# VIVEKANANDHA

## COLLEGE OF ARTS AND SCIENCES FOR WOMEN

## [AUTONOMOUS]

An ISO 9001:2008 Certified Institution
Affiliated to Periyar University
(Approved by AICTE and Re-accredited with „A" Grade by NAAC)
Recognized Under 2(f) and 12 (b) of UGC Act, 1956.
Elayampalayam, Tiruchengode-637 205, Namakkal Dt., Tamil Nadu, India

# DEPARTMENT OF BIOTECHNOLOGY

## PG SYLLABUS

[*For the Candidates admitted on 2021-2022 onwards under Autonomous, CBCS & OBE pattern*]

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**ANGAMMAL EDUCATIONAL TUST**

**ELAYAMPALAYAM – 637 205, TIRUCHENGODE Tk., Namakkal Dt., Tamil Nadu**
**VEERACHIPALAYAM – 637 303, SANKARI Tk., Salem Dt., Tamil Nadu**

**Tel.: 04288 234670 (4 lines), Fax: 04288 234894**

**Website: www.vivekanandha.ac.in**

## PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

| GRADE | OBJECTIVE |
|---|---|
| **PEO: 1** | Biotechnology graduate students shall attain professional/industrial expertise by developing competent, creative and ever ready personality to accept recent, innovative and challenging roles in Industry and Academic and Research sectors |
| **PEO: 2** | Students shall inculcate in the development of entrepreneurial traits in order to cuddle innovative opportunities by adapting emerging biotechnological concepts in terms of techniques with subsequent development of leadership in the course of start-up of small-medium scale biotech based industry |
| **PEO: 3** | Students shall progressively adapt, follow and learn the concepts of biotechnology continuously by aiding modern teaching tools |
| **PEO: 4** | Imparting the basic and outstanding knowledge in all terms of biotechnology |
| **PEO: 5** | Students shall acquire the concepts to disseminate the advanced biotechnological aspects and its cutting edge developments in specific and developing area in the field of Biotechnology |

## PROGRAMME OUTCOMES (POs)

| GRADE | OUTCOME |
|---|---|
| **PO: 1** | To train and develop students with the much needed biotechnological education, so that they develop added competitive skill metrics (CSM) for industrial employment higher education and employment upon graduation |
| **PO: 2** | To comprehend the assorted knowledge of biotechnical concepts domains and their applicability in the development of value added products for the welfare of the society |
| **PO: 3** | To develop a broad range of biotechnological skills and knowledge, development of general and specific competences to meet-out current expectations and requirements of medical, pharmaceutical, bio-molecular and agricultural sectors |
| **PO: 4** | To understand and merge the knowledge and concepts of biochemical, biophysical and bio statistical domains |
| **PO: 5** | To clarify various challenges in health care by integrating different biological domains including clinical, immunological, pharmaceutical and cancer genomics |

## PROGRAMME SPECIFIC OUTCOMES (PSOs)

| GRADE | SPECIFIC OUTCOME |
|---|---|
| **PSO: 1** | To provide solutions for the challenges faced by pharmaceutical and molecular diagnostic Sectors |
| **PSO: 2** | To provide technical products with high frequency of reproducibility to the society |
| **PSO: 3** | To gain vertical mobility in career that will make students more competent to face national/international qualifying exams with practical knowledge acquaintance and in modern biotechnology field |
| **PSO: 4** | To solve complex problems in the field of Biotechnology with an understanding of social, ethical, legal and cultural aspects of the society |
| **PSO: 5** | To understand the over-all theme/concepts of each specialization in biotechnology and analysing the frequency of its applicability in industry, research and for the goodness of Society |

VIVEKANANDHA COLLEGE OF ARTS AND SCIENCES FOR WOMEN (AUTONOMOUS)

DEPARTMENT OF BIOTECHNOLOGY

**CBCS SYLLABUS – PG (OBE PATTERN)**

1. ***Aim of the Program:***
   - Understanding various disciplines in biotechnology and acquire methodological knowledge in them.
   - Application of this knowledge in a suitable manner in required fields.

2. ***Eligibility for Admissions***

A candidate seeking admission to M.Sc Biotechnology must have at least 50% marks in any branch of Life Sciences viz. Zoology, Botany, Biochemistry, Biotechnology, Microbiology, Biological Techniques & Specimen Preparation and Microbiology or Chemistry at the graduate level; Candidates having B.Sc., degree in Industrial Microbiology / Medical Microbiology/ MLT with 50% marks are also eligible. MBBS/ B.Sc., Agriculture/ BVSc/ B.F.Sc/ B.Tech (Biotechnology) Degree holders can also apply.

3. **Duration of the course:** The duration of the course is 2 years. First year consists of I and II semester and second year consists of III and IV semester.

4. **Medium of Instruction and Assessment** : English.- External and Internal evaluation as per university regulations.

5. **Faculty under which the Degree is Awarded:** Faculty of Science

6. ***Specializations offered, if any*** : *NIL*

### *7. Programme Outcomes:*

- **PO1.** Nurturing novel ideas and meaningful insights through scientific thinking and its practical skill in biotechnological aspects
- **PO2.** Enabling critical analysis of problems and situations to reach solutions.
- **PO3.** Development of communication skills to present scientific data in oral and written formats.
- **PO4.** Providing a platform for individual and collective work.
- **PO5**. Understanding the significance of sustainable scientific processes to support the environment.

### *8. Programme Specific Outcome:*

- **PSO1.** Imparting basic knowledge in interdisciplinary fields of biotechnology.
- **PSO2**. Using modern tools to study and analyse biological data
- **PSO3.** To equip the candidates to meet the demands of the society to get sustainable products and processes through biotechnology.
- **PSO4**. To be aware of the ethical issues, personal and environmental safety during biotechnology practices.
- **PSO5**. Promoting scientific discoveries and familiarizing research methodology through implementation of projects.

9. **Assessment:**

Assessment of the students would be made through Continuous Internal Assessment (CIA) and External Assessment (EA) for passing each subject both theory and practical papers.

A candidate would be permitted to appear for the External examinations only on earning 75% of attendance and only when His/ Her conduct has been satisfactory. It shall be open to grant exemption to a candidate for valid reasons subject to conditions prescribed.

9A. **Continuous Internal Assessment** (CIA):

The performance of the students will be assessed continuously by the teacher concern and the Internal Assessments Marks will be as follows:

**Distribution of CIA Marks:**

| Activity | Period (Working Days) | Marks (25) | Activity | Marks (40) |
|---|---|---|---|---|
| Attendance | 90 | 5 | Attendance | 10 |
| CIA I | 30-35 | 2.5 | Observation Note | 10 |
| CIA II | 60 - 65 | 2.5 | Performance | 10 |
| Model Examination | After90 | 10 | Model Examination | 10 |

| | | | | |
|---|---|---|---|---|
| Assignment | 15-20 | 5 | | |
| Total | | 25 | | 40 |

**Distribution of Attendance Marks:**

| Sl.No | Percentage | Marks | |
|---|---|---|---|
| | | Theory | Practical |
| 1 | 76-80 | 1 | 2 |
| 2 | 81-85 | 2 | 4 |
| 3 | 86-90 | 3 | 6 |
| 4 | 91-95 | 4 | 8 |
| 5 | 96-100 | 5 | 10 |

9B. **External Assessment:**

The performance of the students would be assessed by examinations at the end of each semester with a written test for theory for three hours and practical examinations at the end of even semesters for Six hours. Question papers would be set by the selected External examiners in the prescribed format and valuated by the external examiners with the help of the teacher concern.

**The pattern of assessment is as follows:**

**Distribution of Final assessment marks (75/60):**

| Sl.No | Activity | Marks (75) | Activity | Marks(60) |
|---|---|---|---|---|
| | **Theory** | | **Practical** | |
| 1 | One Marks (Objective types 20x1=20) | 20 | Record | 5 |
| 2 | Five Marks (Either of Choice 5x5=25) | 25 | Viva-voce | 5 |
| 3 | Ten marks (Either or Choice 3 out of 5) 3x10=30 | 30 | Spotter | 20 |
| | | | Major (Performance, Write up and result) | 20 |
| | | | Minor (Performance, Write up and result) | 10 |
| **Total** | | **75** | **Total** | **60** |

**10. Project:**

Project work shall be assigned individually and must be carried out under the guidance of a faculty from the same college with or without an external guide OR in an external institution under the combined guidance of internal and external guides. The student has to submit the dissertation before the examiner for evaluation and may give a presentation on the project work, if asked for.

**11. Project Evaluation:**

The evaluation of the project (Both CA and ESA) (through oral presentation or Viva-voce as decided by the Chairman, Board of examinations).

| | **Marks** |
|---|---|
| **Project presentation OR Viva Voce on Project** | 60 |
| **C A** | 40 |
| **Maximum marks (including CA)** | **100** |

**VIVEKANANDHA COLLEGE OF ARTS AND SCIENCES FOR WOMEN (AUTONOMOUS)**

**DEPARTMENT OF BIOTECHNOLOGY**

**CBCS AND OBE PATTERN SYLLABUS-PG**

**(For Candidates admitted from 2021-2022 onwards)**

| Sem | Subject code | Part | Course | Title | Hrs/ week | Credit | Internal | External | Total |
|---|---|---|---|---|---|---|---|---|---|
| **SEMESTER I** | | | | | | | | | |
| **I** | 21P1BTC01 | I | Core I | Cell Biology and Genetics | 5 | 5 | 25 | 75 | 100 |
| | 21P1BTC02 | I | Core II | Molecular Biology | 5 | 5 | 25 | 75 | 100 |
| | 21P1BTC03 | I | Core III | Biological Chemistry | 5 | 5 | 25 | 75 | 100 |
| | 21P1BTC04 | I | Core IV | Microbiology | 5 | 5 | 25 | 75 | 100 |
| | 21P1BTCP01 | I | Core Practical I | Basic Biotechnology (Practical -I) | 5 | 4 | 40 | 60 | 100 |
| | 21P1BTE01 | II | Elective I | Tools in Biotechnology | 4 | 3 | 50 | 10 | 100 |
| | 21P1BTE02 | II | Elective I | Plant Physiology and Animal Physiology | | | | | |
| | | | | Library | 1 | - | - | - | - |
| | **Total** | | | | **30** | **27** | 190 | **410** | **600** |
| **SEMESTER II** | | | | | | | | | |
| **II** | 21P2BTC05 | I | Core V | Genetic Engineering | 5 | 5 | 25 | 75 | 100 |
| | 21P2BTC06 | I | Core VI | Immunology | 5 | 5 | 25 | 75 | 100 |
| | 21P2BTC07 | I | Core VII | Microbial Technology | 5 | 5 | 25 | 75 | 100 |
| | 21P2BTC08 | I | Core VIII | Developmental Biology | 5 | 5 | 25 | 75 | 100 |
| | 21P2BTCP02 | I | Core Practical II | Applied biotechnology (Practical -II) | 5 | 4 | 40 | 60 | 100 |
| | 21P2BTE03 | II | Elective III | Bioinstrumentation | 4 | 3 | 50 | 50 | 100 |
| | 21P2BTE04 | | Elective IV | Genomics and Proteomics | | | | | |
| | | | | Library | 1 | - | - | - | - |
| | **Total** | | | | **30** | **27** | **190** | **410** | **600** |
| | **Grand total of first year** | | | | **60** | **54** | **380** | **820** | **1200** |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **SEMESTER III** | | | | | | | | | |
| **III** | 21P3BTC09 | I | Core IX | Plant Biotechnology | 5 | 5 | 25 | 75 | 100 |
| | 21P3BTC10 | I | Core X | Animal Biotechnology | 5 | 5 | 25 | 75 | 100 |
| | 21P3BTC11 | I | Core XI | Enzymology and Enzyme Technology | 5 | 5 | 25 | 75 | 100 |
| | 21P3BTCP03 | I | Core practical III | Advanced biotechnology (Practical -III) | 5 | 4 | 40 | 60 | 100 |
| | 21P3BTE05 | II | Elective III | Diversity of Life Forms | 3 | 3 | 50 | 50 | 100 |
| | 21P3BTE06 | | | Evolution and Behaviour | | | | | |
| | 21P3BTE07 | II | Elective IV | Pharmaceutical Biotechnology | 4 | 3 | 50 | 50 | 100 |
| | 21P3BTE08 | | | Environmental Biotechnology | | | | | |
| | 21P4MBED01 | III | EDC | Herbal Technology | 2 | 2 | 12 | 38 | 50 |
| | 21P4MBED02 | | | Bioinformatics and system biology | | | | | |
| | | | | Human rights | 1 | 1 | | | |
| | **Total** | | | | **30** | **28** | **227** | **423** | **650** |
| **SEMESTER IV** | | | | | | | | | |
| **IV** | 21P3BTC13 | I | Core IX | Research Methodology | 5 | 5 | 25 | 75 | 100 |
| | 21P4BTPR01 | I | Project work | Project & Viva Voce | 25 | 5 | 40 | 60 | 100 |
| | **Total** | | | | **30** | **10** | **65** | **135** | **200** |
| **Grand total of second year** | | | | | **60** | **38** | **292** | **558** | **850** |
| **Grand total of four semesters** | | | | | **120** | **92** | **672** | **1378** | **2050** |

# SEMESTER I (2021-2022)

## CELL BIOLOGY & GENETICS

| | | | |
|---|---|---|---|
| Paper | : CORE I | Total Hours | : 75 |
| Hours/Week | : 5 | Exam Hours | : 03 |
| Credit | : 5 | Internal | : 25 |
| Paper Code | : 21P1BTC01 | External | : 75 |

**PREAMBLE**

To make the students to understand the basics concepts living cellular organization and cellular function and to impart knowledge of classical genetics.

**COURSE OUTCOMES**

On successful completion of the course, students will be able to,

| Cos | Outcome | CPD |
|---|---|---|
| CO1 | Acquire the conceptual knowledge of fundamentals of Cellular architecture | K1 |
| CO2 | Understand the functions of cellular organelles of cell, nucleus and familiarize with cellular physiology | K1 & K2 |
| CO3 | Have a comprehensive knowledge on cellular energetics and basics of genetics | K2 & K4 |
| CO4 | Gain expertise in gene interaction mechanisms and ploidy levels | K3 & K5 |

**MAPPING WITH PROGRAMME OUTCOMES**

| Cos | PO1 | PO2 | PO3 | PO4 | PO5 |
|---|---|---|---|---|---|
| CO1 | L | M | M | M | L |
| CO2 | M | S | S | S | M |
| CO3 | S | S | S | S | S |
| CO4 | S | S | M | S | S |

S: Strong; M: Medium; L: Low

**UNIT I: THE STRUCTURE AND FUNCTION :**Cell structure and function, cell Membrane structure and function, structure of model membrane, lipid bilayer and membrane protein diffusion, osmosis, ion channels, active transport, ion pumps, mechanism of sorting and regulation of intracellular transport electrical properties of membranes.

**UNIT II: CELL ORGANELLES, CELL DIVISION AND CELL CYCLE:** Cell wall, Nucleus, Mitochondria, Golgi bodies, Lysosomes, Endoplasmic Reticulum, Peroxisomes, Plastids, Chloroplast, Vacuoles, Cytoskeleton and its role in motility. Cell Cycle, Molecular mechanisms of Mitosis and Meiosis, Control of cell cycle, Cancer and Cell Cycle. Bacterial Cell division and Stress Response.

**UNIT III**: **CELL SIGNALLING AND CELL COMMUNICATION** : Hormones and their receptors, Cell surface receptor, G-protein coupled receptors, Second messengers. Signal transduction pathways, Regulation of signaling transduction, Cell communication: Cell adhesion and Adhesion molecules and Gap junctions. ECM and Integrins, Neurotransmission. Haematoposis its regulation.

**UNIT IV: BASIC PRINCIPLES OF GENETICS**: Mendelian principles- Concept of gene, Co-dominance, Gene interactions, Pleiotropy, Penetrance and Expressivity, Linkage & Crossing over, Sex linkage. Gene mapping methods, Linkage mapping by using somatic cell hybrids and Cytoplasmic and Maternal inheritance.

**UNIT V: QUANTITATIVE GENETICS & GENETIC VARIANTS:** Human genetics- Pedigree analysis- Karyotypes- Genetic disorders- Polygenic inheritance-Heritability and its measurements- QTL mapping. Mutation - types, causes, detection, structural and numerical alteration in chromosomes.

**REFERENCES:**


1. Paul, A. 2007. Text book of cell and molecular biology, Books and Allied (P) Ltd. 2nd edition, Kolkata 700 009, pp-1310.
2. Lodish et al Molecular Cell biology 8th ed. Freeman, 2016.
3. Nelson and Cox. Lehninger Principles of Biochemistry. Freeman, 7 th ed. 2017.
4. Krebs JE et al. Lewin's. Genes XI. Jones & Bartlett Publ, 2017.
5. Alberts et al Molecular biology of the cell. 6th ed. Garland Sci. 2014.
6. Watson. Molecular Biology of the Gene. 7th ed. Pearson Edu, 2013.
7. Problems on Genetics, Molecular Genetics and Evolutionary Genetics by Pranab Kr. Banerjee, New Central Book Agency.
8. Genes and Genomes by M Singer, and P Berg, Blackwell Scientific Pub.

## MOLECULAR BIOLOGY

| | | | |
|---|---|---|---|
| Paper | : CORE II | Total Hours | : 75 |
| Hours/Week | : 5 | Exam Hours | : 03 |
| Credit | : 5 | Internal | : 25 |
| Paper Code | : 20P1BTC02 | External | : 75 |

**UNIT I: CHEMISTRY OF NUCLEIC ACIDS:** Introduction to nucleic acids. Nucleic acid as genetic materials, structure, chemical composition of nucleotides and nucleosides. Differences and physiochemical properties of elements in DNA and RNA. Primary structure of DNA: chemical and structural qualities of 3'-5' phosphodiester bonds. Secondary structure of DNA: Watson & Crick model, chargaff's rule, X-ray diffraction analysis of DNA. Triple helix, quadrapule helix, Reversible denaturation and hyperchromic shift. Tertiary structure of DNA: DNA super coiling.

**UNIT II: DNA REPLICATION AND REPAIR:** Central dogma. DNA replication: Meselson& Stahl experiment. Bi-directional DNA replication. Okazaki fragments. Protoemics of DNA replication, fidelity of DNA replication, Inhibitors of DNA replication. Overview of differences in prokaryotic and eukaryotic DNA replication. Telomere replication in eukaryotes. D-loop and rolling circle mode of replication, mutagens.DNA mutation and their mechanisms. Various types and mechanisms of DNA repair models.

**UNIT III: TRANSCRIPTION:** Structure and function of mRNA, rRNA & tRNA. Characteristics of promoter and enhancer sequences, RNA synthesis. Initiation, Elongation and termination. Inhibitors of transcription. Difference between prokaryotic and eukaryotic transcription. Basic concepts of RNA world. Ribozymes, RNA processing: 5' capping, Splicing-alternative splicing, Poly A tail addition and base modification.

**UNIT IV: TRANSLATION:** Introduction to genetic code: Elucidation of genetic code, codon degeneracy, Wobble hypothesis and its importance, prokaryotic and eukaryotic ribosomes. Steps involved in translation: Initiation, elongation and termination of protein synthesis. Inhibitors of protein synthesis. Post-translational modifications and its importance.

**UNIT V: REGULATION OF GENE EXPRESSION:** levels of gene expression, housekeeping genes, upregulation and downregulation. Regulation of gene expression in prokaryotes: *lac* and *trp* operons. Regulation of gene expression in eukaryotes. Organization of genes in prokaryotic and eukaryotic chromosomes. Hierarchial levels of gene regulation. Prokaryotic gene regulation. Regulation of gene expression with reference to lambda phage life cycle.

**REFERENCES:**


1. David Freifelder . 1990. Molecular Biology, 2nd Edition. Narosa Publishing house
2. George M. Malacinski. 2008. Essentials of Molecular Biology, 4th Edition. Narosa Publishing house

3. Veer Bala Rastogi. 2010. Fundamentals of Molecular Biology. Ane Books India
4. James D. Watson, Tania A. Baker, Stephen P. Bell, Alexander Gann, Michael Levine and Richard Losile. 2008. Molecular Biology of the gene, 5th Edition. Pearson Education.
5. Lodhish, Berk, Matsundairg, Kaiser, Krieger, Scott, Zipursky and Darnell. 2004. Molecular Cell Biology, 5th Edition. W. H. Freeman and Company
6. Robert F. Weaver. 1999. Molecular Biology. WCB McGraw Hill
7. E. D. P. De Robertis& E. M. F De Robertis, Jr. 2001. Cell and Molecular Biology, 8th Edition. Lipincott William and Wilkins
8. Lehninger. 2005. Principles of Biochemistry. Nelson Cox, CBS Publishers
9. Alexander McLenna, Andy Bates, Puil Turner & Mike White. 2015. Molecular Biology, 4th Edition. GS Garlan Sciences, Taylor and Francis Group
10. George M. Malacinski& David Freifelder. 1998. Essentials of Molecular Biology, 3rd Edition. Jones and Bartcett Publishers
11. Richard R. Sinden.1994. DNA Structure and function. Academic press
12. R.C. Rastogi. 2010. Cell and Molecular Biology. New Age International Publishers
13. PragyaKhana. 2008. Cell and Molecular Biology. IK International Publishing House
14. William D. Stanfield, Jaine S. Colome and Raul J. Cano. 2008. Shaum's Outline- Molecular Cell Biology. Tata McGraw Hill
15. H.S. Bhamrah&KavitaJuneja. 2002. Molecular Cell Biology. Anmol Publications
16. G. P. Jeyanthi. 2009. Molecular Biology. MJP Publishers
17. N. Vidhyarasthi& D. M. Chelan. 2007. Molecular Biology. IK International Publishing House
18. P.S. Verma& V. K. Agarwal. 1998. Concepts of Molecular Biology. S. Chand and Company Ltd
19. Phil Turner, Alexander McLennan, Andy Bates & Mike White. 2001. Molecular Biology, 3rd Edition. Bios Instant Notes
20. H. D. Kumar.2000. Molecular Biology, 2nd Edition. Vikas Publishing House
21. AVSS Sambamurhty. 2008. Molecular Biology. Narosa Publishing House

# BIOLOGICAL CHEMISTRY

| | | | |
|---|---|---|---|
| Paper | : CORE III | Total Hours | : 75 |
| Hours/Week | : 5 | Exam Hours | : 03 |
| Credit | : 5 | Internal | : 25 |
| Paper Code | : 20P1BTC03 | External | : 75 |

**Aim**

1. To give an introduction about the basic biochemistry related to the biological molecules, their diversity and biosynthesis, degradation and role in the biological systems.

2. This also aims to develop a thorough knowledge among the students about the various biochemical reactions- metabolic pathways- responsible for the manifestation of life disease and metabolic errors.

**Course Objectives**

- The overall objective of the course is for the student to gain a basic working knowledge of biochemical concepts and techniques which will be necessary for future scientific endeavours.
- This course gives an idea on different biological molecules, their origin, biological role and its degradation according to the needs and demand of the system under various conditions.
- The interrelation of each of these metabolic pathways and their contribution in various metabolic disorders are also explained in detail.
- The application of the knowledge generated in the practical aspects of Biotechnology.

**Course Outcome**

On completion of the course, the student should achieve an understanding of the following:

- The structures of amino acids, their chemical properties and their organization into polypeptides and proteins.
- Methods for isolating and characterizing proteins the basic elements of protein structure key
- Principles of protein function.
- Enzymes and how they catalyze reactions as well as enzyme kinetics
- Structure of fundamental monosaccharides and polysaccharides structure
- Basic function of nucleotides structure of different classes of lipids and their roles in biological systems

**Course Content:**

**UNIT I: BASIC PHYSICAL AND CHEMICAL CONCEPTS IN BIOLOGY:** Structure of Atom, molecules and chemical bonds. Stabilizing interactions (Vander waal's, Electrostatic force, Hydrogen Bonding, Hydrophobic interaction, etc) principles of Biophysical chemistry (PH, Buffer, Reaction kinetics. Thermodynamics and Colligative properties.

**UNIT II: CHEMISTRY OF BIOMOLECULES AND CONFIRMATION OF PROTEINS AND NUCLEIC ACIDS:** Composition, structure and functions of Biomolecules: Carbohydrates, Lipids, Proteins,

Nucleic acids and Vitamins . Conformation of proteins: Ramachandran plot, secondary, tertiary and quaternary structure of proterins. Conformation of Nucleic acids: A DNA, B DNA, Z DNA and Types of RNA.

**UNIT III: BIOENERGETICS AND CATALYSIS:** Bioenertgeteis, Glycolysis, Oxidative phosphorylation, Coupled reaction, Group transfer, Biological energy transducers. Principles of catalysis, Enzymes, Mechanism of enzyme action, Isozymes, Enzyme kinetics, Enzyme Inhibition and Enzyme Regulation.

**UNIT IV: METABOLISM OF BIOMOLECULES:** Carbohydrate Metabolism: Biosynthesis: Gluconeogenesis, Pyuvate oxidation, TCA Cycle, Glyoxylate Cycle). Lipid Metabolism: Biosynthesis of fatty acids, Beta-oxidation of fatty acids and Cholesterol Biosynthesis.

**UNIT V: METABOLISM OF BIOMOLEULES:** Amino acid Metabolism: Amino acids classification, Overview of Amino acid catabolism in Mammals. Urea Biosynthesis. Pathways of Amino Acid degradation, Nucleic acid Metabolism: Nucleotide Biosynthesis and degradation, Salvage and denovo pathways. Vitamins: Water and Fat soluble.

**REFERENCE:**


1. Principles of Biochemistry – Smith et al., McGraw Hill International book Company 8th ed 1998.
2. Principles of Biochemistry – Lehninger, Nelson, Cox, CBS publishers. 2005.
3. Fundamentals of Biochemistry – Voet et al., Jhon Wiley and Sons Inc. 2000.
4. Biochemistry – Zubay, WCB Publishers. 4$^{th}$ edition, 1998.
5. Harpers Biochemistry, R.K. Murray, D.K.Granner, P.A Mayes and V.W. Rodwell, Practise Halt International. 1993.
6. Biochemistry – Stryer. 5$^{th}$ 2002.
7. Text book of Biochemistry with clinical Correlations – Homas. M.Devlin.H.John Wiley & sons. Publications. 6$^{th}$ edition 2006.
8. Biochemistry – U. Satyanarayana, Books & Allied (P) Ltd, Kolkata.

## MICROBIOLOGY

| | | | |
|---|---|---|---|
| Paper | : CORE IV | Total Hours | : 75 |
| Hours/Week | : 5 | Exam Hours | : 03 |
| Credit | : 5 | Internal | : 25 |
| Paper Code | : 20P1BTC04 | External | : 75 |

**Course Objectives:**

- To impart knowledge on Microbial diversity and Molecular taxonomy with special referenceto Bacteria, besides fungi and viruses.
- To introduce the concept polyphasic taxonomy which eventually lead to report a novel organism.
- To enlighten on culture independent techniques and anaerobic cultivation.
- To obtain overall holistic knowledge on Agricultural, Food, Medical Microbiology with introduction to Molecular Diagnostics.

**Course Outcomes:**
On the successful completion of the course, student will be able to:

- Learn the importance of microbiology at basic level with laboratory level understanding.
- Get introduced to terms related to Polyphasic taxonomy and apply them during reporting them as a novel species.
- Obtain knowledge on NGS and culture independent techniques

- Understand on cultivation of Anaerobic organisms
- Critically think on the role of Soil, Agriculture, Food and Medical Microbiology
- Apply the knowledge towards Molecular Diagnostics
- Get holistic picture on Microbiology as a whole with Biotechnologist perspective

**Unit: I - Microbial Diversity:**

Concepts of species and hierarchical taxa – Bacterial nomenclature – Bergey's system of classification– Classification of Fungi and Viruses – Cultivation of bacteria, fungi, virus - Pure culture - Polyphasic taxonomy – Preservation and maintenance of microbes – Microbial Culture Collection centers – India and International organizations – Modern methods to study microbial diversity: NGS – MiSeq

**Unit II: - Molecular Taxonomy :**

Microbial Identification through physiological and biochemical methods (BIOLOG, Vitex); MALDI TOF- Polyphasic approach –16S rRNA gene sequencing, Phylogenetic grouping. Techniques used in taxonomy – Mol % G+C analysis, DNA-DNA hybridization, Fatty Acid Methyl Ester (FAME) analysis, peptidoglycan, Isoprenoid, quinines

**Unit III: - Metagenomics and Anaerobic Microbiology**

Molecular methods to study complex microbial communities: DGGE, SSCP, T-RFLP, FISH – Cloning for functional metagenomics: Construction of small insert and large insert metagenomic libraries – Microbiomes – Extremophiles Culturing Techniques for Anaerobes: Roll tube method, Culture conditions in Glove box - requirements - prospects

**Unit IV: - Food and Agricultural Microbiology**

Spoilage of food – Principles and types; Fresh fruits, vegetables and processed foods – Food preservation: physical and chemical- Food sanitation – Indication of food safety- Food poisoning – Food borne pathogens – Quality control and Food laws Microorganisms in soil processes – role of microorganisms in soil fertility – carbon cycle – nitrogen cycle: Biological nitrogen fixation, microbial transformation of Phosphorus – Plant microbe interaction: Biopesticides(*B. thuringiensis* and NPV) - Biofertilizers - PGPR –mycorrhiza

**Unit V: - Medical Microbiology**

**Bacterial Diseases:** Host-parasite relationship, epidemiology, pathogenesis, prevention and treatment – Staphylococcus, Streptococcus, Mycobacterium, Salmonella and Yersinia
**Viral Diseases:** Epidemiology, pathogenesis, prevention and Treatment - H1N1, Polio, Rabies, AIDS
**Fungal Diseases:** Infections caused by yeast: Candida. Filamentous Fungi: Aspergillus sp. **Protozoan Diseases:** Malaria, Leishmaniasis and Ascaris infection

**Text Book**

1. Lansing M. Prescott. Microbiology. McGraw-Hill Higher Education. OladeleOgunseitan. Microbial Diversity - Form and Function in Prokaryotes.

2. Wolfgang R. Streit and Rolf Daniel. Metagenomics: Methods and Protocols.

A. Mark Osborn and Cindy J. Smith. Molecular Microbial Ecology.Taylor and Francis Group.

3. Robert L Tate III. 1995. Soil Microbiology. John Wiley & Sons, New York Subbarao N. S. 2006. Soil Microbiology. (4th Edition of Soil microbiology and Plant growth).

4. Oxford & IBH, New Delhi. Paul EA (2007) Soil Microbiology, Ecology and Biochemistry. III Edition. Academic Press, Oxford, UK.

5. Stephen H. Gillespie and Kathleen B. Bamford. Medical Microbiology and Infection at a Glance. Anaerobic Microbiology: A Practical Approach by P.N. Levett 1992.

**Reference Books**

1. Bergey's Manual of Systematic Bacteriology. Volumes 1-5. Williams & Wilkins.

2. ErkoStackebrandt. Molecular identification, systematics, and population structure of prokaryotes.

3. Springer-Verlag Berlin Heidelberg.Madigan, M.T., Martinko, j. M., Stahl, D.A., and Clark, D.P.2012. Brock‟s Biology of Microorganisms. 13th Edition. Benjamin Cummings, San Francisco, CA.

## LAB IN BASIC BIOTECHNOLOGY

| | | | |
|---|---|---|---|
| Paper | : Core Practical I | Total Hours | : 75 |
| Hours/Week | : 5 | Exam Hours | : 06 |
| Credit | : 4 | Internal | : 40 |
| Paper Code | : 21P1BTCP01 | External | : 60 |

1. Preparation of Solution **(**Normal, Molar, Percentage solution and calculation) and Microscope (oil immersion100X, Ocular and stage micrometers).
2. Analysis of sugars (Glucose, Fructose, Galactose, Pentose, Sucrose, Maltose, Lactose and Starch tests) and Amino acids (Histidine, Tyrosine, Tryptophan, Methionine, Cysteine and Arginine)
3. Estimation of glucose, protein, cholesterol, DNA and RNA by ortho toluidine method, Lowry's method, Zak's method, Diphenylamine method and Oricinal method respectively.
4. Enumeration of cells (cell counting by Neubauer chamber) & buccal smear preparation.
5. Preparation of mitotic cells stages from onion root tip squash and meiosis from grasshopper testis cells.
6. Purification of bacteria by pour plate, spread plate and streakplate methods.
7. Differential staining (Gram's, Acid fast, Capsule & Spore) , Fungal Staining (LCB) and hanging drop method.
8. Biochemical characterization of microorganisms**:** TSI test, Carbohydrate fermentation test, Urease test and Catalase test and (IMViC) test
9. Antibiotic sensitivity test using bacteria culture (Kirby-Bauer method).
10. Separation of amino acids( paper chromatography ) and protein(Column chromatograph)

**TOOLS IN BIOTECHNOLOGY**
**21P1BTE01**

| | | | |
|---|---|---|---|
| Paper | : ELECTIVE I | Total Hours | : 75 |
| Hours/Week | : 5 | Exam Hours | : 03 |
| Credit | : 5 | Internal | : 25 |
| Paper Code | : 20P1BTC05 | External | : 75 |

**Course Objectives**

The main objectives of this course are to:

- Introduce the concepts of gene and genomics, and familiarize student's about gene cloning vectors and current methods.
- Train student's about tools used for gene manipulation and enhance students' knowledge about selection strategies and screening of transformants.
- Impart the knowledge about applications of cloning and its current development.

**Course Outcome**

On completion of the course, the student should achieve an understanding of the following:

- Obtain a comprehensive knowledge about the concepts of gene and genomicsand apply those in gene manipulation techniques
- Gain an in-depth understanding about rDNA technology to develop gene cloning skills.
- Know about the information's on tools used for gene manipulation with suitable examples and apply those while designing recombinant DNA experiments
- Plan the selection strategies for screening of transformants.
- Understand the principal applications of different biotechnology tools used in modern era.

## Course Content:

**UNIT I: Gene and Genomes**

Gene and genomes: Prokaryotic and eukaryotic genomes - structure and form. DNA as thegenetic material. Extra chromosomal DNA - plasmid, mitochondrial DNA. Central dogma – DNA-RNA-Protein.

**UNIT II: Cloning Vectors and rDNA Technology**

Cloning vectors: Plasmid, phagemid, cosmid, artificial chromosomes - BAC. rDNA technology overview. Transformation techniques - $CaCl_2$ transformation technique and electroporation.

**UNIT III: Tools for Gene Manipulation**

Tools for gene manipulation: Restriction enzymes, DNA ligases, DNA modifying enzymesalkaline phosphatase, polynucleotide kinase, and terminal transferase. PCR. Gel Electrophoresis –AGE and PAGE.

**UNIT IV: Selection Strategy and Screening of Transformants**

Selection strategy and screening of transformants: Selection of rDNA clones - Blue-White selection, Markers for selection - selectable and scorable - examples. Colony hybridization, Blotting Techniques: Southern, Northern and Western.

**UNIT V: Application of rDNA Tools**

Application of rDNA Tools: Cloning of insulin gene in bacteria, gene therapy, GMO –application and biosafety issues.

**REFERENCE:**

**Text Book(s)**


1. Primrose. S.B., Twyman R.M. (2014) Principles of Gene Manipulation and Genomics,7th Edition, Blackwell Science Limited.
2. Primrose .S.B (1994) Molecular Biotechnology., Blackwell Scientific Publishers, Oxford
3. Alberts. B., Johnson. A.D., Lewis. J., Morgan. D (2014) Molecular Biology of the Cell.
4. Brown, T. A. (2006). Genomes (3rd ed.). New York: Garland Science Pub.
5. Old, R. W., Primrose, S. B., &Twyman, R. M. (2001). Principles of Gene Manipulation: an Introduction to Genetic Engineering. Oxford: Blackwell Scientific Publications.


**Reference Books:**


1. Micklossnd D.A.., Freyar G.A. (1990) DNA Science – A first course in rDNA technology, Cold Spring Harbor laboratory Press, New York.
2. Glick. B.J., Pasternak j. J., Patten C.L (2010) Molecular Biotechnology: Principles and Applications of Recombinant DNA.
3. Das H. K (2004) Textbook of Biotechnology 4 ed.,Wiley India.
4. Brown T. A. (2016) Gene Cloning and DNA Analysis. An Introduction, 7th Edition Blackwell Scientific Publications.
5. Theiman W.J., Palladino. M.A., (2014) Introduction to Biotechnology,3rd Edition
6. Cooper G. M.,&Hausman R. E. (2013). The Cell: a Molecular Approach (6th Ed.). Washington:

ASM ; Sunderland.

7. Green M. R.,&Sambrook J. (2012). Molecular Cloning: a Laboratory Manual. Cold Spring Harbor, NY: Cold Spring Harbor Laboratory Press.

# 21P1BTE01

**Course Objectives**

The main objectives of this course are to:

- Introduce the concepts of gene and genomics, and familiarize student's about gene cloning vectors and current methods.
- Train student's about tools used for gene manipulation and enhance students' knowledge about selection strategies and screening of transformants.
- Impart the knowledge about applications of cloning and its current development.

**Course Outcome**

On completion of the course, the student should achieve an understanding of the following:

- Obtain a comprehensive knowledge about the concepts of gene and genomicsand apply those in gene manipulation techniques

**UNIT-I: Photosynthesis:** Light harvesting complexes; mechanisms of electron transport; photoprotective mechanisms; CO2 fixation-C3, C4 and CAM pathways. **Nitrogen metabolism:** Nitrate and ammonium assimilation; amino acid biosynthesis. **Plant hormones:** Biosynthesis, storage, breakdown and transport; physiological effects and mechanisms of action.

**UNIT-II: Sensory photobiology** - Structure, function and mechanisms of action of phytochromes, cryptochromes and phototropins; stomatal movement; photoperiodism and biological clocks. **Solute transport and photoassimilate translocation –** uptake, transport and translocation of water, ions, solutes and macromolecules from soil, through cells, across membranes, through xylem and phloem; transpiration; mechanisms of loading and unloading of photoassimilates.

**UNIT-III: Secondary metabolites** - Biosynthesis of terpenes, phenols and nitrogenous compounds and their roles. **Stress physiology** – Responses of plants to biotic (pathogen and insects) and abiotic (water, temperature and salt) stresses.

**UNIT-IV: Blood and circulation** - Blood corpuscles, haemopoiesis and formed elements, plasma function, blood volume, blood volume regulation, blood groups, haemoglobin, immunity, haemostasis. **Cardiovascular System:** Comparative anatomy of heart structure, myogenic heart, specialized tissue, ECG, Cardiac cycle and its regulation. **Respiratory system** - Comparison of respiration in different species, anatomical considerations, transport of gases & regulation.

**UNIT-V: Nervous system** - Neurons, action potential, gross neuroanatomy of the brain and spinal cord, central and peripheral nervous system, **Sense organs** - Vision, hearing and tactile response. **Excretory system - Thermoregulation- Stress and adaptation- Digestive system- Endocrinology and reproduction** - Endocrine glands, basic mechanism of hormone action.

**REFERENCE:**

**Text Book(s)**


1. Plant Physiology by J.L. Jain & Jain
2. Plant Physiology by Taiz

3. Text Book of Medical Physiology by Guyton & Hall

## SEMESTER - II

## GENETIC ENGINEERING

## 21P2BTC05

| | | | |
|---|---|---|---|
| Paper | : CORE V | Total Hours | : 75 |
| Hours/Week | : 5 | Exam Hours | : 03 |
| Credit | : 5 | Internal | : 25 |
| Paper Code | : 21P2BTC05 | External | : 75 |

**Aim**

- To acquaint the students to the versatile tools and techniques employed in genetic

engineering and recombinant DNA technology.

**Course objectives**

- To illustrate creative use of modern tools and techniques for manipulation and analysis of genomic sequences.
- To expose students to application of recombinant DNA technology in biotechnological research.
- To train students in strategizing research methodologies employing genetic engineering techniques.

**Course outcome**

At the end of the course,

- The student will achieve a sound knowledge on methodological repertoire which allows them to innovatively apply these techniques in basic and applied fields of life science researches.

**UNIT I: INTRODUCTION AND TOOLS FOR GENETIC ENGINEERING:** Impact of genetic engineering in modern society; general requirements for performing a genetic engineering experiment; restriction endonucleases and methylases; DNA ligase, Klenow enzyme, T4 DNA polymerase, polynucleotide kinase, alkaline phosphatase; cohesive and blunt end ligation; linkers; adaptors; homopolymeric tailing; labelling of DNA: nick translation, random priming, radioactive and non-radioactive probes, hybridization techniques: northern, southern, south-western and far-western and colony hybridization, fluorescence *in situ* hybridization.

**UNIT II: DIFFERENT TYPES OF VECTORS:** Plasmids; Bacteriophages; M13 mp vectors; PUC19 and Bluescript vectors, hagemids; Lambda vectors; Insertion and Replacement vectors; Cosmids; Artificial chromosome
vectors (YACs; BACs); Principles for maximizing gene expression expression vectors; pMal; GST; pET-based vectors; Protein purification; His-tag; GST-tag; MBP-tag *etc*.; Intein-based vectors; Inclusion bodies; methodologies to reduce formation of inclusion bodies; mammalian expression and replicating vectors; Baculovirus and *Pichia* vectors system, plant based vectors, Ti and Ri as vectors, yeast vectors, shuttle vectors**.**

**UNIT III: DIFFERENT TYPES OF PCR TECHNIQUES:** Principles of PCR: primer design; fidelity of thermostable enzymes; DNA polymerases; types of PCR – multiplex, nested; reverse-transcription PCR, real time PCR, touchdown PCR, hot start PCR, colony PCR, asymmetric PCR, cloning of PCR products; T-vectors; proof reading enzymes; PCR based site specific mutagenesis; PCR in molecular diagnostics; viral and bacterial detection; sequencing methods; enzymatic DNA sequencing; chemical sequencing of DNA; automated DNA sequencing; RNA sequencing; chemical synthesis of oligonucleotides; mutation detection: SSCP, DGGE, RFLP.

**UNIT IV: GENE MANIPULATION AND PROTEIN-DNA INTERACTION:** Insertion of foreign DNA into host cells; transformation, electroporation, transfection; construction of libraries; isolation of mRNA and total RNA; reverse transcriptase and cDNA synthesis; cDNA and genomic libraries; construction of microarrays – genomic arrays, cDNA arrays and oligo arrays; study of protein-DNA interactions: electrophoretic mobility shift assay; DNase footprinting; methyl interference assay, chromatin immune precipitation; protein-protein interactions using yeast two-hybrid system; phage display.

**UNIT V: GENE SILENCING AND GENOME EDITING TECHNOLOGIES:** Gene silencing techniques; introduction to siRNA; siRNA technology; Micro RNA; construction of siRNA vectors; principle and application of gene silencing; gene knockouts and gene therapy; creation of transgenic plants; debate over GM crops; introduction to methods of genetic manipulation in different model systems *e.g.* fruit flies.(*Drosophila*), worms (*C. elegans*), frogs (*Xenopus*), fish (zebra fish) and chick; Transgenics - gene replacement; gene targeting; creation of transgenic and knock-out mice; disease model; introduction to genome editing by CRISPR-CAS with specific emphasis on Chinese and American clinical trials.

**Recommended Textbooks and References**:


1. Old, R. W., Primrose, S. B., & Twyman, R. M. (2001). *Principles of Gene Manipulation: an Introduction to Genetic Engineering*. Oxford: Blackwell Scientific Publications.
2. Green, M. R., & Sambrook, J. (2012). *Molecular Cloning: a Laboratory Manual*. Cold Spring Harbor, NY: Cold Spring Harbor Laboratory Press.
3. Brown, T. A. (2006). *Genomes* (3rd ed.). New York: Garland Science Pub.
4. Selected papers from scientific journals, particularly Nature & Science.
5. Technical Literature from Stratagene, Promega, Novagen, New England Biolab *etc.*. 6.Biotechnology-Fundamentals andApplicationsS.S. Purohit & S.KMathurAgrobotanica , India
7. AgriculturalBiotechnologyS.S. Purohit Agrobotanica , India
8. Biotechnology-Fundamentals andApplicationsS.S. Purohit & S.KMathurS.S. Purohit & S.K Mathur
9. Molecular Biotechnology S.B. Primrose Panima PublishingCorporation, New Delhi
10. Text Book ofBiotechnologyC.R. Chhatwal Anmol Publications pvt Ltd,New Delhi
11. Applied MolecularGeneticsR .L. Miesfeld , Wiley Liss ,New York

## IMMUNOLOGY

## 20P2BTC06

| | | | |
|---|---|---|---|
| Paper | : CORE VI | Total Hours | : 75 |
| Hours/Week | : 5 | Exam Hours | : 03 |
| Credit | : 5 | Internal | : 25 |
| Paper Code | : 21P2BTC06 | External | : 75 |

**Aim:**

1. To get introduced to the principles of immune systems of animals.
2. To introduce to the world of molecular and diagnostic techniques of immunology, immune-techniques and its application.

**Course Objectives:**

- This course is designed to impart the students the importance of immunology and its theoretical aspects and on the principles of immunology and immune-technology
- The application of immunology in medicines is also dealt with.
- It also explains the various antigen-antibody reactions involved in diseases, stem cell technology and vaccine development.

**Course Outcome:**

At the end of the course the students will,

- Get a deep foundation in the immunological processes.
- Students will gain knowledge on how the immune system works and also on the immune system network and interactions during a disease or pathogen invasion.

**UNIT I: IMMUNOLOGY: FUNDAMENTAL CONCEPTS AND OVERVIEW OF THE IMMUNE SYSTEM:** Components of innate and acquired immunity; phagocytosis; complement and inflammatory responses; pathogen recognition receptors (PRR) and pathogen associated molecular pattern (PAMP); innate immune response; mucosal immunity; antigens: immunogens, haptens; Major Histocompatibility Complex: MHC genes, MHC and immune responsiveness and disease susceptibility, Organs of immune system, primary and secondary lymphoid organs.

**UNIT II: IMMUNE RESPONSES GENERATED BY B AND T LYMPHOCYTES:**

Immunoglobulins - basic structure, classes & subclasses of immunoglobulins, antigenic determinants; multigene organization of immunoglobulin genes; B-cell receptor; Immunoglobulin superfamily; principles of cell signaling; basis of self & non-self discrimination; kinetics of immune response, memory; B cell maturation, activation and differentiation; generation of antibody diversity; T-cell maturation, activation and differentiation and T-cell receptors; functional T Cell subsets; cell-mediated immune responses, ADCC; cytokines: properties, receptors and therapeutic uses; antigen processing and presentation- endogenous antigens, exogenous antigens, non-peptide bacterial antigens and super-antigens; cell-cell co-operation, Hapten-carrier system.

**UNIT III: ANTIGEN-ANTIBODY INTERACTIONS:** Precipitation, agglutination and complement mediated immune reactions; advanced immunological techniques: RIA, ELISA, Western blotting, ELISPOT assay, immunofluorescence microscopy, flow cytometry and immunoelectron microscopy; surface plasmon resonance, biosensor assays for assessing ligand – receptor interaction; CMI techniques: lympho proliferation assay, mixed lymphocyte reaction, cell cytotoxicity assays, apoptosis, microarrays, transgenic mice, gene knock outs.

**UNIT IV: CLINICAL IMMUNOLOGY:** Immunity to infection : bacteria, viral, fungal and parasitic infections (with examples from each group); hypersensitivity: Type I-IV; autoimmunity; types of autoimmune diseases; mechanism and role of CD4+ T cells; MHC and TCR in autoimmunity; treatment of autoimmune diseases; transplantation: iimmunological basis of graft rejection; clinical transplantation and immunosuppressive therapy; tumor immunology: tumor antigens; immune response to tumorsand tumor evasion of the immune system, cancer immunotherapy; immunodeficiency: primary immunodeficiencies, acquired or secondary immunodeficiencies, autoimmune disorder, anaphylactic shock, immunosenescence, immune exhaustion in chronic viral infection, immune tolerance, NK cells in chronic viral infection and malignancy.

**UNIT V: VACCINOLOGY:** Active and passive immunization; live, killed, attenuated, subunit vaccines; vaccine technology: role and properties of adjuvants, recombinant DNA and protein based vaccines, plant-based vaccines, reverse vaccinology; peptide vaccines, conjugatevaccines; antibody genes and antibody engineering: chimeric, generation of monoclonal antibodies, hybrid monoclonal antibodies; catalytic antibodies and generation of immunoglobulin gene libraries, idiotypic vaccines and marker vaccines, viral-like particles (VLPs), dendritic cell based vaccines, vaccine against cancer, T cell based vaccine, edible vaccine and therapeutic vaccine.

**Recommended Textbooks and References:**


1. Kindt, T. J., Goldsby, R. A., Osborne, B. A., &Kuby, J. (2006). *Kuby Immunology*. New York: W.H. Freeman.
2. Brostoff, J., Seaddin, J. K., Male, D., &Roitt, I. M. (2002). *Clinical Immunology.*London: Gower Medical Pub.
3. Murphy, K., Travers, P., Walport, M., &Janeway, C. (2012). *Janeway'sImmunobiology.* New York: Garland Science.
4. Paul, W. E. (2012). *Fundamental Immunology*. New York: Raven Press.
5. Goding, J. W. (1996). *Monoclonal Antibodies: Principles and Practice: Production and Application of Monoclonal Antibodies in Cell Biology, Biochemistry, and Immunology.* London: Academic Press.
6. Parham, P. (2005). *The Immune System*. New York: Garland Science.
7. Immunology Joshi. OsmaAgro Botanica N.Delhi
8. Instant notes inImmunologyLydyard, helean,FangerViva Books N.Delhi
9. An introduction toImmunologyCV Rao NarosaN.Delhi
10. Immunology Janus Kuby Freeman NY
11. Principles of cellular andmolecular ImmunologyJonathan Austin,Kathyryn WoodOxford NY
12. Immunology Goldsby, Kindt,Osborne, Janus KubyFreeman NY
13. Medical Immunology Parslow, Stites, Tera,ImbodenMc Graw Hill NY
14. Cellular and molecularImmunologyAbbas, Lichman,Pobea,Harcourt & Brace Co.

## MICROBIAL TECHNOLOGY AND BIOPROCESS TECHNOLOGY

## 21P2BTC07

### Course Objectives:

The objectives of this course are to introduce students to developments/ advances made in field of microbial technology for use in human welfare and solving problems of the society.

**Course Outcome:**

- On completion of this course, students would develop deeper understanding of the microbial technology and its applications.

**UNIT-I: INTRODUCTION TO MICROBIAL TECHNOLOGY:** Microbial technology in human welfare; Isolation and screening of microbes important for industry – advances in methodology and its application; Advanced genome and epigenome editing tools (*e.g.*, engineered zinc finger proteins, TALEs/TALENs, and the CRISPR/Cas9 system as nucleases for genome editing, transcription factors for epigenome editing, and other emerging tools) for manipulation of useful microbes/strains and their applications; Strain improvement to increase yield of selected molecules, *e.g.*, antibiotics, enzymes, biofuels.

**UNIT-II: ENVIRONMENTAL APPLICATIONS OF MICROBIAL TECHNOLOGY:** Environmental application of microbes; Ore leaching; Biodegradation - biomass recycle and removal; Bioremediation - toxic waste removal and soil remediation; Global Biogeochemical cycles; Environment sensing (sensor organisms/ biological sensors); International and National guidelines regarding use of genetically modified organisms in environment, food and pharmaceuticals.

**UNIT-III: PHARMACEUTICAL APPLICATIONS OF MICROBIAL TECHNOLOGY:** Recombinant protein and pharmaceuticals production in microbes – common bottlenecks and issues (technical/operational, commercial and ethical); Attributes required in industrial microbes (*Streptomyces* sp., Yeast) to be used as efficient cloning and expression hosts (biologicals production); Generating diversity and introduction of desirable properties in industrially important microbes (*Streptomyces*/Yeast); Microbial cell factories; Downstream processing approaches used in industrial production process (*Streptomyces* sp., Yeast).

**UNIT-IV: FOOD APPLICATIONS OF MICROBIAL TECHNOLOGY:** Application of microbes and microbial processes in food and healthcare industries – food processing and food preservation, antibiotics and enzymes production, microbes in targeted delivery application – drugs and vaccines (bacterial and viral vectors); Nonrecombinant ways of introducing desirable properties in Generally recognized as safe (GRAS) microbes to be used in food (*e.g.*, Yeast) - exploiting the existing natural diversity or the artificially introduced diversity through conventional acceptable techniques (mutagenesis, protoplast fusion, breeding, genome shuffling, directed evolution).

**UNIT-V: ADVANCES IN MICROBIAL TECHNOLOGY:** Microbial genomics for discovery of novel enzymes, drugs/ antibiotics; Limits of microbial genomics with respect to use in human welfare; Metagenomics and metatranscriptomics – their potential, methods to study and applications/use (animal and plant health, environmental clean-up, global nutrient cycles & global sustainability, understanding evolution), Global metagenomics initiative - surveys/projects and outcome, metagenomic library construction and functional screening in suitable hosts –tools and techniques for discovery/identification of novel enzymes, drugs (*e.g.*, protease, antibiotic).

**Recommended Textbooks and References:**

1. Lee, Y. K. (2013). *Microbial Biotechnology: Principles and Applications*. Hackensack, NJ: World Scientific.
2. Moo-Young, M. (2011). *Comprehensive Biotechnology*. Amsterdam: Elsevier.
3. Nelson, K. E. (2015). Encyclopedia of Metagenomics. *Genes, Genomes and Metagenomes: Basics, Methods, Databases and Tools*. Boston, MA: Springer US.
4. *The New Science of Metagenomics Revealing the Secrets of Our Microbial Planet*. (2007). Washington, D.C.: National Academies Press.
5. Journals: (a) Nature, (b) Nature Biotechnology, (c) Applied microbiology and biotechnology, (d) Trends in Biotechnology, (e) Trends in Microbiology, (f) Current opinion in Microbiology, (g) Biotechnology Advances,

(h) Genome Research)
6. Websites: http://jgi.doe.gov/our-science/

## DEVELOPMENTAL BIOLOGY AND EVOLUTION

## 21P2BTC08

### Course Objectives:

The objectives of this course are to introduce students to developments/ advances made in field of microbial technology for use in human welfare and solving problems of the society.

### Course Outcome:

- On completion of this course, students would develop deeper understanding of the microbial technology and its applications.

**UNIT I: BASIC CONCEPTS OF DEVELOPMENT:** Potency, commitment, specification, induction, competence, determination and differentiation; morphogenetic gradients; cell fate and cell lineages; stem cells; genomic equivalence and the cytoplasmic determinants; imprinting; mutants and transgenics in analysis of development

**UNIT II: GAMETOGENESIS, FERTILIZATION AND EARLY DEVELOPMENT:** Production of gametes, cell surface molecules in sperm-egg recognition in animals; embryo sac development and double fertilization in plants; zygote formation, cleavage, blastula formation, embryonic fields, gastrulation and formation of germ layers in animals; embryogenesis, establishment of symmetry in plants; seed formation and germination.

**UNIT III: MORPHOGENESIS AND ORGANOGENESIS IN ANIMALS:** Cell aggregation and differentiation in *Dictyostelium*; axes and pattern formation in *Drosophila*, amphibia and chick; organogenesis – vulva formation in *Caenorhabditis elegans*, eye lens induction, limb development and regeneration in vertebrates;

differentiation of neurons, post embryonic development- larval formation, metamorphosis; environmental regulation of normal development; sex determination.

**UNIT IV: MORPHOGENESIS AND ORGANOGENESIS IN PLANTS:** Organization of shoot and root apical meristem; shoot and root development; leaf development and phyllotaxy; transition to flowering, floral meristems and floral development in *Arabidopsis* and *Antirrhinum.*

**UNIT V: CANCER AND PROGRAMMED CELL DEATH:** Genetic rearrangements in progenitor cells, oncogenes, tumor suppressor genes, cancer and the cell cycle, virus-induced cancer, metastasis, interaction of cancer cells with normal cells, apoptosis, therapeutic interventions of uncontrolled cell growth. Programmed cell death, aging and senescence.

**Recommended Textbooks and References:**

## LAB IN APPLIED BIOTECHNOLOGY

| | | | |
|---|---|---|---|
| Paper | : Core Practical II | Total Hours | : 75 |
| Hours/Week | : 5 | Exam Hours | : 06 |
| Credit | : 4 | Internal | : 40 |
| Paper Code | : 21P1BTCP02 | External | : 60 |

1. Isolation of Genomic DNA from Bacteria,plants, animals and Separation of DNA by Agarose Gel Electrophoresis
2. Isolation of Plasmid DNA mini prep and maxi prep from *E.coli*
3. Separation of Proteins by SDS PAGE
4. Southern blotting – Demonstration
5. Micro propagation of callus culture
6. ABO Blood grouping (Rh typing) (Agglutination)
7. WIDAL and Pregnancy test (Agglutination)
8. Production and Estimation of alcohol from grapes
9. Production and estimation of citric acid from *Aspergillus* species
10. *Azolla ,Spirullina,* Vermiculture and Mushroom cultivation
11. Separation of amino acids by paper chromatography

12. Separation of proteins by Column chromatography

## BIOINSTRUMENTATION

## 21P2BTE03

**Course Objectives**

The main objectives of this course are to:

- Introduce the concepts of gene and genomics, and familiarize student's about gene cloning vectors and current methods.
- Train student's about tools used for gene manipulation and enhance students' knowledge about selection strategies and screening of transformants.
- Impart the knowledge about applications of cloning and its current development.

**Course Outcome**

On completion of the course, the student should achieve an understanding of the following:

- Obtain a comprehensive knowledge about the concepts of gene and genomicsand apply those in gene manipulation techniques

**UNIT-I: PHYSICAL TECHNIQUES IN SEPARATION OF BIOMOLECULES:** Centrifugation: Basic principles of sedimentation, types of centrifuges and rotors. Preparative and Analytical Centrifuges, Differential and, Density Gradient Centrifugation and ultra centrifugation. Chromatography Techniques: Theory and Application of Paper Chromatography, TLC, Gel Filtration Chromatography, Ion Exchange Chromatography, Affinity Chromatography, GLC, HPLC, NanoLC and HPTLC.

**UNIT-II: ELECTROPHORETIC TECHNIQUES AND CELL ANALYSIS:** Theory and Application of PAGE, SDS PAGE, Agarose Gel Electrophoresis 2DE, Iso-electric Focusing, isotachophoresis, pulse field

gel electrophoresis, Immuno diffusion, Immuno Electrophoresis. ELISA. Cell analysis: Principles and Applications of Light, Phase Contrast, Fluorescence Microscopy, Scanning Electron Microscopy, Transmission Electron Microscopy, Confocal Microscopy, Atomic force microscopy and Electron Cryo microscopy.

**UNIT-III: STRUCTURAL ANALYSIS OF BIOMOLECULES:** UV- visible, IR, NMR, LASER Raman Spectroscopy, Mass Spectroscopy, Fluorescence Spectroscopy, Surface Plasmon Resonance (SPR) and Electron Paramagnetic Resonance (EPR). Differential colorimetry, X ray crystallography, X ray computer tomography and patch clamping.

**UNIT-IV: MOLECULAR TECHNIQUES:** PCR, Real Time PCR, Cytophotometry, Flow Cytometry, FACS, MACS and Microarray. Circular dichroism and optical rotatory dispersion, Polarography and Manometry – theory and application, Biosensors.

**UNIT-V: TRACER AND RADIOACTIVE METHODS:** Tracer and other techniques – Radioactive decay, units of radioactivity, detection – Geiger Muller counter, Scintillation counter, Autoradiography. Applications of radio isotopes in biological and medical sciences - RIA. Safety aspects in handling radioactive isotope.

**REFERENCES:**

**Text Book(s):**


1. Instrumental methods of chemical analysis – P.K. Sharma
2. Biophysical chemistry – UpadhyayUpadhyay and Nath (2009)
3. Handbook of Biomedical Instrumentation – R.S. Khandpur, Tata (2003). McGraw Hill


**Reference Books:**


1. A Biologist's guide to principle and techniques of practical biochemistry – Brigan L. Williams.
2. Experimental methods in Biophysical chemistry- Nicolau, C.
3. PCR - The Basics (Garland Science, 2nd Edition). McPherson. M. J. & Moller S. G. (2006). Taylor & Francis
4. Introduction to Spectroscopy- DonaldL.Pavia Gary M.Lipman, George S Kriz

## GENOMICS AND PROTEOMICS

| | | | |
|---|---|---|---|
| Paper | : Elective IV | Total Hours | : 75 |
| Hours/Week | : 4 | Exam Hours | : 03 |
| Credit | : 4 | Internal | : 25 |
| Paper Code | : **21P2BTE04** | External | : 75 |

**Subject Description**

The students are able to understand the fundamental principle and techniques in genomics and proteomics which will enable them to sequence and analyze the gene and unlock potential candidate gene that may help to discovery new drugs and therapeutics, to establish evolutionary relationship, study and analyze gene and protein expressions.

**Goal**

The enable the students to understand the concepts and applications of genomics and proteomics

**Objective**

- To understand the basic concepts in genomics and various techniques applied to enumerate genome sequences and its functions
- To understand the fundamentals of proteomics and various techniques supporting the protein sequence and functional analysis

**UNIT-I:** Genomics- Prokaryotic &Eukaryotic Genomes Organization- Nuclear Genomes- - Organelle genomes-origin- Repetitive DNA contents-Tandem repeats – DNA transposons- Comparative genomics and application of genomics in understanding genetic disease of humans.

**UNIT-II:** Traditional approaches to expression profiling to study genes- SAGE for large scale gene expression and analysis- DNA sequencing- shot gun sequencing – Contig assembly-techniques for gene location – ORF- Next generation sequencing (NGS)- RT-PCR-RACE-S1nuclease mapping – exon trapping-transcriptome analysis-DNA chips and Microarrays, Real time PCR

**UNIT-III:** Genome Mapping – Human genome project Genetic Mapping –SNP AFLP-Human pedigree analysis–FISH – STS mapping –Gene therapy for inherited disorders and infectious diseases.

**UNIT-IV:** Proteomics: Definition, Characterization of proteins using 2-D gel electrophoresis, Multidimensional liquid chromatography and Mass spectrometry Tools of Proteomics- MALDI-TOF-ESI – tandem Mass analyzers-peptide Mass finger printing-protein identification with MS data.

**UNIT-V:** Metabolomics & Global biochemical networks, different levels of metabolite analysis, basic mass spectrometery metabolomics analysis, sample selection and handling for analysis of metabolites, methodology to construct global biochemical network.Protein mining - SALSA algorithm for mining specific features- protein microarrays protein expression profiling.

**Text book**

- Old and Primrose, 2006, Principles of Gene manipulation and genomics.

**Reference book**


1. Terence A Brown, 2002, Genomes, 2nd Edition, Bios Scientific Publishers.
2. Tom Strachan and Andrew P Read, 1999, Human Molecular Genetics, 2nd edition, Bios Scientific Publishers.
3. Daniel C. Liebler, 2002, Introduction to Proteomics, tools for the New biology- Humana press. Totowa,NJ.
4. Pennington.S, M. Dunn, 2001, Proteomics: From Protein Sequence to Function, 1st edition, Bios Scientific Publishers.

## SEMESTER - III
## PLANT BIOTECHNOLOGY
## 21P3BTC09

**Aim**

To give an idea of plant tissue culture

To introduce the various plant genetic engineering and transformations and itsapplications in various fields.

**Course Objectives**

- It gives introduction to the various transformation techniques employed in plant systems.
- It also describes the application of genetically modified plants in the various fields of science.

**Course Outcome**

At the end of the course,

- The students will gain an insight into the concepts and techniques of plant biotechnology and its application to crop plants
- They can also go for further research works during M.Phil and PhD courses

**UNIT I: PLANT TISSUE CULTURE:** History - principle - media composition, types Sterilisation, preparation and application. Micropropagation, meristems culture, callus cultures, suspension cultures, Organogenesis, somatic hybridization & somatic embryogenesis - shoot formation, Root formation & hardening, protoplast isolation and fusion. Somaclonalvariation. Germplasm storage and cryopreservation.

**UNIT II: PLANT MOLECULAR BIOLOGY**: Plant genomic DNA-organelle DNA: Mitochondrial DNA & chloroplast DNA. Gene expression in higher plants: post transcription processing of plant RNA. Communication in plant cells: nucleus - mitochondria interaction and chloroplast - mitochondria evolved by endosymbiosis. Plant transformation technology: agrobacterium mediated gene transfer, Direct transfer and particle bombardment.

**UNIT III: MEDICINAL PLANTS APPLICATION:** Diversity of medicinal plants in India**:** *Phyllanthusamarus, Casiaaugustifolia, Aloe verra, Bacopamonnieri, Saracaasoca, Withaniasomnifera, Ocimumtenuiflorum, Allium cepa , Piper betle and Cinnamomumzeylanicum.* Molecular pharming - concept of plants as biofactories, production of industrial enzymes and pharmaceutically important compounds.

**UNIT IV: AGRICULTURE & FOREST BIOTECHNOLOGY:** seed production technology. Genetically modified plant: Resistances: herbicides- insect pest –pathogen . Metabolic engineering: secondary metabolic production, molecular farming. Risk assessment of transgenic plants**:** impact on agriculture development and insect protected crops. Agroforesty. Transgenictrees. Biotechnology production of wood composites. Biological control of forest pest.

**UNIT V: INTELLECTUAL PROPERTY RIGHTS:** IPR in context with PBT, Patenting in PBT. International treaty on plant genetic resources for food and agriculture.IPR on biological resources & access to germplasm. Agriculture legislations. National biodiversity authority. Plant biotechnology in developing countries: Asia and India. Revocation of turmeric and neem patent.

**References**

1. Modern Concepts of Biotechnology H.D. Kumar Vikas Publishing House Pvt. Ltd., New Delhi .
2. Role of Biotechnology in Medicinal and Aromatic Plants Irfan A. Khan and AtiyaKhanumUkaaz Publications, Hydreabad
3. Plant Tissue Culture Kalyan Kumar D. New Central Book Agency (P) Ltd, Calcutta
4. An introduction to Plant tissue Culture M.K. Razdan Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi
5. Biotechnology B.D. Sigh Kalyan Publishers New Delhi
6. Introduction to Plant Biotechnology H.S. Chawla Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi
7. Plant Biotechnology Recent Advances P.C. TrivediPanima Publishing Corporation, New Delhi
8. Biotechnology J.E. Smith Cambridge University Press
9. Plant Biochemistry and Molecular Biology Hans, Walter Held Oxford, NY 10. Plant Cell, Tissue, and Organ Culture- Fundamental Methods.

## ANIMAL BIOTECHNOLOGY
## 21P3BTC10

**Aim**

- To give an idea of animal tissue culture
- To introduce the various genetic and transformation techniques in animals and and its applications in various fields.

**Course Objectives:**

- It gives introduction to the various transformation techniques employed in animal systems.
- It also describes the application of genetically modified animals in the various fields of science.
- The techniques of animal cell culture and its industrial and medical applications are described.

**Course Outcome**

At the end of the course,

- The students will gain an insight into the concepts and techniques of animal biotechnology and its wide industrial and medicinal applications.
- They can also go for further research works during M.Phil and PhD courses

**UNIT I:** Animal Tissue culture history, Laboratory design, aseptic conditions, methodology and Media: Balanced salt solutions and simple growth medium, Chemical, physical and metabolic functions of different constituents of culture medium. Role of Carbon di oxide, Role of serum, and supplements. Serum & protein free defined media and their applications: equipments and materials for animal cell culture technology. Basic techniques of mammalian cell culture in vitro.

**UNIT II:** Biology and characterization of the cultured cells, measuring parameters of growth. Cell synchronization. Somatic cell fusion, organ and histotypic Culture. Tissue engineering. Applications of animal cell culture, stem cell cultures, embryonic stem cells and their applications .cell culture based vaccines.

**UNIT III:** Invitro fertilization and embryo transfer, Sex determination or sex specific markers, Assisted reproductive technology, Intracytoplasmic sperm injection, Cryopreservation of gametes and embryo. Animal cloning – reproductive cloning, therapeutic cloning, Xenotransplantation, Animal genes and their regulation, some specific promoters for tissue specific expression.

**UNIT IV:** Improvements of animals using transgenic approach with specific examples, Animals as bioreactors: applications of biotechnology in sericulture, production of transgenic fishes. General steps to make and analyze transgenic fish .Genetically improved tilapia, Genetic engineering for production of regulatory proteins and blood products. Hormone production, Invitro culture of tissues and organs, Stem cell technology, Embryonic stem cells, maintenance of stem cell culture, Characterization of stem cells.

**UNIT V:** Gene therapy, Cancer Gene therapy, mechanism of gene therapy, Somatic versus germ line gene therapy, Immunotherapy. Vaccinology: history of development of vaccines, introduction to the concept of vaccines, conventional methods of animal vaccine production, recombinant approaches to vaccine production, modern vaccines.

**REFERENCES:**


1. Freshney RI. (2005). Culture of animal cells: A manual of basic techniques, 5th Edition, John Wiley and Sons.
2. John R W Masters. (2000). Animal cell culture, 3rd Edition, Oxford University Press.
3. Florence PR. (2006). Animal Biotechnology, Dominant Publishers and Distributors.

4. Sandy Primrose, RichardTwyman and Bob Old. (2001). Principles of Gene Manipulation, 6th Edition, Blackwell Science Ltd. p: 174-319.

5. Ranga MM. (2006). Animal Biotechnology.

6. Animal Biotechnology by Professor P.K. Gupta

7. Text Book of Animal biotechnology - **B Singh, S K Gautam and M S Chauhan**

## ENZYMOLOGY AND ENZYME TECHNOLOGY

## 21P3BTC11

**Aim**

- To give an idea of animal tissue culture
- To introduce the various genetic and transformation techniques in animals and and its applications in various fields.

**Course Objectives:**

- It gives introduction to the various transformation techniques employed in animal systems.
- It also describes the application of genetically modified animals in the various fields of science.
- The techniques of animal cell culture and its industrial and medical applications are described.

**Course Outcome**

At the end of the course,

- The students will gain an insight into the concepts and techniques of animal biotechnology and its wide industrial and medicinal applications.
- They can also go for further research works during M.Phil and PhD courses

**UNIT I - ENZYMES:** Introduction, Definition, History, Classification and Nomenclature of enzymes. Intracellular localization of enzymes, Extraction and purification of enzymes. Enzyme units. Substrate specificity.

**UNIT II - ACTIVE SITE**: Salient features, Theories of ES complex formation – Lock and Key, Induced fit and Substrate strain theory. Structure and functions of coenzymes, Isoenzymes and their separation rates. Collision and transition state theories. Factors affecting enzyme activity.

**UNIT III - ENZYME KINETICS:** Order of reaction, Activation energy, Kinetics of enzyme catalyzed reactions – Steady state kinetics – Michaelis Menten equation, and its transformation. Bi – substrate reaction – random, ordered and ping pong mechanisms. Enzyme - Enzyme interaction. Protein ligand binding

**UNIT IV - ENZYME INHIBITION:** Reversible and irreversible inhibitors. Mechanism of catalysis – acid base, electrostatic, covalent, metal ion and enzyme catalysis, electrostatic proximity and orientation effects. Mechanism and action of chymotrypsin, lysozyme and carboxy peptidase. Isoenzymes– multiple forms of Isoenzymes

**UNIT V - IMMOBILIZATION OF ENZYMES:** Methods and application. Clinical and Industrial application of enzymes, Enzyme engineering – site directed mutagenesis. Methods for protein sequencing. Methods for analysis of secondary and tertiary structures of enzymes.

**REFERENCES:**

1. Enzymes: Biochemistry, Biotechnology, Clinical chemistry – Trevor Palmer, East West Press Edition, New Delhi, 2004.

2. Fundamentals of Enzymology - Nicholas C. Price Lewis Stevens, 2nd edition, Oxford University Press, Newyork, 1998.

3. Biochemistry – U.Satyanarayana & U.Chakrapani, Books and Allied (P) Ltd, Kolkata, 2008.

4. Lehninger Principles of Biochemistry – David L. Nelson and Michael M.Cox, W.H Freeman and Company, New York, 2007.

5. Biochemistry – Lubert Stryer, Jeremy M. Berg, John L.Tymoczko, V edition, W.H.Freeman & Company, Newyork, 2001.

6. Enzyme Technology – Ashok Pandey, Colin Webb, Calos Ricardo Soccl, Christian Larroche, Asiatech publishers Inc, New Delhi, 2005.

## LAB IN ADVANCED BIOTECHNOLOGY

## 21P3BTCP03

**Aim**

- To give an idea of animal tissue culture
- To introduce the various genetic and transformation techniques in animals and and its applications in various fields.

**Course Objectives:**

- It gives introduction to the various transformation techniques employed in animal systems.
- It also describes the application of genetically modified animals in the various fields of science.
- The techniques of animal cell culture and its industrial and medical applications are described.

**Course Outcome**

At the end of the course,

- The students will gain an insight into the concepts and techniques of animal biotechnology and its wide industrial and medicinal applications.
- They can also go for further research works during M.Phil and PhD courses

1. Micro propagation of callus culture
2. Separation of Proteins by thin layer chromatography
3. Amplification of Genomic and ligated plasmid by PCR
4. Program to convert DNA to RNA/Protein
5. BLAST and Multiple Sequence and Phylogenetic Analysis
6. Western Blotting- Demonstration
7. Establishment of virus free plant using MS media
8. Establishment and maintenance of callus culture and Preparation of synthetic seeds
9. Isolation of auxotrophic mutants by replica plating technique
10. Gene and Protein Structure prediction (Secondary and tertiary)-bioinformatics tools.
11. Transformation & Selection of recombinant clones by (IPTG-X-gal: Blue white selection)

# DIVERSITY OF LIFE FORMS

## 21P3BTE05

**Aim**

To give an idea of plant tissue culture

To introduce the various plant genetic engineering and transformations and its applications in various fields.

**Course Objectives**

- It gives introduction to the various transformation techniques employed in plant systems.
- It also describes the application of genetically modified plants in the various fields of science.

**Course Outcome**

At the end of the course,

- The students will gain an insight into the concepts and techniques of plant biotechnology and its application to crop plants

They can also go for further research works during M.Phil and PhD courses

**UNIT-I: Principles & methods of taxonomy:** Concepts of species and hierarchical taxa, biological nomenclature, classical & Quantititative methods of taxonomy of plants, animals and microorganisms.

**UNIT-II: Levels of structural organization:** Unicellular, colonial and multicellular forms. Levels of organization of tissues, organs & systems. Comparative anatomy, adaptive radiation, adaptive modifications.

**UNIT-III: Outline classification of plants, animals & microorganisms:** Important criteria used for classification in each taxon. Classification of plants, animals and microorganisms. Evolutionary relationships among taxa.

**UNIT-IV: Natural history of Indian subcontinent:** Major habitat types of the subcontinent, geographic origins and migrations of species. Comman Indian mammals, birds. Seasonality and phenology of the subcontinent.

**UNIT-V: Organisms of health & agricultural importance and Conservation of Biodiversity:** Common parasites and pathogens of humans, domestic animals and crops. Rare, endangered & extinct species. Conservation strategies.

References:


1. Plant Diversity I and II by Pandey
2. Inverterbrates and Vertebrates by Verma and Agarwal

# EVOLUTION AND BEHAVIOUR

## 21P3BTE06

**Aim**

To give an idea of plant tissue culture

To introduce the various plant genetic engineering and transformations and its applications in various fields.

**Course Objectives**

- It gives introduction to the various transformation techniques employed in plant systems.
- It also describes the application of genetically modified plants in the various fields of science.

**Course Outcome**

At the end of the course,

- The students will gain an insight into the concepts and techniques of plant biotechnology and its application to crop plants

They can also go for further research works during M.Phil and PhD courses

**UNIT-I: Emergence of evolutionary thoughts:** Lamarck; Darwin–concepts of variation, adaptation, struggle, fitness and natural selection; Mendelism; Spontaneity of mutations; The evolutionary synthesis.

**UNIT-II: Origin of cells and unicellular evolution:** Origin of basic biological molecules; Abiotic synthesis of organic monomers and polymers; Concept of Oparin and Haldane; Experiement of Miller (1953); The first cell; Evolution of prokaryotes; Origin of eukaryotic cells; Evolution of unicellular eukaryotes; Anaerobic metabolism, photosynthesis and aerobic metabolism.

**UNIT-III: Paleontology and Evolutionary History and Molecular Evolution:** The evolutionary time scale; Eras, periods and epoch; Major events in the evolutionary time scale; Origins of unicellular and multi cellular organisms; Major groups of plants and animals; Stages in primate evolution including Homo. Concepts of neutral evolution, molecular divergence and molecular clocks; Molecular tools in phylogeny, classification and identification; Protein and nucleotide sequence analysis; origin of new genes and proteins; Gene duplication and divergence.

**UNIT-IV: The Mechanisms of Evolution:** Population genetics – Populations, Gene pool, Gene frequency; Hardy-Weinberg Law; concepts and rate of change in gene frequency through natural selection, migration and random genetic drift; Adaptive radiation; Isolating mechanisms; Speciation; Allopatricity and Sympatricity; Convergent evolution; Sexual selection; Co-evolution.

**UNIT-V: Brain, Behavior and Evolution**: Approaches and methods in study of behavior; Proximate and ultimate causation; Altruism and evolution-Group selection, Kin selection, Reciprocal altruism; Neural basis of learning, memory, cognition, sleep and arousal; Biological clocks; Development of behavior; Social communication; Social dominance; Use of space and territoriality; Mating systems, Parental investment and

Reproductive success; Parental care; Aggressive behavior; Habitat selection and optimality in foraging; Migration, orientation and navigation; Domestication and behavioral changes.

**REFERENCES:**


1. Biology by Campbell and Reece, 7th Edition.


## PHARMACEUTICAL BIOTECHNOLOGY

| | | | |
|---|---|---|---|
| Paper | : Elective I | Total Hours | : 75 |
| Hours/Week | : 4 | Exam Hours | : 03 |
| Credit | : 3 | Internal | : 25 |
| Paper Code | : 20U5BTE01 | External | : 75 |

### PREAMBLE

This paper encodes information on pharmacology, drug designing, sources and applications of drug discovery. Students also understand the basic and applications of pharmacology and sources of drug. Also enables them to understand the concepts of rDNA technology in drug designing.

### COURSE OUTCOMES

On successful completion of the course, students will be able to,

| COs | Outcome | CPD |
|---|---|---|
| **CO1** | To understand the principles of pharmacology and its development History | **K1 & K2** |
| **CO2** | To understand principles of action of drugs and mechanism of action to wards various diseases | **K2, K3 & K4** |
| **CO3** | To understand the concepts of developing therapeutic agents through genetic engineering principles | **K4, K5 & K6** |
| **CO4** | To explore the applications of pharmaceutical chemistry and its Development | **K4, K5 & K6** |

### MAPPING WITH PROGRAMME OUTCOMES

| Cos | PO1 | PO2 | PO3 | PO4 | PO5 |
|---|---|---|---|---|---|
| **CO1** | M | S | S | S | S |
| **CO2** | S | S | S | S | S |
| **CO3** | M | S | S | M | S |
| **CO4** | M | S | S | S | S |

**S:** Strong; **M:** Medium; **L**: Low

**UNIT-I: Introduction to pharmacology**: History & development in pharmacology. Principles of pharmacology. – Pharmacology in the 20th century – Drugs – Sources, dosage forms and routes of administration

**UNIT-II: Drug names & Classification systems**: General Principles of Drug action Pharmacokinetics, Pharmacodynamics, measurement of drug action.

**UNIT-III: Diagnosis and Chemotherapy :** Prenatal diagnosis: Invasive Techniques- Amniocentesis, Fetoscopy, Non Invasive Techniques – Ultra Sonography. Diagnosis using protein & enzymes markers, DNA/RNA based diagnostics. Therapeutic drugs – Protein synthesis inhibitors, Antibacterial, antifungal, anti protozoal, antiviral, anti helmithic, anticancer, anti-inflammatory drugs.

**UNIT-IV: Introduction to r-DNA technology**: production of biological: Human Insulin, HGH, GRF, Erythropoietins, IFN, TNF, Interleukins, Clotting factor VIII. Synthetic therapy**:** Synthetic DNA, therapeutic ribozymes, synthetic drugs

**UNIT-V: Production and applications:** Probiotics, anticancer and anti-inflammatory agents. Biochips, biofilms and biosurfactants. Tissue Engineering, Recombinant vaccines and Cell adhesion based therapy

**SUGGESTED READINGS**


1. A Text Book of Biotechnology. R.C. Dubey. S.Chand& Co Ltd, New Delhi.
2. Pharmacology – H.P. Rang, M.M. Pale, J.M. Moore, and Churchill Livingston.
3. Basic Pharmacology – Foxter Cox. Butterworth‟s 1980
4. Pharmacology and Pharmacotherapeutics – R.S.Satoskar, S.D. Bhandhakam and S.S. Alinapure
5. Pharmaceutical Biotechnology – S.S. Purohit, Kaknani, Saleja
6. Pharmacology – Mary J. Myuk, Richard A.Hoarey, Pamala Lippinwitt, Williams Edition.
7. Integrated pharmacology – Page, Curtis, Sulter, Walker, Halfman. Mosby Publishing Co.

## ENVIRONMENTAL BIOTECHNOLOGY

| | | | |
|---|---|---|---|
| Paper | : Elective IV | Total Hours | : 75 |
| Hours/Week | : 5 | Exam Hours | : 03 |
| Credit | : 5 | Internal | : 25 |
| Paper Code | : 21P3BTE08 | External | : 75 |

**Subject description:**

This course presents the basic or research, research purpose, problem solving in research, statistical methods used in research, data description, waste water treatments and alternative source of energy.

Goal

**Objectives:**

- To equip the students with basic knowledge of how to do research, problem solving in research
- To know about the different waste water treatments and different energy sources and to familiarize with biofuel technology.

**UNIT-I: Environmental issues:** Climate change, Conservation Energy, Environmental degradation, Environmental Health Genetic engineering Intensive farming Land degradation soil, Land use. Nanotechnology Nuclear issues Over population, Burial, Ozone depletion-CFCP pollution, Water pollution, Air pollution, Reservoirs Resources depletion Consumerism-Fishing, Logging, Mining Toxins, Waste.

**UNIT-II: Bioremediation and Bio-leaching:** Environmental impact of pollution and measurement methods- Composting of organic wastes, microbial bioremediation of oil spills; Waste water treatment- sewage treatment and common industrial effluent treatment; Concepts of bioremediation (in-situ and ex-situ), Bioremediation of toxic metal ions-biosorption and bio accumulation principles. Concepts of phytoremediation; Microbial biotransformation of pesticides and xenobiotics: Microbial leaching of ores- direct and indirect mechanisms.

**UNIT-III: Biofuel technology:** Classification of biofuel, First generation biofuels, Bioalcohols, Biodiesel, Green diesel, Vegetable oil, Bioethers, Biogas, Syngas, Solid biofuels, Second generation biofuels (advanced biofuels), Biofuels by region, Issues with biofuel production and use.

**UNIT-IV: Waste Water treatment**: Definition, source, types and composition of waste water, domestic sewage and industrial waste water. Methods of analysis of waste water- Std. parameters for physical, chemical and biological analysis, microbiological analysis, rationales and methods, their significance and limitations. Primary treatment: (Chemical/Physical) sedimentation, screening, coagulation, flocculation,

dilution, neutralization, equalization etc. Secondary treatment: (Biological/ biochemical) Activated sludge process, Trickling filters, anaerobic filters, sludge digestion, Aerated lagoons, Algal ponds, Evapo-transpiration system.

**UNIT-V: Alternate Source of Energy**, Biomass as a source of energy. Biocomposting, Vermiculture, Biofertilizers, Organic farming, Biomass project, Biomass centre & Species used for Biomass production.s Biomineralization, Bioelectricity through microbial fuel cell. Energy management and safety.

**REFERENCES:**

**Text Books**


1. Alan, S. (1999). Environmental Biotechnology. Pearson Education Limited, England.
2. Allsopp, D. and Seal, K.J. (1986). Introduction to Biodeterioration. ELBS/Edward Arnold, London.
3. Athie, D and Ceri, C.C. (1990). The use of Macrophytes in Water Pollution Control. Pergamon Press, Oxford.
4. Chin, K.K. and Kumarasivam, K. (1986). Industrial Water Technology Treatment- Reuse and Recycling. Pergamon Press, Oxford.
5. Dart, R.K. and Stretton, R.J. (1994). Microbiological aspects of pollution control. Elsevier Pub. Co., Amsterdam, New York.
6. Fry, F.C. and Gadd, G.M. Herbert, R.A. Jones, C.W. and Watson-Crick, J.A. (1982). Microbial Control of Pollution. Cambridge University Press, New York.
7. Henze, M and Gujer, W. (1992). Interactions of waste water: Biomat and Reactor Configurations in Biological Treatment Plan. Pergamon Press, Oxford.
8. Jenkins, D. and Olson, B. H. (1989). Water and Waste water Microbiology. Pergamon Press, Oxford.
9. John, C. and Todd, V.C. (1990). Integrated environmetal Management. Lewis Publishers Inc., Chel.
10. Kaul, T.N. and Trrivedy, R.K. (1993). Pollution Control in Distilleries. Enviromedia, Karad, India.
11. McEldowney, Sharon, Hardman, David, J. and Waite, S. (1993). Pollution, Ecology Biotreatment. Longman Scientific and Technical, Harlow, England.
12. Technoglous, G. Burton, F.L. and Stensel, H.D. (2004). Wastewater Engineering-Treatment, Disposal and Reuse. Metcalf and Eddy Inc., TataMcGraw Hill, New Delhi.


**Publications**


1. De, A. K. (2004). Environmental Chemistry . Wiley Eastern Ltd., New Delhi.





2. Jogdand, S.N. (1995). Environmental Biotechnology. Himalaya

Publishing House, Bombay. Sastry, C.A. Hashim, M.A. and Angamuthu, P. (1995). Waste Treatment Plants. Narosa Publishing House, New Delhi, India.

## SEMESTER – IV

## RESEARCH METHODOLOGY AND BIOSTATISTICS

| | | | |
|---|---|---|---|
| Paper | : Core XII | Total Hours | : 75 |
| Hours/Week | : 4 | Exam Hours | : 03 |
| Credit | : 4 | Internal | : 25 |
| Paper Code | : 21P3BTC12 | External | : 75 |

**Aim:** To enable the students to learn about the basics of research and application of Bioinformatics

**Objectives:**

To equip the students with basic knowledge of how to do research, problem solving in research and to know about the biological database and tools and its application

**UNIT-I:** Research definition, Types of Research: Descriptive vs. Analytical Research, Applied vs. Fundamental Research, Quantitative vs. Qualitative Research, Conceptual vs. Empirical Research, Formulating the Research Problem, Research Methods vs. Research Methodology, Literature Review, Review Concepts and Theories, Current trends in Research, Mono,Trans, Inter- disciplinary Research, Computer & Internet: Its Role in Research, Threats and Challenges to Good Research

**UNIT-II:** Hypothesis: Formulation, Sources, Characteristics, Role, Test, Research Design, Legal Research, Clinical Trials, Evolutive and Evaluative, Identificatory and Impact studies, Projective and Predictive, Writing an: Article, Essay, Research Paper, Research Project, Legislation Drafting, Judgment Writing, Thesis, Dissertation, Book, Reviews - Book Review; Case Review, Criteria of Good Research, Research Ethics, Citation Methods: Foot Note, Text Note, End Note, Bibliography, Citation Rules.

**UNIT-III:**

Principle and Application Of Research Methods: Spectrophotometer, Visible, UV, Fluorescence Flame photometer, Atomic absorption spectrophotometer, IR, NMR. Laboratory Safety Methods: Biohazardous Agents – Risk Groups and Biosafety levels – Laboratory safety measures.

**UNIT-IV:** Statistics in Research: Sampling Design, Data Collection- Primary and Secondary data, Processing and Analysis of Data, Limitation and uses of Statistics, Graphs, mean, Median, Mode, Standard deviation, Standard error.

**UNIT-V:** Biological Data Acquisition: Access, Retrieval and Submission methods for DNA sequence, protein sequence and protein structure information; Databases – Annotated sequence databases, Organism specific databases; Sequence Similarity Searches: Local versus global. Distance metrics, Scoring matrices, Dynamic programming algorithms, Needleman-wunsch and Smith-waterman.

**REFERENCES:**

**TEXTBOOKS**


1. Research Methodology: A Step-by-Step Guide for Beginners–by Ranjit Kumar
2. Practical Research: Planning and Design (10th Edition) 10th Edition by Paul D. Leedy, Jeanne Ellis Ormrod
3. Developing Research Proposals (Success in Research) by Pam Denicolo, Lucinda Becker
4. Research Methodology – C.R.Kothari
5. 1.B.K. Mahajan, (1997)Methods in Biostatistics, Sixth Edition, Jaypee Brothers Medical Publishers(p)Ltd
6. 2.S.P. Gupta, (2011)Statistical Methods (41th edition),Sultan Chand & sons, New Delhi
7. Gurumani, N.1943.Research Methodology for Biological Sciences.MJP Publications
8. Plummer, D.T.1996. An Introduction to Practical Biochemistry.
9. Johanson, D.A 1940. Plant Microtechniques, Mac graw Hill
10. Stock.R and Rice, C.B.F.1980.Chromatograophic methods, Champman and Hall
11. Burdan R.H.Knippenbergh P.H. 1989.Techniques in Biochemistry and Molecular Biology 2nd Ed,Elsevier.
12. Daphne J.O and Michael, B.J.1989.Cell separation in Plants physiology,Biochemistry and Molecular Biology.Springer-verlag,Berlin Ramawat K.G, Shaily Goyal. 2009.Comprehensive Biotechnology 4th Ed,S.Chand.


**Title of the Paper – Project & Viva Voce**

**Paper Code - 21P4BTPR01**

Project work

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