# MOTHER TERESA WOMEN'S UNIVERSITY,

# KODAIKANAL - 624 102
# Tamil Nadu.

**From 2018 – 2019 Onwards**

**MOTHER TERESA WOMEN'S UNIVERSITY**

**KODAIKANAL**


# Common Course structure for

# PG Programmes under CBCS

# M.Sc Biotechnology

# From 2018 – 2019 Onwards

**MOTHER TERESA WOMEN'S UNIVERSITY, KODAIKANAL**

**M.SC. BIOTECHNOLOGY**

| P. No. | Paper Code | Course Title | Hours | Credits | Internal | External | Total |
|---|---|---|---|---|---|---|---|
| | **Semester I** | | | | | | |
| 1 | PBTT11 | Core I (Theory)- Biochemistry | 5 | 5 | 25 | 75 | 100 |
| 2 | PBTT12 | Core II (Theory)- Microbiology | 5 | 5 | 25 | 75 | 100 |
| 3 | PBTT13 | Core III (Theory)- Molecular Biology | 5 | 5 | 25 | 75 | 100 |
| 4 | PBTP11 | Practical-I- Lab in Analytical Biochemistry, Microbiology and Molecular Biology | 5 | 5 | 25 | 75 | 100 |
| 5 | PBTE11 | **Elective I**<br>Choice 1:Cell Biology and Genetics<br>Choice 2: Developmental Biology | 5 | 4 | 25 | 75 | 100 |
| | | ***Total*** | **25** | **25** | | | **500** |
| | **Semester II** | | | | | | |
| 6 | PBTT21 | Core IV (Theory)- Immunology | 5 | 5 | 25 | 75 | 100 |
| 7 | PBTT22 | Core V (Theory)- Recombinant DNA Technology | 5 | 5 | 25 | 75 | 100 |
| 8 | PBTT23 | Core VI (Theory)- Environmental Biotechnology | 5 | 5 | 25 | 75 | 100 |
| 9 | PBTP22 | Practical-III- Lab in Immunology and Recombinant DNA Technology, Lab in Environmental Biotechnology | 5 | 5 | 25 | 75 | 100 |
| 10 | PBTE22 | **Elective II- Other Department Elective**<br>Choice 1:Bioinformatic and computer Application<br>Choice 2: Nanotechnology and cancer biology | 5 | 4 | 25 | 75 | 100 |
| | | ***Total*** | **25** | **25** | | | **500** |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | **Semester III** | | | | | | |
| 11 | PBTT31 | Core VII (Theory)-Plant Biotechnology | 5 | 5 | 25 | 75 | 100 |
| 12 | PBTT32 | Core VIII (Theory)- Animal Biotechnology | 5 | 5 | 25 | 75 | 100 |
| 13 | PBTT33 | Core IX (Theory)- Bioinstrumentation and Biostatistics | 5 | 5 | 25 | 75 | 100 |
| 14 | PBTP33 | Practical-V- Lab in Plant Biotechnology & Animal Biotechnology | 5 | 5 | 25 | 75 | 100 |
| 15 | PBTE33 | **Elective III**<br>Choice 1: Women Studies<br>Choice 2: Employability Skill | 5 | 4 | 25 | 75 | 100 |
| | | ***Total*** | **25** | **25** | | | **500** |
| | **Semester IV** | | | | | | |
| 16 | PBTT41 | Core X (Theory)Bioethics, Biosafety and IPR | 5 | 5 | 25 | 75 | 100 |
| 17 | PBTT42 | Core XI (Theory) Bioprocess Technology | 5 | 5 | 25 | 75 | 100 |
| 18 | PBTP44 | Major Project | 5 | 5 | 25 | 75 | 100 |
| | | ***Total*** | **15** | **15** | | | **300** |
| **Grand Total** | | | | **90** | | | **1800** |

**Regulations:**

**1. Course Objectives**

**To enable the students**

- To understand the emerging trends in biotechnology.
- Students will get knowledge about the structure and functions of biomolecules, enzyme kinetics, bio polymers and metabolic reactions in a living system.
- To learn knowledge in genome organization of organisms.
- To develop practical and theoretical knowledge in Applied biotechnology

**2. Qualification for Admission:**

i. Candidate should have passed a UG degree (B.Sc Microbiology/ Biochemistry/ Zoology/ Botany/ Immunology/ Biotechnology/ Applied Microbiology / Integrated Biology / Medical Microbiology) or equivalent life science degree.

ii. Candidate should have secured at least 50%.

iii. A relaxation of 5-10% in the total percentage will be given to SC, ST candidates.

iv. Candidates sponsored by industries/hospitals/Clinical laboratories may be considered for admission.

3. **Duration of the course:**

The students will undergo the prescribed course of study for a period of not less than two academic years (Four semesters).

4. **Medium of Instruction**: English

5. **Subject of Study**: As given in Appendix A

6. **Scheme of Examination**: As given in Course Structure and Scheme of Examination Appendix B

7. **Eligibility of the degree**:

i. Candidates will be eligible if they complete the course with the required credits and pass in the prescribed examinations.

8. The candidate requires 75% of attendance to attend the semester exam.

9. The internal marks would be divided as 5 for assignment 5 for seminar and 15 for written tests. One or two seminars/assignments can be given and a consolidate of them can be considered.

11. The passing minimum is 50 percent (both in internal and external separately) in each paper.

12. The candidate has to undergo a project individually.

13. To complete the course the students should gain the prescribed credits i.e. 90 credits.

**Core** –The candidate has to study 14 cores including practical and gain the respective credits. (14 * 5 credits each = 70 credits).

**Elective-** Each candidate has to study three electives and gain the respective credits. (3 * 5 credits each = 15 credits).

**Project** – The candidate has to undergo one project in the fourth semester and gain 5 credits.

**MOTHER TERESA WOMEN'S UNIVERSITY, KODAIKANAL**

**M.SC. BIOTECHNOLOGY**

**Semester I**

**CORE I – BIOCHEMISTRY – PMTT11**

**Objectives:**

1. Students will get knowledge about the structure and functions of biomolecules, enzyme kinetics, bio polymers and metabolic reactions in a living system.
2. To learn about structure of biomolecules.
3. To determining how they are metabolized in organisms, and elucidating their role in the operation of the organism.
4. On the successful completion of the course the students will get an overall understanding of Biomolecules, their structure and classifications, enzyme kinetics and metabolic reactions in a living system.

**CORE I (Theory) – BIOCHEMISTRY – PMTT11**

**Semester : I** **Hours/Week: 5**

**Sub code : PMTT11** **Credit :5**

**Learning Outcome:** On the successful completion of the course the students will get an over all understanding of Biomolecules, their structure and classifications, enzyme kinetics and metabolic reactions in a living system.

**UNIT I**

Atom, Molecules & chemical bonds properties of H2O, acid and buffer. Carbohydrates – Occurrence, chemical properties, stereo and optical isomerism, structure and classification. Metabolism and its regulation – Glycolysis, TCA cycle, Oxidative phosphorlylation, pentose phosphate pathway and gluconeogenesis, ATP synthesis, Photosynthesis, Glygenolysis.

**UNIT II**

Lipids – occurrence, chemical properties and classification-biosynthesis of fatty acids triglycerides, phospholipids and cholesterol – Oxidation of fatty acids, Vitamins – classifications, derivatives, hormones – Types functions & disorders.

**UNIT III**

Amino acids and Proteins – Amino acids: structure, classification and chemical properties, structure of peptide bond – protein: classification, amino acid composition. Protein structure – Primary structure, secondary structure – alpha helia and beta pleated structure, tertiary and quaternary structure. Protein metabolism and degradation: A.A oxidation & Urea cycle. Ramachandran plot.

**UNIT IV**

Nuclic acids – DNA & RNA – structure of purine and pyrimidine bases, nucleotides and nucleotide biosynthesis, its regulation & degradation of purine and pyrimidine nucleotides – Biosynthesis of deoxyribonucleotides.

**UNIT V**

Enzymes – Nomenclature and Classification – protein enzymes, coenzymes, prosthetic groups, cofactors, isoenzymes, ribozymes, abzymes: chemical properties of enzymes: types of specificity – absolute, group, stereochemical and geometrical; factors influencing enzyme activity – temperature, pH, concentration of enzyme, substrate and effect if ions; enzyme kinetics, types of enzyme inhibition – reversible, competitive, non-competitive, uncompetitive, irreversible inhibition; allosteric enzymes.

**REFERENCES**


1. Nelson D.L and Cox M.M. 2006. Lehninger Principles of Biochemistry, 4th edition, Macmillan worth Publishers.
2. Murray R.K, Granner D.K and Rodwell V.M. 2006. Harper's Illustrated Biochemistry, 27th Edition , The McGraw-Hill companies, Inc.
3. Berg J.M, Tymoczke J.L and Stryer W.H. 2007. Biochemistry, Freeman and Company, USA
4. Principles of Biochemistry Third Edition International Student Version Chapter 13 Biochemical Signaling Copyright © 2008 by John Wiley & Sons, Inc. Donald Voet • Judith G. Voet • Charlotte W. Pratt
5. U. Satyanarayana, Biochemistry, Books and Allied (P) Ltd., Calcutta, Latest Edition.

## CORE II –MICROBIOLOGY – PBTT12

**Objectives:**

1. To learn about the basic applications of microorganisms.
2. To understand the identification of microorganisms using advanced microbiological methods
3. The knowledge about different types of microorganisms and their identification techniques in modern biology.
4. To identify the microorganisms based on the modern polyphasic approach.
5. The students will be able to identify any microorganisms, predict the intermediate metabolism of any microbe used in industrial production processes, economical uses of microorganism and pathogenesis of various microbes in the environment.

## CORE II (Theory) –MICROBIOLOGY – PBTT12

**Semester : I** **Hours/week :5**

**Sub code : PBTT12** **Credits:5**

**Learning outcome:** The students will be able to identify any microorganisms, predict the intermediate metabolism of any microbe used in industrial production processes, economical uses of microorganism and pathogenesis of various microbes in the environment.

### UNIT I

Historical perspectives of microbiology, Domain and Kingdom concepts in classification of microorganisms, Criteria for classification. Classification of Bacteria according to Bergey's manual. Diversity of prokaryotic microorganisms.

### UNIT II

Microbial growth: Isolation of microorganisms – Bacteria's and fungi, Pure culture technique and enrichment culture techniques, methods of sterilization. Growth curve, Measurement of growth and Growth yields, diauxy growth, Synchronous culture, continuous culture, influence of environmental factors on growth. Current methods of microbial identification.

**UNIT III**

Bacteria – Purple and Green Bacteria, Cyanobacteria, acetic acid bacteria, Pseudomonads, lactic and propionic acid bacteria, endospore forming rods and cocci; Mycobacteria and Mycoplasms, Archaea: Halophiles; Methanogens; Hyperthermophilic archeae – Eukarya: Fungi – Introduction, structure and characteristics of fungal divisions Algae – Introduction, Characteristics of Algal divisions.

**UNIT IV**

Viruses: General properties of viruses. DNA and RNA viruses, Classification of viruses – Baltimore, Viriods and Prions. Cultivation and Host parasite relationship, Host defense against microbial invasion, Microbial mechanism for escaping host defenses. Bacteriophage – lytic and lysogenic cycle and types.

**UNIT V**

Bacterial pathogenicity: *Mycobacterium tuberculosis* - Progress of tuberculosis –classical and recent advances in diagnosis and treatment. *Trepenoma pallidum* - process of infection, transmission diagnosis and treatment. Viral pathogenicity: HIV, Rabies, Ebola and Dengue - replication cycle, transmission, diagnosis and treatment; Fungal pathogenicity: Ringworm infection and treatment. Protozoan diseases: malaria – life cycle of plasmodium, classical and recent advances in diagnosis and treatment.

**REFERENCES**


1. Atlas R. M and Bartha R. 2000. Microbial Ecology-Fundamentals and Applications
2. Prescott L.M, Harley J.P. and Klein D.A. 2005. Microbiology, Sixth edition
3. McGraw Hill, Boston.
4. Maier R.M., Pepper I.L. and Gerba C.P. 2006. Environmental Microbiology, Elseiver Publication, New Delhi, India.
5. Salyers A.A. and Whitt B.D. 2001. Microbiology – Diversity, Disease and the Environment, Fitzerald Scientific Press, Maryland.

6. Persing D.H. 2004. Molecular Microbiology – Diagnostic Principles and Practice, ASM Press, Washington, USA.
7. Zhou J., Thomson D.K, Xu Y and Tiedje J.M. 2004. Microbial Functional Genomics, J.Wiley and Sons Publishers.
8. Greenwood D, Slack R and Peutherer J. 1997. Medical Microbiology. ELST, Churchill Livingstone, Hong Kong.
9. Microbiology: An Introduction (2014), Twelth edition. Gerard J. Tortora, Berdell R. Funke, Christine L. Case.
10. Alcamo's Fundamentals of Microbiology (2011), Fifteenth edition. Jeffery C. Pommerville and I. Edward Alcoma. Chicago, Sudburg, Mass: Jones and Bartlette Publishers.
11. Molecular Microbiology – Diagnostic Principles and Practice (2004), D.H. Persing, ASM Press, Washington, USA.
12. Microbial Functional Genomics (2004) by J.Zhou, D.K. Thomson. Y.Xu. J.M. Tiedje, J.Wiley & Sons Publishers
13. Microbial Ecology. Fundamentals and Applications (2000) by R. M. Atlas and R. Bartha
14. Microbiology (1993) by M.J. Pelzer Jr., E.C.S. Chan and N.R. Kreig, McGraw Hill Inc., New York.

## CORE III- MOLECULAR BIOLOGY – PBTT13

**Objectives:**

1. To learn basic knowledge about nucleotides structure and its function.
2. To Understanding the structural and functional aspects of the cell provides the student with a strong foundation in the molecular mechanisms underlying cellular function.
3. To learn knowledge in genome organization of organisms.
4. Understanding the structural and functional aspects of the genes provides the student with a strong foundation in the molecular mechanisms.

## CORE III (Theory) MOLECULAR BIOLOGY – PBTT13

**Semester : I** **Hours/Week: 5**

**Sub code : PBTT13** **Credit : 5**

**Learning outcomes:**

Student can get thorough knowledge in genome organization of organisms. Understanding the structural and functional aspects of the genes provides the student with a strong foundation in the molecular mechanisms.

**UNIT I**

DNA as genetic material. Structure, types and function of DNA & RNA, mi RNA, RNA i– Si RNA, PNA, extra chromosomal genetic material. DNA replication models: prokaryotic & Eukaryotic replication. DNA binding proteins, Histones, Mutations, Mutagens – Physical & chemical. Transposon– types.

**UNIT II**

RNA synthesis and processing (transcription factors and machinery, formation of initiation complex, transcription activator and repressor, RNA polymerases, capping, elongation and termination, RNA processing, RNA editing, Splicing and polyadenylation, RNA transport.

Protein synthesis and processing (Ribosome, formation of initiation complex, initiation factors and their regulation, elongation and elongation factors, termination, genetic code, aminoacylation of tRNA, tRNA – identity. Aminoacyl tRNA synthetase and translational proof-reading, translational inhibitors, post-translational modification of proteins.

**UNIT III**

Control of gene expression at transcription and translation level (Regulating the expression of phages, viruses, prokaryotic and eukaryotic gene, role of chromatin in gene expression and gene silencing). Recombination -Homologous, Non homologues and site specific recombination.

**UNIT IV**

DNA repair mechanisms: photo activation, excision repair recombination repair; SOS and adaptive responses and their regulation. Gene mapping methods- linkage maps, tetrads analysis, mapping with molecular markers, mapping by somatic cell hybrids, development of cell signaling; hormones & their receptors, cell surface receptor, signaling through G-protein coupled receptors, signal transduction pathways, second messengers, regulations of signaling pathways.

**UNIT V**

Bacterial and plant two component systems, light signaling in plants, bacterial chemo taxis and Quorum sensing. Molecular Chaperons-Heat Shock proteins. Oncogenes and anti-oncogenes.

**REFERENCES**


1. Maloy S.R., Cronan Jr. J. E., and Freifelder D. 2006. Microbial Genetics, Jones and Bartlett Publishers, Sudbury, Massachusetts.
2. Chichester and Dale JW, 1994. Molecular genetics of Bacteria. John Wiley & sons. New York.
3. Hartl D.A and Jones E.W. 2000. Genetics: Analysis of genes and genomes, Jones & Bartlett Publishers, Sudbury, Massachusetts.
4. Alberts B, Johnson A, Lewis J, Raff M, Roberts K, Walter P. 1994. Molecular Biology of the Cell, Fourth Edition, Academic Press. New York.

5. Lodish, Berk, Baltimore et al . 2000. Molecular Cell Biology, 6th Eds, W.H. Freeman & Co.
6. Cooper G. 2000. The Cell: A molecular approach. 2nd Eds, Sinauer Associates Inc.
7. Kleinsmith L. J. and Kish V.M. 1995. Principles of Cell and Molecular Biology. 2nd edn., McLaughlin, S., Trost, K., Mac Elree, E. (eds.)., Harper Collins Publishers, New York.
8. De Robertis and De Robertis. 2005. 8th Eds. Cell and Molecular Biology. Lippincott Williams & Wilkins.
9. Brown T.A, 2002. Genomes. 2nd Edition. Wiley-Liss, New York.
10. Molecular Biology of the Cell (2014), 6th Edition, B. Alberts, A. Johnson, J. Lewis, M. Raff, K. Roberts and P Walter, Garland Publishing (Taylor & Francis Group), New York & London (ISBN: 9780815344322).
11. Molecular Cell Biology (2014), Harvey Lodish, 7th Edition, W.H.Freeman and Company, New York.
12. Primrose S.B, Twyman R.M., Old R.W. 2002. Principles of Gene Manipulation and genomics. 7th Edition. Blackwell Science.

## PRACTICAL I: LAB IN ANALYTICAL BIOCHEMISTRY & LAB IN MICROBIOLOGY AND MOLECULARBIOLOGY – PBTP11

**Objectives:**

1. To learn the technique about identification of microorganism from biological samples.
2. To know the isolation and purification of actinomycetes and fungi and biochemical characterization of selected bacteria.
3. To know the technique about spontaneous mutation by gradient plate technique, induced mutagenesis (UV, NTG) and replica plate technique.
4. To learn technique about molecular mechanisms underlying cellular function, isolation of plasmid DNA and genomic DNA and DNA repair mechanism.

## PRACTICAL I: LAB IN ANALYTICAL BIOCHEMISTRY & LAB IN MICROBIOLOGY AND MOLECULARBIOLOGY – PBTP11

**Semester : I** **Hours/Week: 5**

**Sub code : PBTP11** **Credit :5**

1. Preparation of solutions – Molar, Normal, Percentage, Stock, Working etc.

2. Preparation of buffers – PBS, Tris and Acetate buffer.

3.Qualitative analysis of carbohydrate, protein, and lipid

4. Estimation of mono saccharide

5. Extraction and Estimation of starch from potato/ tapioca

6. Estimation of protein

7. Estimation of nucleic acids by absorbance at 260 nm

8. Enzyme assay: Estimation of salivary amylase from saliva & phosphatase from potato

9. Estimation of DNA by diphenylamine

10. Estimation of RNA by orcinol method.

11. Estimation of lipids

12. Estimation of vitamins – ascorbic acid, α-tocopherol & β – carotenoids.

13. Separation of amino acids by Paper chromatography

14.Separation of amino acids by and Thin layer chromatography

15. Separation of pigments by column chromatography

16. Estimation of glucose (DNS method)

## LAB IN MICROBIOLOGY AND MOLECULARBIOLOGY

5. Isolation of microorganism from samples.
6. Methods of Counting colonies in petridish cultures
7. Preparation of media.
8. Pure culture techniques – serial dilution – pour plate, spread plate, streak plate and stab culture
9. Bacterial staining methods – single, Grams and negative
10. Fungal staining methods – Lacto phenol cotton blue
11. Motility of bacteria
12. Enumeration of bacteria/Yeast cell, viable count(Plate count), Total count (Haemocytometer)
13. Isolation and purification of actinomycetes, fungi
14. Biochemical characterization of selected bacteria.
15. Spontaneous mutation by gradient plate technique.
16. Induced mutagenesis (UV, NTG)
17. Detection of mutants by replica plate technique.
18. Study of mutation by Ames test.
19. Antibiotic sensitivity
20. Bacteriophage titration – plaque forming cells.
21. Isolation of Plasmid DNA
22. Isolation of Genomic DNA
23. DNA repair mechanism.

## ELECTIVE I

## Option I: CELL BIOLOGY AND GENETICS – PBTE11

**Objectives:**

1. knowledge about structure and function of cells, cellular energetics, protein trafficking, bio molecules and cellular development.
2. Understanding the structural and functional aspects of the cell provides the student with a strong foundation in the molecular mechanisms underlying cellular function
3. To pursue careers in cellular and sub cellular biological research, biomedical research.
4. This paper provides a thorough knowledge about cell structure and function, cellular transport, signaling, protein trafficking, cellular development, gene expression and genetic diseases.

## ELECTIVE I

## Option I: CELL BIOLOGY AND GENETICS – PBTE11

**Semester : I** **Hours/Week: 5**

**Sub code : PBTE11** **Credit :5**

**Learning outcomes:**

This paper provides a thorough knowledge about cell structure and function, cellular transport, signaling, protein trafficking, cellular development, gene expression and genetic diseases.

**UNIT I**

Structure of prokaryotic and Eukaryotic cell. Structure and function of nucleus, endoplasmic reticulum, Golgi complex, Mitochondria, Chloroplast & lysosomes. Cytoskeleton (Microfilaments, intermediate filaments, microtubules and associated proteins), Motile cells, Nerve cells, Nerve impulse, muscle cell, muscle contraction.

**UNIT II**

Ultra structure of plasma membrane – components & membrane asymmetry; Transport process – active transport, monophores & ion channels. Exo & endocytosis, Phago and pino cytosis, Ribosomes, vacuoles, peroxisomes.

**UNIT III**

Chromosomes – morphology, Ultra structure, specialized chromosomes. Molecular events of cell cycle and its regulation. Cell division – Amitosis & meiosis. Cell differentiation and cell death.

**UNIT IV**

Mendelian principles- segregation and independent assortment. Incomplete dominance. Trihybrid ratio. Epistasis. Pedegree analysis. Chromosome abnormalities, quantitative inheritance, Hardy-Weinberg equilibrium, genetic drift and speciation.

**UNIT V**

Sex determination and Linkage: (Drosophila, Hymenoptera, Mammals). Environmental factor and Sex determination, Sex differentiation. Sex linkage in diploids crossing over. Genetic disorders.

**REFERENCES**


1. Molecular Biology of the Cell, Fourth Edition.(Bruce Alberts) , Alexander Johnson , Julian Lewis, Martin Raff , Keith Roberts, Peter Walter. Academic Press. New York. (1994)
2. Molecular Cell Biology. 6th Eds. Lodish , Berk , Baltimore et al . W.H. Freeman & Co.(2000)
3. Cell and Molecular Biology: Concepts and Experiments, 5th Eds. Gerald Karp. Wiley (2008)
4. The Cell: A molecular approach. 2nd Eds. Geoffrey Cooper. Sinauer Associates Inc. (2000)
5. Kleinsmith, L. J. & Kish, V.M. 1995. Principles of Cell and Molecular Biology. 2nd edn.,McLaughlin, S.,Trost, K., Mac Elree, E. (eds.)., Harper Collins Publishers, New York.
6. De Robertis and De Robertis. 8th Eds. Cell and Molecular Biology. Lippincott Williams & Wilkins (2005)
7. Molecular Biotechnology. 2nd Edition. Sandy B Primrose. Blackwell Scientific Publishers (1991)
8. Genomes. 2nd Edition. T.A.Brown. Wiley-Liss (New York). 2002

9. Molecular Genetics of Bacteria . 2nd Edition. Larry Snyder, Wendy Champness. Amer Society for Microbiology. 2002.

10. Benjamin Lewin. Genes VIII.2003. Benjamin-Cummings Pub Co.

## Option II: DEVELOPMENTAL BIOLOGY – PBTE11

**Objectives:**

1. Information on the development and physiology of various animal and plant systems.
2. To enable the students to know the actual pathway of physiological metabolism of mammals including humans.
3. The gained information about the various living system which will help in the future to develop the drugs.
4. Students can understand the basic concepts of developmental biology in both plants and animals.

**Option II: DEVELOPMENTAL BIOLOGY – PBTE11**

**Semester : I** **Hours/Week: 5**

**Sub code : PBTE11** **Credit :5**

**Learning outcome:** Students can understand the basic concepts of developmental biology in both plants and animals.

**UNIT I**

Sperm & egg, spermatogenesis, Oogenesis, Sperm and Oocyte maturation. Cell surface molecules in sperm – egg recognition. Egg activation and signaling mechanism, Fertilization, polyspermy. Parthenogenesis.

**UNIT II**

cleavage, blastula formation, gastrulation and formation of germ layers. Organogenesis – development of heart, eye and brain in chick. Hormonal control of ovulation and pregnancy, menstrual cycle, gestation period, abortion, ectopic pregnancy.

**UNIT III**

Embryosac development and double fertilization in plants. Embryogenesis, establishment of symmetry in plants; seed formation and germination.

**UNIT IV**

Post embryonic development- larval formation, metamorphosis, Regeneration, Sex determination. Genetic errors of Human development, teratogenesis,

**UNIT V**

Organization of shoot & root apical meristem; shoot & root development; leaf development and phyllotaxy; transition to flowering, floral meristems and floral development in Arabidopsis.

**REFERENCES**


1. Developmental Biology, Gilbert, (8th Ed., 2006) Sinauer Associates Inc.,Massachusetts, USA.
2. Principles of Development, Wolpert, Beddington, Brockes, Jessell, Lawrence,Meyerowitz, (3rd Ed., 2006), Oxford University Press, New Delhi, INDIA.
3. Analysis of Biological Development, Kalthoff, (2nd Ed., 2000), McGraw-HillScience, New Delhi, INDIA.
4. Principles of Development, Second Edition. Lewis Wolpert, Rosa Beddington, Thomas Jessell,
5. Peter Lawrence, Elliot Meyerowitz, Jim Smith. Oxford University Press. 2002.
6. From embryology to Evo-Devo : a history of developmental evolution. Edited by Manfred D. Laubichler and Jane Maienschein. Cambridge, Mass : MIT Press, c2007.


## SEMESTER II

## CORE IV- IMMUNLOGY– PBTT21

**Objectives:**

1. To expose the students with various immune systems of human body.
2. Understanding the immune system, antigen antibody reactions, applications of immunological techniques, humoral and cell mediated immunity.
3. To learn about hypersensitivity reactions and hybridoma technology.
4. This course will provide the student insights into the various aspects of Immunology such as classical immunology, clinical immunology, Immunotherapy and diagnostic immunology.
5. Student can understand the basic concepts of immune system and will get trained in various techniques involved in Immunology for drug discovery and solve immune problems.

## SEMESTER II

## CORE IV (Theory)- IMMUNLOGY– PBTT21

**Semester : II** **Hours/Week: 5**

**Sub code : PBTT21** **Credit :5**

**Learning outcome:** Student can understand the basic concepts of immune system and will get trained in various techniques involved in Immunology for drug discovery and solve immune problems.

### UNIT I

Overview of the immune system, Milestones of Immunology. Innate and adaptive immunity. Lymphoid glands – Primary and secondary structure and function. Cells of the immune system & their functions. Immunoglobulins – structure and function, immunoglobulins (organization and expression) Activation, maturation and Differentiation of B cells and t cells.

### UNIT II

Immunogenicity – Immunogens, adjuvants, Epitopes, haptens and carriers. Antigens Antibody interactions. Cell mediated and humoral immune response.

Cellular interactions – Cell surface receptors, CAMS, Major Histocompatibility complex (MHC); Structure and interactions. Antigen processing and Presentation.

### UNIT III

Lymphokines and cytokine receptors, therapeutic uses. Complement systems: activation pathways – classical, alternative and lectin.

### UNIT IV

Hypersensivity I,II,III,IV, Immunotolerence, Transplantation, graft rejection & immunosuppressive theraphy, HLA theraphy, Auto immune disorders – types, mechanisms and treatment, congenited and acquired immunodeficiencies.

### UNIT V

Vaccines (traditional and novel) Hybridoma technology, ELISA, FACs, Immunofluroscent microscopy, Immunodiffusion , Immuno electrophoresis, Western blotting

### REFERENCES

1. Weir D. M and Steward J. 1993. Immunology. VII edition, ELBS. London.
2. Riot I. M. 1994. Essential Immunology. Blackwell scientific. Publications. Oxford.
3. Jacqueline S, Williams and Wilkins A. 1998. Basic Immunology. Waterly Company.
4. Janeway Travers. 1997. Immunobiology. The immune system in health & disease. 3rd edition. Current biology Ltd., London, New York.
5. Lydyard P, Whelam A & Fanzer MW 2000. Instant notes in immunology, Edited by Hames BD, Viva books Pvt. Ltd.
6. Paul 1998. Fundamental Immunology. 3rd Edition.
7. Peter J. Delves, Ivan M. Roit (eds). 1998. Academic press encylopedia of Immunology – 2nd edition.
8. Richard M. Hyde. 1995. Immunology III edition. National medical series. Williams & Wilkins, Harvard Publishing company.
9. Clark WR 1991. The experimental foundations of modern Immunology, John Wiley & sons Inc, New York.
10. Kuby Immunology (2007) by Thomas J. Kindt, Richard A. Goldsby and Barbara A. Osborne. W.H.Freeman and Company
11. Immunology (2006) by David Male, Jonathan Brostoff, David B Roth and Ivan Roit. Elsevier Publishers.

Chapel H and Halbey M. 1986. Essentials of Clinical Immunology. ELBS.

## CORE V- RECOMBINANT DNA TECHNOLOGY – PBTT22

**Objectives:**

1. To expose students to application of rDNA technology to various fields of biotechnology (medicine and research areas).
2. The student a thorough knowledge in principles and methods in genetic engineering, vectors in gene cloning, transformation in higher organisms and gene therapy.
3. To learn about techniques employed are carved as self-study.

4. To get information on the latest advances in recombinant DNA technology, principles, techniques for genetic engineering new organism to solve the social problems. which is a powerful tool needed for modern biotechnology research.

**CORE V (Theory)- RECOMBINANT DNA TECHNOLOGY – PBTT22**

**Semester : II** **Hours/Week: 5**

**Sub code : PBTT22** **Credit :5**

**Learning outcome:** Students will acquire knowledge on tools of Recombinant DNA technology, principles, techniques for genetic engineering new organism to solve the social problems.

**UNIT I**

Restriction enzymes, DNA ligase, Klenow fragment, DNA polymerase I, T4/T7 DNA polymerase, Taq polymerase linkers, adaptors, Homopolymeric tailing, Alkaline phosphatase, Reverse transcriptase, Radioactive and non radioactive probes, hybridization, Microarray.

**UNIT II**

Host cells – Prokaryotic & Lukaryotic, Vectors – plasmids, Lamda phage, M13, PUC 18, Cosmids, artificial chromosomal vectors (YAC,BAC), Animal virus derived-SV40, Vaccinia, retroviral, Expression vectors-pET based yeast vectors and Shuttle vectors, Ti and R vectors.

**UNIT III**

Transformation, Electroporation, Lipofection, Microinjection, Construction of Genomic DNA and cDNA libraries, cDNA and genomic cloning, Expression cloning, protein-protein interactive cloning.

**UNIT IV**

Primer design, PCR- Multiplex, nested, reverse transcriptase, realtime, Touchdown, Hot start and colony. PCR in molecular diagnostics, Viral & Bacterial detections, mutation & polymorphism detection – RFLP, SSCP, Oligo ligation assay, Allele specific amplification, DNA fingerprinting, site directed mutagenesis.

**UNIT V**

DNA sequencing –chemical, enzymatic, Automated & Pyro Human genome project, DNA barcoding, DNA based nanostructure and applications.

**REFERENCES**

1. Gene Cloning and DNA Analysis. An introduction (2006) by T.A Brown, Blackwell Scientific Publications.
2. Principle of Gene Manipulation and Genomics (2006) by S.B. Primrose and R.M Twyman, Blackwell Scientific Publications.
3. Molecular Biology of the Gene, 6th edition (2008) by James D Watson, Tania A Baker, Stephen P Bell, Alexander Gann, Michael Levine and Richard Losick, Benjamin Cummings.
4. From Genes to Clones: Introduction to gene technology (1987) by Winnacker, E.L.
5. Next generation sequencing (2008) by Michael Janitz, Wiley-Blackwell Publications.

## CORE VI- ENVIRONMENTAL BIOTECHNOLOGY – PBTT23

**Objectives:**

1. To understand the energy sources, environmental pollution and remediation using biotechnology and its control.
2. Students will get an idea about the hazards to our environment, solutions to protect and for sustainable development.
3. To learn remediation of contaminated environments (land, air, water), and for environment-friendly processes such as green manufacturing technologies and sustainable development.
4. Student can identify the environmental problems such as global warming, ozone depletion and waste disposal and acquire skills to solve the environmental problems through biotechnological approach and become environmental conscious.

## CORE VI (Theory)- ENVIRONMENTAL BIOTECHNOLOGY – PBTT23

**Semester : II** **Hours/Week: 5**

**Sub code :** **Credit :5**

**Learning outcome:** Student can identify the environmental problems such as global warming, ozone depletion and waste disposal and acquire skills to solve the environmental problems through biotechnological approach and become environmental conscious.

**UNIT I**

Natural resource and fuels: Environment components, Role of Biotechnology in Environmental protection, Classification of natural resources – Inexhaustible, Exhaustible- resources. Conservation of natural resources – water, forest, energy and soil resources. Insitu – Exsitu conservation. Production of biogas and biofuel(alcohol), environmental act.

**UNIT II**

Pollution: Types of environmental pollution. Bioindicators and biosensors for detection of pollution.Bioechnological methods for control of pollution. Green house effect and global warming. Ozone depletion and acid rain, Bhopal disaster, London smog.

**UNIT III**

Water chemistry – physical-chemical and biological parameters – sources and efficiency of water pollution, oil pollution, super bug, water treatment, water borne diseases, Treatment of effluent from distillery and sugar industry. Minamata disease, GAP, YAP, need for water management. Eutrophication, Oil disaster.

**UNIT IV**

Types of solid wastes, sources and its impact on environment, solid waste disposal-land filling, composting, incineration, 3R concepts, Vermicomposting, Radioactive wastes sources, Disposal - Deino coccus, Sources effects and control measures. Love canal disaster.

**UNIT V**

Biopesticides and Biofertilizers, Single cell protein, Biomineralisation, Mechanism of Biomineralization. Biomining. Xenobiotics – Pesticides degradation, Degradative plasmids, hydrocarbons, Biotechnology for Hazardous waste management, Persistent organic pollutants, Biological detoxification of PAH, Eco – mark, Biodegradable plastics.

**REFERENCES**


1. Jordening HJ and Winter J. 2005. Environmental Biotechnology: Concepts and Applications. Wiley.
2. Dwivedi S.K, Kalita M.C, and Dwivedi P. 2007. Biodiversity and Environmental Biotechnology. 1st edition. Scientific Publishers, India, New Delhi.
3. Sharma P.D. 1994. Environmental Biology. Rastogi Publishers,New Delhi.
4. Chatterjee A.K. 2002. Introduction to Environmental Biotechnology. Printice Hall, India.

## PRACTICAL III: LAB IN IMMUNOLOGY & RECOMBINANT DNA TECHNOLOGY & LAB IN ENVIRONMENTAL BIOTECHNOLOGY – PBTP22

**Objectives:**

1. To introduce students to different techniques that are commercially used in molecular diagnosis of diseases and give an account of different diseases that are routinely diagnosed using molecular testing.
2. To give a broad overview of molecular theory and exposure to molecular and immunology techniques, a forum to understand clinical applications of various molecular tests.
3. To introduce students to different techniques that are commercially used in molecular and immunology diagnosis of diseases and give an account of different diseases that are routinely diagnosed using molecular and immunology testing.
4. To get information on the latest advances in recombinant DNA technology, which is a powerful tool needed for modern biotechnology research.
5. To practice remediation of contaminated environments (land, air, water), and for environment-friendly processes such as green manufacturing technologies and sustainable development.

## PRACTICAL III: LAB IN IMMUNOLOGY & RECOMBINANT DNA TECHNOLOGY & LAB IN ENVIRONMENTAL BIOTECHNOLOGY – PBTP22

**Semester : II** **Hours/Week: 5**

**Sub code : PBTP22** **Credit :5**

1. Preparation of Serum and Plasma
2. Differential count of WBC
3. Blood grouping

4. Widal slide test
5. Pregnancy test
6. Outchterlony's double immunodiffusion technique
7. Rocket immune electrophoresis
8. Routes of inoculation of laboratory animals
9. ELISA
10. Western blotting
11. Restriction digestion, ligation
12. Preparation of competent *E.coli* cells & transformation of *E.Coli* using recombinant DNA
13. Primer designing and PCR

## LAB IN ENVIRONMENTAL BIOTECHNOLOGY

1. Sampling techniques of water

2. Determination of colour, pH and temperature

3. Estimation of total alkalinity

5. Estimation of chloride

6. Estimation of total hardness

7. Estimation of Calcium

8. Estimation of DO, BOD and COD

9. Estimation of phosphate

10. Estimation of chromium and ferrous ion

11. Quick field soil test

12. Isolation of micro-organism from chrome tanning effluent

13. MPN- Water portability Test

14. Microbial treatment of industrial (sugar or dye) effluent and determination of COD

## ELECTIVE II: OTHER DEPARTMENT ELECTIVE – PBTE22

### Option 1: BIOINFORMATICS – MBTE225

**Objectives:**

1. To Understand and learn the technical details of several current experiments or technologies used in the field of biology.
2. Understand some of the larger questions and issues with systems biology and large-scale data collection and analysis.
3. To give the students comprehensive training in the emerging exciting upcoming area of Systems Biology, which will help students to get a career in both industry/R&D.
4. To learn information in different areas of biology - on genome sequences of many organisms, genetic and biochemical interaction networks, cell interactions during development, and organism response to environmental stimuli, along with molecular understanding of diseases.
5. Students can acquire knowledge on tools to predict bio macromolecules structure and interaction, analyze the genomics and proteomics data and drug designing process. They also will get basic knowledge on computer application.

## ELECTIVE II: OTHER DEPARTMENT ELECTIVE – PBTE22

### Option 1: BIOINFORMATICS

**Semester : II** **Hours/Week: 5**

**Sub code : PBTE22** **Credit :5**

**Learning outcome**: Students can acquire knowledge on tools to predict bio macromolecules structure and interaction, analyze the genomics and proteomics data and drug designing process. They also will get basic knowledge on computer application.

**UNIT I**

Introduction to computer – Characteristics – Components of computers. Hardware, Software – basics of Windows: Operating system – Accessories of windows; paint, calculation, recycle bin, Windows explorer, Internet explorer, Internet services – Mail services. Google and yahoo search engines.

**UNIT II**

MS office; introduction – components; MS word – screen layout-formatting features, editing features, mail merge, insertion of objects: clip art, mathematical equation, charts, printing & page layout. MS excel. Introduction, spread sheet layout, Cell manipulation, formula automatic recalculation. Statistical function cell manipulation, creation of charts, sheet manipulation. Printing of worksheet.. MS power point – introduction – views: slide, sorter view, slide show – design template, animal setting, insertion of objects – land outs Software : origin, SPSS

**UNIT III**

Introduction to Bioinformatics – definition, History and application. Biological database; Nucleic acid sequence databases: Nucleic acid sequence databases: Gen bank, NCBI,EMBL,DDBJ, Protein sequence Database: SWISSPORT, PIR; structural database; PDB, cath, SCOP.

**UNIT IV**

Sequence alignment – global Vs local alignment, pairwise alignment, principles of sequence similarity search algorithms. Multiple sequence alignment, Formatting & editing multiple sequence alignments. Phylogenetic trees.

**UNIT V**

Submitting DNA sequence and protein sequence to database. Database similarity searching, collecting and shorting sequences. Types of BLAST and FASTA. Various file formats for biomolecular sequences: Genbank, FASTA, GCG,MSF,NBRF-PIR etc

**REFERENCES**


1. Introduction to Bioinformatics: A theoretical and Practical Approach. 1st Edition. : Stephen A. Krawetz, David D. Womble. Humana Press. 2003

2. Bioinformatics: A Practical Guide to the Analysis of Genes and Proteins. 3rd Edition. Andreas D. Baxevanis , B. F. Francis Ouellette . Wiley, John & Sons.2004.

## Choice 2: NANOTECHNOLOGY AND CANCER BIOLOGY

**Objectives:**

1. To provide the students with knowledge and the basic understanding of nanotechnology and cancer.
2. The properties of materials at the nanometre scale, and the principles behind advanced experimental and computational techniques for studying nanomaterials.
3. To give an idea about Synthesis of nanomaterials, charecterisation and their application
4. To give students an historical perspective on the most commonly studied topics in cancer biology.
5. To link specific cancer biology subjects with clinical aspects of the disease.
6. **S**tudents can understand the nanomaterials, its synthesis and application for almost all the field to the benefit of humankind. Students will also acquire knowledge on cancer biology.

## Choice 2: NANOTECHNOLOGY AND CANCER BIOLOGY

**Semester : II** **Hours/Week: 5**

**Sub code : PBTE22** **Credit :5**

**Learning outcomes: S**tudents can understand the nanomaterials, its synthesis and application for almost all the field to the benefit of humankind. Students will also acquire knowledge on cancer biology.

**UNIT I**

Nanotechnology – definition – Quantum dots, Nanowires & properties, 2D films. Nano scale materials. Naopores . Characterization of Nanoparticles and Nanomaterials.

**UNIT II**

Application of nanotechnology; Nano sensors-types & its applications, Nano carriers for drug delivery-polymeric NP, Micelles, Micro emulsions, Lipoproteins as pharmaceutical carriers. Solid lipid NP as drug carriers. Nanocapsules-Preparation, Characterization & therapeutic applications. Nano medicine-Biopharmaceuticals. Implantable materials, Devices, Surgical aids, diagnostic tools, Genetic testing, Imaging.

**UNIT III**

Nanotechnology for cancer research & therapy. Environmental nano remediation technology. Thermal, physico-chemical and Biological methods. Nano filtration for the treatment wastes, removal of organics, Inorganics and pathogens. Nanotechnology for water purification.

**UNIT IV**

Epidemiology of cancer, cancer types, characteristics of cancer cells, carcinogenesis: Cancer initiation, promotion and progression, termination. Factors responsible for Carcinogenesis; Physical, Chemical and Biological.

**UNIT V**

Tumor immunology – tumor antigens, cytokines, vaccine development, immunotherapy and its limitations, Tumor cell evasions of immune defenses. Principles of chemotherapy and chemoprevention.

**REFERENCES**


1. Maloy S.R., Cronan Jr. J. E., and Freifelder D. 2006. Microbial Genetics, Jones and Bartlett Publishers, Sudbury, Massachusetts.
2. Chichester and Dale JW, 1994. Molecular genetics of Bacteria. John Wiley & sons. New York.

3. Hartl D.A and Jones E.W. 2000. Genetics: Analysis of genes and genomes, Jones & Bartlett Publishers, Sudbury, Massachusetts.
4. Alberts B, Johnson A, Lewis J, Raff M, Roberts K, Walter P. 1994. Molecular Biology of the Cell, Fourth Edition, Academic Press. New York.
5. Lodish, Berk, Baltimore et al . 2000. Molecular Cell Biology, 6th Eds, W.H. Freeman & Co.
6. Cooper G. 2000. The Cell: A molecular approach. 2nd Eds, Sinauer Associates Inc.
7. Kleinsmith L. J. and Kish V.M. 1995. Principles of Cell and Molecular Biology. 2nd edn., McLaughlin, S., Trost, K., Mac Elree, E. (eds.)., Harper Collins Publishers, New York.
8. De Robertis and De Robertis. 2005. 8th Eds. Cell and Molecular Biology. Lippincott Williams & Wilkins.
9. Brown T.A, 2002. Genomes. 2nd Edition. Wiley-Liss, New York.
10. Primrose S.B, Twyman R.M., Old R.W. 2002. Principles of Gene Manipulation and genomics. 7th Edition. Blackwell Science.
11. The Cell: A Molecular Approach (2016) 7th Edition, ASM Press, Washington D.C. & Sinauer Associates, Inc, Sunderland, Massachusetts. Geoffrey M.Cooper and Robert E.Hausman
12. Cell and Molecular Biology – Concepts and Experiments (2016), (ed), John Wiley & Sons Inc, New York. Gerald Karp, Harris, D
13. Genes IX (2007), 9th Edition, Jones and Barlett Publishers. ISBN: 0763740632. Benjamin Lewin

## SEMESTER III

## CORE VII-PLANT BIOTECHNOLOGY – PBTT31

**Objectives:**

1. To equip students with theoretical knowledge regarding the techniques and applications of Plant Biotechnology and Genetic Engineering.

2. To give the students comprehensive training in the plant biotechnology and its application for increasing agricultural production, environment improvement, human, nutrition and health.
3. Students will learn about genome organization in plants, basic techniques in tissue culture and its applications.
4. To learn knowledge about Genetic transformation in plants, metabolic engineering, production of pharmaceuticals and industrial products known as plant molecular farming.
5. On successful completion of the course the students will be aware of various in vitro culture techniques, preservation of plant cells, gene transferring mechanism and transgenic plants.

## SEMESTER III

### CORE VII (Theory) PLANT BIOTECHNOLOGY – PBTT31

**Semester : III** **Hours/Week: 5**

**Sub code : PBTT31** **Credit :5**

**Learning outcomes:** On successful completion of the course the students will be aware of various in vitro culture techniques, preservation of plant cells, gene transferring mechanism and transgenic plants.

**UNIT I**

Laboratory setup- Plant cell and tissue culture-culture media; composition and preparation, plant hormones, sterilization, Callus culture, Micropropagation, suspension culture, root tip culture, anther culture pollen culture, ovary culture, embryo culture.

**UNIT II**

Somoclonal variation, Somatic hybridization – protoplast isolation fusion and culture, synthetic seeds, germplasm conservation hardening and green house technology.

**UNIT III**

Transgenesis in plants: Gene transfer – Agrobacterium mediated, Caulio virus, Baculo virus mediated, Promoters, reporter genes and marker genes, terminator. Gene silencing.

**UNIT IV**

Terminator seed technology – delayed fruit ripening, transgenic plants-plantibodies, golden ride, edible vaccine, insect resistant-Bt, heribicide resistance-glyphospate, Disease resistant-antifungal proteins, Virus resistance-coat protein & nucleo capsid, Nemotode resistant, Abiotic stress tolerant.

**UNIT V**

Plant as bioreactor: Green & red fluorescent protein, starch and fructans. Nitrogen fixation and genes. Biosafety guidelines for research involving GMO's benefits and risks.IPR related to plants, IPP.

## CORE VIII - ANIMAL BIOTECHNOLOGY – PBTT32

**Objectives:**

1. To understanding about the basics of Animal cell culture, transgenic animals, pest & animal management, Molecular markers and regulations about the use of Biotechnology.
2. To expose students to application of rDNA technology to various fields of biotechnology (medicine and research areas).
3. To learn about principles and methods in genetic engineering, vectors in gene cloning, transformation in higher organisms and gene therapy. Techniques employed are carved as self-study.
4. To understand animal tissue culture techniques, advanced researches and stem cell technology.

### CORE VIII (Theory) - ANIMAL BIOTECHNOLOGY – PBTT32

**Semester : III** **Hours/Week: 5**

**Sub code : PBTT32** **Credit :5**

**Learning outcome:** Students will understand animal tissue culture techniques, advanced researches and stem cell technology .

**UNIT- I**

Structure and organization of animal cell. Constituents of culture medium; serum and supplements; Facilities for animal cell culture-infrastructure, equipment, culture vessels. Biology and characterization of cultured cells-cell adhesion, proliferation, differentiation, morphology of cells and identification.

**UNIT-II**

Primary cell culture techniques - aggregation, Cell growth & viability determination. Measuremnet of cell death, Transformation and Cytotoxicity assays. chromosome analysis and antigenic markers.. Mass culture of cells - manipulation of cell line selection - types of cell lines - maintenance of cell lines - immobilization of cells and its application - synchronization of cell - cryopreservation - germplasm conservation and establishment of gene banks.

**UNIT -III**

Sources of contamination, Monitoring and eradication – suspension, monolayer, organ culture. Knock out and Knock in, Suicide gene therapy Gene silencing. Transgenic animals and Molecular pharming: Animal Biotechnology for the production of regulatory proteins, blood products, cell culture based vaccines and hormones and other therapeutic proteins.

**UNIT-IV**

Gene therapy – IVF & Embryo transfer, Gene transfer techniques, Tissue engineering, Organ transplant. Synthetic viral vectors in gene transfer. Biotechnological applications for HIV. diagnostics and therapy. DNA based diagnosis of genetic diseases. Oncogenes and anti oncogenes.

**UNIT-V**

Stem cells: types – Hematopoietic stem cells, Mesenchymal stem cells, embryonic stem cells, fetal stem cells, Adult stem cells- characterization, isolation, cultures. Stem cells as vector for cancer therapthy. Collection, processing, preservation and banking of Umbical cord blood stem cells.

## REFERENCES


1. Ralf Pörtner. 2007. Animal Cell Biotechnology: Methods and Protocols (Methods in Biotechnology). 2nd Edition. Humana Press. USA.
2. R.Spier and J.Griffiths. 1994. Animal Cell Biotechnology. Academic Press. London.
3. D.C. Darling and S.J. Morgan. 1994. Animal Cells Culture and media, BIOS Scientific Publishers Limited. Oxford. UK.
4. Jennie P. Mather and David Barnes. 1998. Methods in Cell Biology. Volume 57: Animal Cell Culture Methods. Academic Press. New York.
5. Ann Harris. 1996. Epithelial Cell Culture, Cambridge University Press. USA.
6. M .M. Ranga. 2000.Animal Biotechnology, Agrobios, India.
7. R Ian Freshney.2005. Culture of Animal Cells: A Manual of Basic Techniques (5th Edition): Wiley-Liss, New York.
8. John R W Masters. 2000. Animal Cell Culture – Practical Approach, Ed. Oxford Univ Press.
9. JD Watson, M. Gilamn, J. Witkowski. 1992. Recombinant DNA technology. Scientific American books, New York.
10. Bhernard R Glick and Jack J. Pasterna, 2009, Molecular Biotechnology II edition, 4th edition, ASM press. USA.


## CORE XI-BIOINSTRUMENTATION AND BIOSTATISTICS – PBTT33

**Objectives:**

1. To develop knowledge handle the instruments for biological research and interrupt the data.
2. To acquire knowledge on applications of statistics in research.
3. To gain knowledge in experimental design and data collection techniques.
4. To develop the technical art of writing research report and presentations.

### CORE XI (Theory) BIOINSTRUMENTATION AND BIOSTATISTICS – PBTT33

**Semester : III** **Hours/Week: 5**

**Sub code : PBTT33** **Credit :5**

**Learning Outcome:** Students will acquire knowledge to handle the instruments for biological research and interrupt the data.

**UNIT -I**

Microscopy-Principle and applications of light, phase contrast, fluorescence, inverted, scanning and transmission electron microscopy, scanning tunneling microscopy, atomic force microscopy, confocal microscopy, field emission scanning electron microscope, cytophotometry and flow cytometry. Micrometry, lyophilizer, Preparation of microbial, animal and plant samples for microscopy.

**UNIT - II**

Centrifugation: Basic principle and applications: Differential, density and Ultracentrifugation, Principle methodology and applications of gel – filtration, ion –exchange and affinity chromatography; Thin layer and gas chromatography; High performance liquid chromatography, ultra sonicator, pH meter.

**UNIT -III**

Principle of biophysical method and used for analysis of biopolymer structure; X ray diffraction, fluorescence, UV, visible, IR. Atomic absorption and plasma emission spectroscopy, NMR, MS, ELISA reader, Electrophoresis: Principle and applications of Native, SDS,2D, Agarose gel, MADI-TOF, thermocycler, microarray.

**UNIT-IV**

Collection and presentation of experimental data. Brief description and tabulation of data and its graphical representation. Measures of central tendency: arthimetic mean, median, mode, geometric mean, Harmonic mean. Measures of dispersion: range, interquartile range, standard deviation.

**UNIT-V**

Hypothesis testing - Idea of two types of errors and level of significance. Tests of significance: Parametric (F & t test); Non parametric: Chi square tests. Simple linear regression and correlation. Analysis of variance.

## REFERENCES


1. John G Webster. 2004. Bioinstrumentation .Student edition, John Wiley & sons, Ltd. New York.
2. Edward Batschelet. 1992. *Introduction to Mathematics for Life Scientists*, 3rd ed., Springer. New York.
3. M Becker, G A Caldwell and E A Zachgo. 1996. Biotechnology: A laboratory course (Second Edition) Academic Press, USA.
4. Sokal, R.R. and F.J. Rohlf. 1969. Biometry: The Principles and Practice of Statistics in Biological Research. W.H. Freeman and Company, USA.
5. Zar, J.H. 1996. Biostatistical analysis. Prentice Hall, USA.


## PRACTICAL V- LAB IN PLANT BIOTECHNOLOGY & LAB IN ANIMAL BIOTECHNOLOGY – PBTP33

**Objectives:**

1. To know the basic principles and techniques involved in plant cell culture and to understand the concepts of transformation and achievements of biotechnology in Plant systems.
2. To know practical knowledge about the basics of animal cell culture, transgenic animals, pest & animal management, Molecular markers and regulations about the use of Biotechnology.


## PRACTICAL V- LAB IN PLANT BIOTECHNOLOGY & LAB IN ANIMAL BIOTECHNOLOGY – PBTP33

**Semester : III** **Hours/Week: 5**

**Sub code : PBTP33** **Credit :5**

1. Preparation of media, stock preparation and sterilization techniques.
2. Plant genomic DNA extraction.
3. Micropropagation using shoot tip.
4. Callus culture.
5. Synthetic seed preparation
6. Protoplast isolation
7. Transformation using *Agrobacterium tumefaciens*.
8. Haploid culture Root induction.
9. Root induction
10. Embryo culture
11. Nodal culture
12. Single cell culture
13. Suspension culture

## LAB IN ANIMAL BIOTECHNOLOGY

1. Balanced salt solutions
2. Animal cell culture media preparation
3. Filter sterilization of cultural media
4. Cell disaggregation
5. Handling of animals
6. Isolation of fibroblast from chick embryo
7. Virus inoculation methods
8. Isolation of genomic DNA from Animal cells
9. Cell growth analysis
10. Cell viability test – MTT
11. Resuscitation of frozen cell lines
12. Sub culture of Adherence cell lines

## PROFESSIONAL SKILL –II

**Objectives:**

1. To know how to writing research paper and communication, Science indexed journals, impact factor, citation index, H- index.
2. Empowering youth in acquiring right soft skills required for their future.
3. To know the scope and opportunities for Biotechnology students
4. To learn about funding agencies, Proposal writing and Biodata, Resume and CV writing, References, Testimonials, cover letters

## ELECTIVE III

### Choice 1 : WOMEN STUDIES – PBTP44

**Semester : IV** **Hours/Week: 5**

**Sub code : PBTP44** **Credit :5**

**Learning outcomes: S**tudents can understand the role, rights and responsibility of women in society.

**UNIT-I**

Current women movements, National committees and Commissions for Women-Government Organization for women and Child Development

**UNIT-II**

Indian women-Family, Caste, Class, Culture, religion Social System, Division of Labor, Exploitation, Marriage, reproductive Technology and Motherhood, Freedom, Widows

Health status of women in India-Morality and Morbidity factors, Issues of old age, Girl child in Society-child labors, Help lines

**UNIT-III**

Negative capability in education-values in education-Vocational education, Women in organized and unorganized sector-Training, skills and income generation. Importance of entrepreneurship Entrepreneurial traits-factors contributing to women entrepreneurship.

**UNIT-IV**

Women Empowerment and Women Development approaches in Indian five year Plans, State Policy and Programmes -Collectivity and group dynamics-Self help groups and leadership-Panchayti raj-Political role and participation-NGOs and women Development. National and International funding Agencies.

**UNIT-V**

Indian constitution and provision relating to women, personnel laws Labors Laws-violence against women-Legal protection Family courts-enforcement, machinery-Police and Judiciary

Human rights as women's Rights

## Choice 2 : EMPLOYABILITY SKILL

**Semester : IV** **Hours/Week: 5**

**Sub code : PBTP44** **Credit :5**

**Learning outcome:** Empowering students to get ready for achieving their goals.

All the candidates of M.Sc (Biotechnology) are required to submit the following to enrich their employability skills.

Career Decision

Career Plan

Relevant materials collected

Steps taken to achieve the Goal

Preparedness and Qualifying themselves for that carrier

Resume

**Evaluation Guidelines.**

The project is evaluated on the basis of following heads :

Presentation - 25% of total marks.

Viva - 20% of total marks.

Report - 30% of total marks.

## SEMESTER IV

### Core X: BIOETHICS, BIOSAFETY AND IPR – MBTC415

**Objectives:**

1. To get an idea about the advantages and disadvantages of biotechnological applications, ethical implications, and intellectual property rights.
2. To study the diversity of plants and animal life in a particular habitat, ethical issues and potential of biotechnology for the benefit of mankind.
3. To learn about IPR – types; copy rights, patents, trade marks, trade secret design rights, geographical indication-patentable and non-patentable –PCT and importance of patent writing.
4. Student will acquire knowledge in bioethics, biohazard and bio-safety level and Intellectual property rights.

## SEMESTER IV

## Core X (Theory) BIOETHICS, BIOSAFETY AND IPR – MBTC415

**Semester : IV** **Hours/Week: 5**

**Sub code : MBTC415** **Credit :5**

**Learning outcomes:** Student will acquire knowledge in bioethics, biohazard and bio-safety level and Intellectual property rights.

### UNIT I

Introduction to bioethics, concepts, ethical terms, issues on genetic modification and recombinant DNA technologies, ethics in agriculture and Environment benefits and risks, GM crops, Release of GMO to the environment. Risk of genetic engineering, Ecocide-Eco terrorism.

### UNIT II

Animal rights, ethics of human cloning, Reproductive cloning, Ethical legal and Socio economic aspects of Gene therapy, Somatic, Embryonic and Adult stem cell research, ELSI of human genome project. Transgenic plants and animals.

### UNIT III

Primary containments for biohazards, Biosafety levels, recommended biosafety levels for specific microorganism, infectious agents and Infected animals. Biosafety guidelines by Govt. of India, Role of Intuitional biosafety committee, GEAC, RCGM, Cartagena protocol. CPCSEA Guidelines

### UNIT IV

Introduction to IPR – types; copy rights, patents, trade marks, trade secret design rights, geographical indication-patentable and non-patentable – PCT, importance of IPR, Types of Patent applications, PCT cost, procedure and requirements for international patenting- patent infringement – scope, litigation, meaning, case studies & examples. Biopiracy.

### UNIT V

Introduction to WTO, GATT,WIPO,TRIPS, Patenting in India, Indian patent act, WIPO treaty budaspest treaty, publication of patents-Gazette of India, Patenting by research students, lectures and scientist University/Organizational rules in India and aboard.

### REFERENCES


1. Patents (2003), N.Subbaram, Pharma Book Syndicate, Hyderabad.
2. Bioethics and Biosafety in Biotechnology (2007), V.Sree Krishna, New Age International

(P) Limited Publishers. ISBN (13): 978-81-224-2248-1

3. Molecular Biotechnology: Principles and Applications of Recombinant DNA (2010), 4th Edition, Glick, B.R., and Pasternack, J.J., ASM Press, Washington, DC.
4. Introduction to Plant Biotechnology (2001), 3rd Edition, H.S.Chawla, Oxford & IBH Publishing Co. Pvt. Ltd.
5. Bioethics and Biosafety (2008) M. K. Sateesh, I. K. International Pvt. Ltd, New Delhi, India.
6. Intellectual Property Rights (2008) Prabuddha Ganguly, Tata McGraw Hill Publishing Company, India. ISBN: 9780070077171 9. http://www.patentoffice.com/index.php
7. Recombinant DNA Safety Guidelines, Department of Biotechnology, Ministry of Science and Technology. Government of India.
8. Revised Guidelines for research in Transgenic Plants, Department of Biotechnology, Ministry of Science and Technology. Government of India.
9. Ethics and Biotechnology by Anthony Oakley Dyson, John Harris. Routledge. 1994.

## Core XI: BIOPROCESS TECHNOLOGY – MBTC425

**Objectives:**

1. To understanding the knowledge about food production, pest control, and the development of new drug and for other related biotechnological applications.
2. To exploiting knowledge about microbes and to study the downstream processes for product recovery in fermentation.
3. To learn about commercially valuable biochemical and genetic resources in plants, animals and microorganisms.
4. Student will understand basics of industrial Biotechnology and requirements for large scale productions.

## Core XI (Theory): BIOPROCESS TECHNOLOGY – MBTC425

**Semester : IV** **Hours/Week: 5**

**Sub code :** **Credit :5**

**Learning outcomes:** Student will understand basics of industrial Biotechnology and requirements for large scale productions.

**UNIT I**

Milestones of fermentation technology. Identification of industrially important microorganism, primary and secondary screening, strain development, product assays.

**UNIT II**

Designing and types of fermentor – liquid, solid state and immobilized, Media and ingredients for industrial fermentation, industrial sterilization of fermentor media and air. Types of heat exchangers, immobilization techniques, Bioreactor for cell cultures.

**UNIT III**

Instrumentation for monitoring bioreactor and fermentation process – PH, temperature pressure dissolved O2, air flow rate, shaft speed, foaming, viscosity and controlling.

**UNIT IV**

Downstream processing – recovery and purification of fermentation products – filtration, centrifugation, cell disruption, liquid- liquid extraction, Solvent extraction, precipitation, chromatography, ultra filtration, drying, crystallization, lyophilization.

**UNIT V**

Industrial production of Antibiotics – penicillin, enzymes – protease, organic acids-citric acid, vitamins – b12, amino acids-glucamic acid, Ethanol, Beer, wine, Diary and food products.

**REFERENCES**


1. Stanbury, RF and Whitaker A., Principles of Fermentation Technology, Pergamon press, Oxford, 1997.
2. Shuler ML and Kargi F., Bioprocess Engineering: Basic concepts, Prentice Hall, Engelwood Cliffs, 2002.
3. Kalaichelvan and Arulpandi, Bioprocess Technology. MJP. Publishers 2008.
4. Doran. Bioprocess Engineering Principle. Elsevier. 2007.

5. Biotechnology: The Biological Principles (1990) Edited by M D Trevan, S Boffey, K H Goulding, and P Stanbury, Tata McGraw-Hill Publishing company Ltd, New Delhi, India.

## MAJOR PROJECT – MBTC435

**Semester : IV** **Duration: 500 hours**

**Sub code : MBTC435** **Credit :5**

**Learning outcome:** Empowering students to carryout individual research projects.

All the candidates of M.Sc (Biotechnology) are required to undergo a Major project and submit the following:

1. Dissertation/Thesis based on the work done by the student.
2. Soft copy of the project on CD/DVD

Project Evaluation Guidelines.

The project is evaluated on the basis of following heads:

Presentation - 25% of total marks.

Viva - 20% of total marks.

Thesis/ Dissertation - 30% of total marks.