine, etc.

**Learning Objectives:**

1. Illustrate various mechanisms that regulate immune responses and maintain Tolerance
2. Describe key events and cellular players in antigen presentation, and how the nature of the antigen will shape resulting effector responses
3. Learn the concepts of cellular and molecular processes that represent the human immune system.
4. Elucidate the role of immunological regulation and tolerance at a cellular and molecular level
5. Compile concepts on immunological principles and diagnosis

| Unit – I | History and overview of the immune system | 10 Hours |
|---|---|---|

Types of immunity - innate, acquired, passive and active, self vs non-self-discrimination. Physiology of immune response: HI and CMI specificity and memory. Cells and organs of the immune system .Lymphoid tissue, origin and development. Hematopoiesis and differentiation of lymphocytes

| Unit - II | Lymphocyte-sub-populations of mouse and man | 10 Hours |
|---|---|---|

APCcells, lymphokines, Phagocytic cells, K and NK Cells. Nature and biology of antigens, epitopes, haptens, adjuvents. Immunoglobulins - structure, distribution and function. Immunoglobulin super family Isotopic, Allot pic and Idiotic variants, generation of antibody diversity

| Unit - III | MCAb and Vaccines | 10 Hours |
|---|---|---|

Monoclonal antibody production and its applications. Types of vaccine and vaccination schedule. Role of MHC antigens in immune responses, Structure and function of class I and class II MHC molecules.MHC antigens in transplantation and HLA tissue typing. Transplantation immunology- immunological basis of graft rejection, clinical transplantation and Immunosuppressive therapy. Tumor Immunology - Tumor antigen, Immune response to tumors

| Unit - IV | Effectors mechanisms in immunity | 10 Hours |
|---|---|---|

Effector mechanisms in immunity – macrophage activation, cell mediated cytotoxicity, cytotoxicity assay. Hypersensitivity reactions and types. The complement system, modeofactivation, classical and alternate pathway, biological functions of C-proteins

| Unit – V | Immunotechniques | 10 Hours |
|---|---|---|

Immuno techniques – Principle and Applications: Immuno diffusion, Immuno fluorescence, Insitu localization technique – FISH and GISH. RIA and ELISA, FACS, Western blot, ELISPOT assay. Agglutination tests. VDRL test. Purification of antibodies, Quantitation of immunoglobulin by RID, EID and nephelometry, CMI techniques and Immunotherapy.

**Text Book(s):**


- Peter J. Delves, Seamus J. Martin, Dennis R. Burton, Ivan M. Roitt, 2011.
- Roitt. Essential Immunology, 12 editions, Wiley-Blackwell. USA.
- Kannan. I., 2010. Immunology. MJP Publishers, Chennai.
- Abbas, A. K., A.H.L. Lichtman and S. Pillai, 2010. Cellular and Molecular Immunology. 6th Edition. Saunders Elsevier Publications, Philadelphia.


**Reference Books:**


- Seemi Garhat Bashir, 2009.Text Book of Immunology, PHI Learning Pvt. Ltd. New Delhi.
- Thomas J. Kindt, BarbaraA. Osborne and Richard A. Gold by, 2006. Kuby Immunology, 6thedition, W. H. Freeman & Company.
- Nandini Shetty, 1996, Immunology: introductory text book - I.New Age International, New Delhi.


**Web Resources:**

- www.library.csusm.edu/courseguides/biology
- www.immunologylink.com
- http://www.wiley.com/college/bio/karp12791/weblinks.html

**Teaching Methodology**: Videos, Audios, PPT, Role Play, Quiz, Field Visit, Seminar, Chalk & Talk, Lecturing, Case Study, Demonstration, Problem Solving, Group Discussion, Flipped Learning

**Learning Outcomes:**

Upon successful completion of this course, the student will be able to:

| COs | Statements | Bloom's Level |
|---|---|---|
| CO1 | Illustrate various mechanisms that regulate immune responses and maintain Tolerance | K2 |
| CO2 | Describe key events and cellular players in antigen presentation, and how the nature of the antigen will shape resulting effector responses | K3 |
| CO3 | Learn the concepts of cellular and molecular processes that represent the human immune system. | K4 |
| CO4 | Elucidate the role of immunological regulation and tolerance at a cellular and molecular level | K5 |
| CO5 | Compile concepts on immunological principles and diagnosis | K6 |

K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

**Mapping (COs vs POs)**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 |
|---|---|---|---|---|---|---|---|---|---|
| **CO1** | **S** | **S** | **S** | **S** | **S** | **S** | **S** | **S** | **S** |
| **CO2** | **M** | **S** | **S** | **S** | **S** | **M** | **S** | **M** | **M** |
| **CO3** | **S** | **S** | **S** | **M** | **M** | **S** | **M** | **S** | **S** |
| **CO4** | **S** | **S** | **S** | **S** | **S** | **S** | **S** | **M** | **S** |
| **CO5** | **M** | **S** | **S** | **S** | **S** | **S** | **M** | **S** | **M** |

**S - Strong, M – Medium, L – Low**

| Semester: III | Course Code: 23PBTCT09 | Hours/Week: 4 | Credit: 5 |
|---|---|---|---|

## COURSE TITLE: CORE - IX BIOPROCESS TECHNOLOGY

**Course Overview:**

1. The paper imparts a thorough knowledge on the basics of bioprocess and industrial fermentation.
2. The student will get to understand the core concepts of fermentation and its commercial application.

**Learning Objectives:**

1. Outline the basis of Bioprocess Engineering
2. Relater reactors in fermentation
3. Differentiate fermentation processes
4. Assess Scale up and Scale down
5. Compile the output of fermentation processes

| Unit – I | Introduction to fermentation | 10 Hours |
|---|---|---|

General requirements of fermentation. Microbial growth kinetics of batch and continuous culture. Solid substrate, slurry fermentation and its application. Microbial cell culture. Immobilization of cells and enzymes.

| Unit - II | Types of bioreactors | 10 Hours |
|---|---|---|

Submerged reactors, surface reactors, mechanically agitated reactors, non-mechanically agitated reactors. Design of fermenters, body construction. Production of citric acid, penicillin and insulin. Isolation and improvement of Industrially important Micro-organisms, Media for Industrial fermentation and Sterilization.

| Unit - III | Introduction to bio products and bio separation | 10 Hours |
|---|---|---|

Introduction to bio products and bio separation. Primary recovery process: Cell disruption methods. Cell lysis and Flocculation: Osmotic and mechanical methods of lysis.Flocculation by electrolysis; polymorphic flocculation. Precipitation methods. Sedimentation: Principles, Sedimentation coefficients. Extraction Principles, Liquid-liquid extraction.

| Unit - IV | Down Stream Processing | 10 Hours |
|---|---|---|

Chromatography Techniques, Membrane separation, ultrafiltration. Drying. Principles and rotary dryer, freezer and spray dryer.

| Unit – V | Aerobic and anaerobic fermentation | 10 Hours |
|---|---|---|

Aerobic and anaerobic fermentation processes and their application in the field of biotechnology industry. Production of commercially important primary and secondary metabolites, Effluent Treatment and antibiotics.

**Text Book(s):**

- Min-tzeLiong, 2011. Bioprocess Sciences and Technology. Nova Science PubInc.
- Michael L.Shuler, Fikret Kargi. 2003. Bioprocess Engineering. PHI publishers.

**Reference Books:**

- P.A.Belter, E.L.Cursler, and W.S.Hu. 1988. Bio separation: Downstream processing for Biotechnology. John Wiley and sons.
- R.G.Harrison, P. Todd, SR. Rudgeand D. P.Petrides. 2003. Bio separation science and engineering. Oxford Press.

**Web Resources:**

- www.wild fermentation.com/John Schollar and Benedikte Watmore, Practical Fermentation-a technical guide
- web.mit.edu/professional/short.../fermentation_technology.html

**Teaching Methodology**: Videos, Audios, PPT, Role Play, Quiz, Field Visit, Seminar, Chalk & Talk, Lecturing, Case Study, Demonstration, Problem Solving, Group Discussion, Flipped Learning

**Learning Outcomes:**

Upon successful completion of this course, the student will be able to:

| COs | Statements | Bloom's Level |
|---|---|---|
| CO1 | Outline the basis of Bioprocess Engineering | K1 |
| CO2 | Relater reactors in fermentation | K2 |
| CO3 | Differentiate fermentation processes | K3 |
| CO4 | Assess Scale up and Scale down | K4 |
| CO5 | Compile the output of fermentation processes | K5 |

K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

**Mapping (COs vs POs)**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 |
|---|---|---|---|---|---|---|---|---|---|
| **CO1** | S | S | S | S | S | S | S | S | S |
| **CO2** | M | S | S | S | S | M | S | M | M |
| **CO3** | S | S | S | M | M | S | M | S | S |
| **CO4** | S | S | S | S | S | S | S | M | S |
| **CO5** | M | S | S | S | S | S | M | S | M |

**S - Strong, M – Medium, L – Low**

| Semester: III | Course Code: 23PBTCP03 | Hours/week: 6 | Credit: 4 |
|---|---|---|---|

## COURSE TITLE: CORE PRACTICAL – III BIOINFORMATICS, IMMUNOLOGY & BIOPROCESS TECHNOLOGY

**Course Overview:**

1. The practical will establish a basic study skill on the subject and will improve the student‘s ability tocalculate and improve their practical skill and knowledge.

**Learning Objectives:**

1. To learn the Bioinformatics tools for sequence retrieval and alignment
2. To apply the learned tools for various applications
3. To isolate, identify & enumerate immune cells
4. To learn the technique of immunodiagnostics
5. To study upstream & downstream techniques

| Unit – I | (A) Bioinformatics-practical | 15 Hours |
|---|---|---|

**MAJOR**

1. Prediction of signal sequence using Signal P online tool
2. Pattern Search (Domains & Motifs) using Pfam
3. ORF gene Search - Genscan
4. Sequence translation using ExPASy translate tool
5. Characterization of retrieved protein sequence byProtParam tool.

**MINOR**

1. Sequence retrieval from Genbank
2. Sequence identity search- Sequence similarity searchusing BLAST
3. Sequence similarity search using FASTA

**DEMONSTRATION**

1. Molecular visualization of proteins using RASMOL.
2. Docking of small molecule with protein structure usingHex software.

Docking of two proteins using Patch Dock (Protein-Protein docking) tool.

| Unit – II | (B) Immunology - practical | 15 Hours |
|---|---|---|

**MAJOR**

1. Identification of various immune cells from humanperipheral blood.
2. Radial Immuno diffusion
3. Ouchterlony Immuno diffusion
4. Immuno electrophoresis
5. Counter current immune electrophoresis.

**MINOR**

1. Immunodiagnostics: CRP
2. Immunodiagnostics: ASO
3. Immunodiagnostics: Widal
4. Immunodiagnostics: RA
5. Immunodiagnostics: Blood grouping and typing
6. Immunodiagnostics: hCG
7. Preparation of serum and plasma

**DEMONSTRATION**

1. Lymphocyte separation and identification
2. Bioassays for cytokines
3. ELISA

| Unit – III | C) Bioprocess Technology - Practical | 15 Hours |
|---|---|---|

**MAJOR**

1. Isolation of industrially important microorganisms formicrobial processes.
2. Production and estimation of protease
3. Production and estimation of amylase.
4. Production of wine using grapes
5. Production of penicillin
6. Citric acid production
7. Use of alginate for cell immobilization.

**MINOR**

1. Solid state and Submerged fermentation
2. Media preparation and sterilization

**DEMONSTRATION**

1. Parts and design of fermenter
2. Media standardization (C:N ratio) for maximum biomassproduction of an industrially important microorganism.

**Teaching Methodology**: Videos, Audios, PPT, Role Play, Quiz, Field Visit, Seminar, Chalk & Talk, Lecturing, Case Study, Demonstration, Problem Solving, Group Discussion, Flipped Learning

**Learning Outcomes:**

Upon successful completion of this course, the student will be able to:

| COs | Statements | Bloom's Level |
|---|---|---|
| CO1 | To learn the Bioinformatics tools for sequence retrieval and alignment | K1 |
| CO2 | To apply the learned tools for various applications | K3 |
| CO3 | To isolate, identify & enumerate immune cells | K3 |
| CO4 | To learn the technique of immunodiagnostics | K4 |
| CO5 | To study upstream & downstream techniques | K5 |

K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

**Mapping (COs vs POs)**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 |
|---|---|---|---|---|---|---|---|---|---|
| **CO1** | **S** | **S** | **S** | **S** | **S** | **S** | **S** | **S** | **S** |
| **CO2** | **M** | **S** | **S** | **S** | **S** | **M** | **S** | **M** | **M** |
| **CO3** | **S** | **S** | **S** | **M** | **M** | **S** | **M** | **S** | **S** |
| **CO4** | **S** | **S** | **S** | **S** | **S** | **S** | **S** | **M** | **S** |
| **CO5** | **M** | **S** | **S** | **S** | **S** | **S** | **M** | **S** | **M** |

**S - Strong, M – Medium, L – Low**

| Semester: III | Course Code: 23PBTMEA5 | Hours/Week : 2 | Credit: 3 |
|---|---|---|---|

## COURSE TITLE: ELECTIVE – V NANO BIOTECHNOLOGY

**Course Overview:**

1. The subject imparts knowledge on the fundamentals of nanoparticles.
2. The student will be provided with a basic knowledge and understanding about the role of Nano particle in biotechnology.

**Learning Objectives:**

1. Understand the bases for Introduction to Nanotechnology
2. To impart understanding on Nanoparticle based Drug Delivery.
3. Fabrication of nanomaterial's for bone tissue grafting
4. Methods of Nanofabrication
5. Understand the application of Nanotechnology

| Unit – I | Introduction to Nanotechnology | 07 Hours |
|---|---|---|

Introduction to Nanotechnology- Scientific revolution, Feynman's vision, Classification of Nano biomaterials –Types of nanomaterial's –nanoparticles, nanotubes, nanowires, Nano fibers, Size dependent variation in the properties of Nano materials,

| Unit – II | Preparation of Nano materials | 07 Hours |
|---|---|---|

Preparation of Nano materials, Top down and bottom up approaches, Biosynthesis, Nano biomaterials- Polymer, Ceramic, Metal based Nano biomaterials, Carbon based Nano materials, DNA based Nanostructures, Protein based Nanostructures, Quantum dots, Hydrogels, Films and Scaffolds.

| Unit – III | Application of Nano materials | 07 Hours |
|---|---|---|

Application of Nano materials in Bone substitutes and Dentistry, Food and Cosmetic applications, Bio-sensors and Lab-on-a-chip, Bio-devices and implantable devices, Bioremediation, Nano materials for anti-microbial coating–medical implants and paints, Application of Nanotechnology in textile industry.

| Unit – IV | Nano materials for diagnosis and therapy | 07 Hours |
|---|---|---|

Nano materials for diagnosis and therapy, Implications of drug delivery, Nano-carriers for application in medicine, polymeric nanoparticles as drug carriers, Drug release mechanism, Targeted Drug Delivery using Nano carriers, Nanoparticle technologies for cancer therapy and diagnosis, Point of Care and Personalized medicine, Magnetic nanoparticles for imaging Hyperthermia.

| Unit – V | Medical application of Bioinformatics | 07 Hours |
|---|---|---|

Nano toxicology, Portals of Entry of the nanoparticles into the Human Body, Bio-toxicity of Nanoparticles,

**Text Book(s):**


- Nanotechnology, S.Shanmugam, Mjp publication. 2011.
- Advanced nanomaterials, kurt E. geckeler, Hiroyuki Nishide, Wiley VHC.2010.
- Nanotechnology and tissue engineering. T.Laurencin, Lakshmi S. Nair, CRC press. 2012.
- Handbook of carbon nanomaterials. Francis D souza, Karl M. Kadish.
- World scientific publishing co. pte. ltd. 2011.
- OdedShoseyov (Editor), Ilan Levy, 2010. Nano Biotechnology: Bio Inspired Devices andMaterials of the Future, Humana Press.
- Chad A. Mirkin and Christof M. Niemeyer, 2007. Nano biotechnology II: More Concepts andApplications, Wiley-VCH.


**Reference Books:**


- ChallaS.S.R.Kumar (Ed). 2006. Biological and pharmaceutical nanomaterials, Wiley-VCHVerlag Gmbh & Co, KgaA.
- K.K.K.Jain 2006. Nano biotechnology in Molecular Diagnostics: Current Techniques andApplications Horizon Bioscience
- Niemeyer, C.M., Mirkin, C.A. (Eds). 2004. Nano biotechnology Concepts, Applications andPerspectives, Wiley-VCH, Weinheim.
- Andrze w. Miziolek, Shashi P.Karna, J malthew Mauro and Richard A.Vaia. 2005 DefenseApplications of Nano materials :
- Springer Handbook of Nanotechnology- Ed. by B. Bhushan, Springer-Verlag (2004)

- The Chemistry of Nano materials: Synthesis, Properties and Applications, C.N.R. Rao, A.Muller, A. K. Cheetham (Eds), Wiley-VCH Verlag (2004)
- Nano materials for medical diagnosis and therapy, Challa Kumar, Wiley-VCH, 2007.
- Nanotechnology for cancer therapy, Mansoor M. Amiji, CRC Press, 2007.
- K.K.Jain, Nano Biotechnology, Horizions Biosciences, 2006
- Nano materials: An introduction to synthesis, properties and application, Dieter Vollath, WileyVCH, 2008


**Web Resources:**

- http://www.wiley.com/college/bio/karp12791/weblinks.html
- www.biochemweb.org/
- http://library.nuft.edu.ua/ebook/file/Gad2007.pdf

**Teaching Methodology**: Videos, Audios, PPT, Role Play, Quiz, Field Visit, Seminar, Chalk & Talk, Lecturing, Case Study, Demonstration, Problem Solving, Group Discussion, Flipped Learning

**Learning Outcomes:**

Upon successful completion of this course, the student will be able to:

| COs | Statements | Bloom's Level |
|---|---|---|
| CO1 | Understand the bases for Introduction to Nanotechnology | K1 |
| CO2 | To impart understanding on Nanoparticle based Drug Delivery. | K2 |
| CO3 | Fabrication of nanomaterial for bone tissue grafting | K3 |
| CO4 | Methods of Nanofabrication | K4 |
| CO5 | Understand the application of Nanotechnology | K5 |

K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

| Mapping (COs vs POs) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** |
| **CO1** | S | S | S | S | S | S | S | S | S |
| **CO2** | M | S | S | S | S | M | S | M | M |
| **CO3** | S | S | S | M | M | S | M | S | S |
| **CO4** | S | S | S | S | S | S | S | M | S |
| **CO5** | M | S | S | S | S | S | M | S | M |

**S - Strong, M – Medium, L – Low**

| **Semester: III** | **Course Code: 23PBTI01** | **Credit: 2** |
|---|---|---|
| **Course Title: Internship in Industries to Biotechnology Field (Food / Clinical Trials/ Dairy/ Aqua sciences, Pharmaceutical / CSIR/DBT/DST Research Laboratories** | | |

**Course Overview:**

1. To gain hands on training and expertise in handling sophisticated instruments and acquire in depth knowledge in their applications.

**Learning Objectives:**

1. Understand working principles and the techniques of various processes
2. Apply standard operating procedures followed in industries
3. Prepare to face challenges & gain confidence in the field of study.
4. Critically assess the utilization of sophisticated instruments and expensive Consumables
5. Develop work ethics to be followed in a scientific laboratory

**Teaching Methodology**: Videos, Audios, PPT, Role Play, Quiz, Field Visit, Seminar, Chalk & Talk, Lecturing, Case Study, Demonstration, Problem Solving, Group Discussion, Flipped Learning

**Learning Outcomes:**

Upon successful completion of this course, the student will be able to:

| COs | Statements | Bloom's Level |
|---|---|---|
| CO1 | Understand the bases for Introduction to Nanotechnology | K2 |
| CO2 | To impart understanding on Nanoparticle based Drug Delivery. | K2 |
| CO3 | Fabrication of nanomaterial for bone tissue grafting | K3 |
| CO4 | Methods of Nanofabrication | K4 |
| CO5 | Understand the application of Nanotechnology | K2 |

K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

**Mapping (COs vs POs)**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 |
|---|---|---|---|---|---|---|---|---|---|
| **CO1** | S | S | S | S | S | S | S | S | S |
| **CO2** | M | S | S | S | S | M | S | M | M |
| **CO3** | S | S | S | M | M | S | M | S | S |
| **CO4** | S | S | S | S | S | S | S | M | S |
| **CO5** | M | S | S | S | S | S | M | S | M |

**S - Strong, M – Medium, L – Low**