MOTHER TERESA WOMEN'S UNIVERSITY,

KODAIKANAL - 624 102
Tamil Nadu.

Curriculum Framework and Syllabi for

M.Sc Biotechnology

(For the candidates to be admitted from the academic year 2018-2019 onwards)

(UNDER CHOICE BASED CREDIT SYSTEM- CBCS)

PREAMBLE

Mother Teresa Women's University, whose foundation stone was laid by St. Mother Teresa herself, stands as an epitome of Women empowerment. The University stands as the first and the only Women's University in the State, and the third University in the Nation. With emphasis on research, supported by strong postgraduate programs in various disciplines, the University fosters high quality research activities in various disciplines at M.Phil. and Ph.D. levels.

The Department of Biotechnology was started in 2002. The mission of the Department is to provide academic training and conduct research in the interdisciplinary areas of biotechnology with a particular emphasis on extending the knowledge generated from these studies towards the development of technologies of commercial significance. It is a DST CURIE, DST-FIST and UGC-Non-SAP sponsored Department. The Department is equipped with sophisticated instrument like GC-MS, HPLC, Multiplex PCR, FTIR,XRD and many more. The faculties of the Department operate many funded projects in special area of research like Mycotechnology, Environmental Science, Microbiology and Microbial genetics and they are operated in state of art laboratories. Additionally Department has exclusive general lab for Plant Biotechnology, Molecular Biology, Microbiology, Animal Biotechnology and Nanoscience.

VISION

- To emerge into a top-notch International Women's University by creating empowered and socially responsible woman achievers through excellence in teaching, research and extension and enabling them to attain gender equity.

MISSION

- Striving for excellence in the tripartite goal f teaching, research and extension
- Promoting the educational standard of women at all levels
- Identifying and addressing the emerging trends and needs
- Providing community based learning experience
- Promoting community issues based research activities with global standards
- Developing intellectual professionals with ethics for the benefit of mankind and environment.
- Extending collaborative and innovative research work for National Development.
- Equipping the learners with employability skills and groom them as Capacity Builders.

- Promoting global entrepreneurs addressing the market challenges.

PROGRAMME EDUCATIONAL OBJECTIVIES (PEO)	
The graduates of M.Sc. Biotechnology program will be able to	
PEO1:	Think critically and creatively about the use of biotechnology to address local and global problems.
PEO2:	Implement the scientific skills for development of industrial applications and entrepreneurship.
PEO3:	Function on interdisciplinary framework of biotechnology and related fields.
PEO4:	Adopt ethical attitude and exhibit effective skills in teamwork and leadership qualities
PEO5:	Apply research strategies to solve biotechnology problems.
PEO6:	Discover in depth knowledge of microbial, animal and plant biotechnology, and also broad area of biochemistry, Immunology and molecular biology

PROGRAMME OUTCOME (PO)	
At the end of the program the students will be able to acquire:	
PO1:	Scientific Knowledge living organisms both prokaryotic and eukaryotic cells, morphology, cellular, molecular and its functions.
PO2:	Problem Solving skill research-based knowledge and research methods including design of experiments, analysis and interpretation of biological data and thereby solve the biotechnological problems
PO3:	Ability to design and development of Solution for any specific needs from societal and environmental aspects.
PO4:	Knowledge to conduct investigations of complex problems by recognizing the need for prepare and creating, selecting, learning and applying appropriate techniques, resources,

	and modern instrumentation to solve complex biotechnological activities with an understanding of the limitations.
PO5:	Skill to use tools in Biotechnology & Bioinformatics for Gene Mapping DNA analysis and offer new vistas for Drug design and discovery.
PO6:	Advanced skills to apply their knowledge in other advanced subject area like Nano biotechnology, immunotechnology and animal and Plant Biotechnology for the betterment and advancement of their professional career.
PO7:	Develop individual and team work with sound knowledge on Ethics, Leadership and consensus building skills relevant to Biotechnology aspects of business enterprise.
PO8:	Ability to link with society & Ethics by applying background knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional.

PROGRAMME SPECIFIC OUTCOME (PSO)	
PSO1:	Students will acquire knowledge about cell structure and functions, major bio-molecules, and their metabolic pathways.
PSO2:	Students will understand the importance of microbes in environmental aspects, medical, industrial, agricultural, microbe interaction with plant and animal, food aspects which is an integrated part of Biotechnology. They will become familiar with the tools and techniques of genetic engineering.
PSO3:	Student will know molecular aspects of cellular function of eukaryotic cell, immune cells, human pathogens, current therapy and environmental issues, developmental biology along with physiology will give an understanding of the causes, diagnosis and treatment of disease, and how they affect different parts of the body.
PSO4:	Students will imbibe the importance of Plant and Animal biotechnology as in vitro culture, maintenance and preservation of plant & animal cells, tissues and organs, large scale production of bioproducts, types of pollution, waste water management, solid waste management, biopesticides, biofertilizer and composting.
PSO5:	Students will apply the knowledge of basic sciences and technology as well as nanotechnology in cancer biology and its applications to demonstrate research skills and develop technology for commercialization and employability skill to become entrepreneur with proper knowledge on Ethical issues, Biosafety, IPR.

MOTHER TERESA WOMEN'S UNIVERSITY, KODAIKANAL

M.SC. BIOTECHNOLOGY

STRUCTURE 2018-2019 ONWARDS

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** Choice 1:Cell Biology and Genetics Choice 2: Developmental Biology	5	5	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** Choice 1:Bioinformatic and computer Application Choice 2: Nanotechnology and cancer biology	5	5	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** Choice 1: Women Studies Choice 2: Employability Skill	5	5	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.
- To acquire knowledge about the structure and functions of cells, biomolecules, enzyme kinetics, bio polymers and metabolic reactions in a living system.
- To know genome organization, function and regulation in 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

Course Title & Code	**CORE I (Theory) – BIOCHEMISTRY – PMTT11**		
Semester	Semester-I	Credits:5	Hours/weeks: 5
Cognitive Level	K1: Recall K2: Understand K4: Analyze		
Learning Objective	• To know about the structure and functions of biomolecules, bio polymers and metabolic reactions in a living system. • To learn about dynamics of biomolecules. • To determine, how they are metabolized in organisms and elucidating their role. • To acquire an overall understanding on classifications of biomolecules and enzyme kinetics.		

COURSE OUTCOMES

Upon completion of this course the students will be able to

CO1: know the biomolecules and metabolisms of biochemical pathways **K1**

CO2: understand the lipid molecules, vitamins and hormones **K2**

CO3: know the structure, classification and properties of amino acids and proteins **K1**

CO4: know about nucleotide structure, biosynthesis and its regulation & degradation **K1**

CO5: learn the basic concept of Enzymes – Nomenclature and Classification, factors influencing enzyme activity **K4**

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 helix 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.

E-book links

1) https://doi.org/10.1002/cbf.1216
2) https://www.pdfdrive.com/biochemistry-biochemistry-e19576202.html
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5) https://www.pdfdrive.com/lehninger-principles-of-biochemistry-5th-edition-e164892141.html

Mapping of COs with POs &PSOs:

CO	PO								PSO					SCORE
	1	2	3	4	5	6	7	8	1	2	3	4	5	
CO1	S	S	S	S	S	S	S	S	S	S	S	S	S	3.0
CO2	S	S	S	S	S	S	S	S	S	S	S	S	S	3.0
CO3	S	S	S	S	S	S	S	S	S	S	S	S	S	3.0
CO4	S	S	S	S	S	S	S	S	S	S	S	S	S	3.0
CO5	S	S	S	S	S	S	S	S	S	S	S	S	S	3.0
													Mean score	3.0

The Mean Score is 3.0, which is strongly correlated

Strongly Correlating(S) - 3 marks
Moderately Correlating (M) - 2 marks
Weakly Correlating (W) - 1 mark
No Correlation (N) - 0 mark

Course Title & Code	**CORE II (Theory) –MICROBIOLOGY – PBTT12**		
Semester	Semester-I	Credits:5	Hours/weeks: 5
Cognitive Level	K1: Recall K2: Understand K3: Apply K4: Analyze		
Learning Objective	• To learn about the basic applications of microorganisms. • To understand the identification of microorganisms using advanced microbiological methods. • To know about different types of microorganisms and their identification techniques in modern biology. • To identify the microorganisms based on the modern polyphasic approach. • 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.		

COURSE OUTCOMES

Upon completion of this course the students will be able to

CO1: know the history, criteria, classification and diversity of Bacteria. **K1**

CO2: understand the cultural techniques for isolation and molecular identification of any microbes. **K2**
CO3: become well-versed with the extremophiles organisms, structure and characteristics of fungi and algae. K2
CO4: acquire knowledge on classification, cultivation of virus as well as host and microbial interaction. **K4**
CO5: learn the essential conception of bacteria, fungi and virus pathogenicity, transmission, diagnosis and treatment with examples. **K3**

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

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4. Maier R.M., Pepper I.L. and Gerba C.P. 2006. Environmental Microbiology, Elseiver Publication, New Delhi, India.
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14. Microbiology (1993) by M.J. Pelzer Jr., E.C.S. Chan and N.R. Kreig, McGraw Hill Inc., New York.

E-book links

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2. vhttps://www.pdfdrive.com/microbiology-and-immunology-textbook-of-2nd-edition-e33405391.html
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Mapping of COs with POs &PSOs:

CO	PO								PSO					SCORE
	1	2	3	4	5	6	7	8	1	2	3	4	5	
CO1	S	S	S	S	S	S	S	S	S	S	S	S	S	3.0
CO2	S	S	S	S	S	S	S	S	S	S	S	S	S	3.0
CO3	S	S	S	S	S	S	S	S	S	S	S	S	S	3.0
CO4	S	S	S	S	S	S	S	S	S	S	S	S	S	3.0
CO5	S	S	S	S	S	S	S	S	S	S	S	S	S	3.0
													MEAN SCORE	3.0

The Mean Score is 3.0, which is strongly correlated

Course Title & Code	**CORE III- MOLECULAR BIOLOGY – PBTT13**		
Semester	Semester-I	Credits:5	Hours/weeks: 5
Cognitive Level	K1: Recall K2: Understand K3: Apply K4: Analyze		

Learning Objective	• To learn basic knowledge about nucleotides structure and its function. • To understand the structural and functional aspects of the cell which provides the student with a strong foundation in the molecular mechanisms underlying cellular function. • To know genome organization of organisms. • To understand the gene regulations and their role of molecular mechanisms in cells.

COURSE OUTCOMES

Upon completion of this course the students will be able to

CO1: know the structure, types, replication process and function of nucleic acids in Prokaryotic & Eukaryotic organisms. **K1**

CO2: understanding the synthesis and processing of RNA and Protein inside the cells. **K2**

CO3: Know more about the control of gene expression and molecular Recombination event.**K4**

CO4: learn the methods of DNA repair mechanisms in the cell, Gene mapping techniques and cellular signal transduction pathways **K3**

CO5: study the basic concept of Quorum sensing, Oncogenes and anti-oncogenes. **K2**

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, and 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

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12. Primrose S.B, Twyman R.M., Old R.W. 2002. Principles of Gene Manipulation and genomics. 7th Edition. Blackwell Science.

E-book links

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6. https://www.pdfdrive.com/karps-cell-and-molecular-biology-e176035175.html

Mapping of COs with POs &PSOs:

	PO								PSO					SCORE
CO	1	2	3	4	5	6	7	8	1	2	3	4	5	
CO1	S	S	S	S	S	S	S	S	S	S	S	S	S	3.0
CO2	S	S	S	S	S	S	S	S	S	S	S	S	S	3.0
CO3	S	S	S	S	S	S	S	S	S	S	S	S	S	3.0
CO4	S	S	S	S	S	S	S	S	S	S	S	S	S	3.0
CO5	M	S	S	S	S	S	S	S	S	S	S	S	S	3.0
													MEAN SCORE	3.0

The Mean Score is 3.0, which is strongly correlated

Course Title & Code	**PRACTICAL I: LAB IN ANALYTICAL BIOCHEMISTRY & LAB IN MICROBIOLOGY AND MOLECULARBIOLOGY – PBTP11**		
Semester	Semester-I	Credits:5	Hours/weeks: 5
Cognitive Level	K1: Recall K2: Understand K4: Analyze		
Learning Objective	• To learn the technique for identification of microorganism from biological samples. • To apply the isolation and purification of actinomycetes and fungi and biochemical characterization of selected bacteria. • To know the techniques in mutations . • To get skill on isolation of biomolecules and DNA repair mechanism.		

COURSE OUTCOMES

Upon completion of this course the students will be able to

CO1: gain practical knowledge about biomolecules **K1**

CO2: develop skill and perform different chromatographic techniques **K4**

CO3: gain hands on experience in isolation and identification of microbes in the laboratory **K1**

CO4: gain knowledge about analysis of mutation studies **K2**

CO5: acquire knowledge on separation of biomolecules. **K1**

LAB IN ANALYTICAL BIOCHEMISTRY

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

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

Mapping of COs with POs &PSOs:

CO	PO								PSO					SCORE
	1	2	3	4	5	6	7	8	1	2	3	4	5	
CO1	S	S	S	S	S	S	S	S	S	S	S	S	S	3.0
CO2	S	S	S	S	S	S	S	S	S	S	S	S	S	3.0
CO3	S	S	S	S	S	S	S	S	S	S	S	S	S	3.0
CO4	S	S	S	S	S	S	S	S	S	S	S	S	S	3,0
CO5	S	S	S	S	S	S	S	S	S	S	S	S	S	3.0
													MEAN SCORE	3,0

. **The Mean Score is 3.0, which is strongly correlated**

Course Title & Code	**ELECTIVE I** **Option I: CELL BIOLOGY AND GENETICS – PBTE11**		
Semester	Semester-I	Credits:5	Hours/weeks: 5
Cognitive Level	K1: Recall K2: Understand K3: Apply		
Learning Objective	• To know about structure and function of cells, cellular energetics, protein trafficking, bio molecules and cellular development. • To understand the structural and functional aspects of the cell provides the student with a strong foundation in the molecular mechanisms underlying cellular function • To acquire a thorough knowledge about cell structure and function, cellular transport, signaling, protein trafficking, cellular development, gene expression and genetic diseases.		

COURSE OUTCOMES

Upon completion of this course the students will be able to

CO1: know the structure of prokaryotic and Eukaryotic cell and organelles **K1**
CO2: understand the ultra-structure of plasma membrane, transport process in the cell **K2**
CO3: understand the Molecular events of cell cycle and its regulation and Cell division **K2**
CO4: know about the basic Mendelian principles, Pedigree analysis and Chromosome abnormalities **K1**
CO5: educate the vital perception of Sex determination and Linkage (Drosophila, Hymenoptera, Mammals). **K3**

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.

E-book links

1) https://www.pdfdrive.com/cell-division-genetics-and-molecular-biology-cell-division-genetics-and-molecular-biology-e22406140.html
2) https://www.pdfdrive.com/cell-biology-genetics-molecular-biology-evolution-and-ecology-e157248372.html
3) https://www.pdfdrive.com/the-handy-biology-answer-book-the-handy-answer-book-series-e175569465.html
4) https://www.pdfdrive.com/cellmolecular-biology-and-biotechnology-e33452455.html
5) https://www.pdfdrive.com/molecular-cell-biology-e187264624.html

Mapping of COs with POs &PSOs:

CO	PO								PSO					SCORE
	1	2	3	4	5	6	7	8	1	2	3	4	5	
CO1	S	S	S	S	S	S	S	S	S	S	S	S	S	3.0
CO2	S	S	S	S	S	S	S	S	S	S	S	S	S	3.0
CO3	S	S	S	S	S	S	S	S	S	S	S	S	S	3.0
CO4	S	S	S	S	S	S	S	S	S	S	S	S	S	3.0
CO5	S	S	S	S	S	S	S	S	S	S	S	S	S	3.0
													MEAN SCORE	3.0

The Mean Score is 3.0, which is strongly correlated

Course Title & Code	**ELECTIVE I** **Option II: DEVELOPMENTAL BIOLOGY – PBTE11**		
Semester	Semester-I	Credits:5	Hours/weeks: 5
Cognitive Level	K1: Recall K2: Understand K3: Apply K4: Analyze		
Learning Objective	• To acquire knowledge on the development and physiology of various animal and plant systems. • To enable the students to know the actual pathway of physiological metabolism of mammals including humans. • To gained information about the various living system which will help in the future to develop the drugs. • To understand the basic concepts of developmental biology in both plants and animals.		

COURSE OUTCOMES

Upon completion of this course the students will be able to

CO1: know about the Fertilization process in the animal kingdom. **K1**

CO2: understand the development of organs in chick and Hormonal control process in ovulation pregnancy, menstrual cycle, gestation period and abortion. **K2**
CO3: understand the Embryogenesis, seed formation and germination in plants.**K2**
CO4: know about the basic Sex determination as well as understand the genetic errors of human development **K3**
CO5: comprehend the critical model of organization of shoot & root, floral meristems and floral development in Arabidopsis. **K4**

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.

E-book links

1) https://www.pdfdrive.com/developmental-biology-9th-edition-e156874068.html

2) https://www.pdfdrive.com/developmental-biology-eighth-edition-e161981415.html
3) https://www.pdfdrive.com/developmental-biology-e188565455.html

Mapping of COs with POs &PSOs:

CO	PO								PSO					SCORE
	1	2	3	4	5	6	7	8	1	2	3	4	5	
CO1	S	S	S	S	S	S	S	S	S	S	M	S	S	2.92
CO2	S	S	S	S	S	S	S	S	S	S	S	S	S	3.0
CO3	S	S	S	S	S	S	M	S	S	S	S	S	S	2.92
CO4	S	S	S	S	S	S	S	S	S	S	S	S	M	2.92
CO5	S	S	S	S	S	S	S	S	S	S	S	S	S	3.0
													MEAN SCORE	2.95

The Mean Score is 2.95, which is moderately correlated

Course Title & Code	**CORE IV- IMMUNOLOGY– PBTT21**		
Semester	Semester-II	Credits:5	Hours/weeks: 5
Cognitive Level	K1: Recall K2: Understand K3: Apply K4: Analyze		
Learning Objective	• To expose the students to know about various immune systems of human body. • To make students understand the immune system, antigen-antibody reactions, applications of immunological techniques, humoral and cell mediated immunity. • To learn about hypersensitivity reactions and hybridoma technology. • To provide student with insight on various aspects of Immunology such as classical immunology, clinical immunology, Immunotherapy and diagnostic immunology. • To understand the basic concepts of immune system and will get trained in various techniques involved in Immunology for drug discovery and solve immune		

	problems.

COURSE OUTCOMES

Upon completion of this course the students will be able to

CO1: know the basics of immune system about the cells and immunoglobins **K1**
CO2: understand the difference between Antigens and Antibody and its mechanisms inside the host **K2**
CO3: learn communication of immune cells by cytokines, signaling molecules and regulation of immunity.**K2**
CO4: become aware on current issues and problems of Hypersensivity, Immunotolerence, Transplantation, graft rejection & immunosuppressive therapy **K3**
CO5: study the tools and techniques in immunotechnology and vaccine development. **K4**

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.

E-book links

1) https://www.pdfdrive.com/microbiology-and-immunology-textbook-of-2nd-edition-e33405391.html

2) https://www.pdfdrive.com/cellular-molecular-immunology-7th-edition-e157242744.html
3) https://www.pdfdrive.com/basic-immunology-e21670961.html
4) https://www.pdfdrive.com/medical-microbiology-virology-immunology-e43491517.html

Mapping of COs with POs &PSOs:

CO	PO								PSO					SCORE
	1	2	3	4	5	6	7	8	1	2	3	4	5	
CO1	S	S	S	S	S	S	S	S	S	S	S	S	S	3.0
CO2	S	S	S	S	S	S	S	S	S	S	S	S	S	3.0
CO3	S	S	S	S	S	S	S	S	S	S	S	S	S	3.0
CO4	S	S	S	S	S	S	S	S	S	S	S	S	S	3.0
CO5	S	S	S	S	S	S	S	S	S	S	S	S	S	3.0
													MEAN SCORE	3.0

The Mean Score is 3.0, which is strongly correlated

Course Title & Code	**CORE V- RECOMBINANT DNA TECHNOLOGY – PBTT22**		
Semester	Semester-II	Credits:5	Hours/weeks: 5
Cognitive Level	K1: Recall K2: Understand K3: Apply K4: Analyze		

Learning Objective	• To expose the students to know the application of rDNA technology in various fields of biotechnology. • The student gets thorough knowledge in principles and methods in genetic engineering, vectors in gene cloning, transformation in higher organisms and gene therapy. • To learn about the techniques in modern rDNA technology • To know the principles and techniques in genetic engineering to solve the social problems.

COURSE OUTCOMES

Upon completion of this course the students will be able to

CO1: study and know the tools and advanced techniques of genetic engineering **K1**

CO2: understand the difference between hosts and its suitable vectors for gene cloning **K2**

CO3: learn the procedure of gene transformation techniques in the cell.**K4**

CO4: know about PCR techniques and primer designing using bioinformatics tools K3

CO5: perform identification of organisms using DNA barcoding, DNA based nanostructure and applications **K4**

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 & Eukaryotic, 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.

E-book links

1) https://www.pdfdrive.com/molecular-biotechnology-principles-and-applications-of-recombinant-dna-4th-edition-e162050162.html
2) https://www.pdfdrive.com/molecular-biotechnology-principles-and-applications-of-recombinant-dna-e156918014.html
3) https://www.pdfdrive.com/recombinant-dna-technology-molecular-biology-and-paradigms-e11385991.html
4) https://www.pdfdrive.com/recombinant-dna-principles-and-methodologies-e185941491.html

Mapping of COs with POs &PSOs:

CO	PO								PSO					**SCORE**
	1	2	3	4	5	6	7	8	1	2	3	4	5	
CO1	S	S	S	S	S	S	S	S	S	S	S	S	S	3.0
CO2	S	S	S	S	S	S	S	S	S	S	S	S	S	3.0

CO3	S	S	S	S	S	S	S	S	S	S	S	S	S	3.0
CO4	S	S	S	S	S	S	S	S	S	S	S	S	S	3.0
CO5	S	S	S	S	S	S	S	S	S	S	S	S	S	3.0
													MEAN SCORE	**3.0**

The Mean Score is 3.0, which is strongly correlated

Course Title & Code	**\CORE VI- ENVIRONMENTAL BIOTECHNOLOGY – PBTT23**		
Semester	Semester-II	Credits:5	Hours/weeks: 5
Cognitive Level	K1: Recall K2: Understand K3: Apply K4: Analyze K6: Create		
Learning Objective	• To expose students to the application of Environmental biotechnology. • To get a thorough knowledge about the different types of pollution and its control methods. • To learn about techniques of bioremediation. • To know about the Vermicomposting techniques and its application.		

COURSE OUTCOMES

Upon completion of this course the students will be able to

CO1: identify and conserve the diversity of plants and animals and to use the resource in natural way to avoid pollution **K1**

CO2: understand and identify the environmental issues due to pollution **K2**

CO3: learn procedure and do research in water treatment, water borne diseases and treatment of effluent from industry **K3**

CO4: gain knowledge about types of solid wastes generated in house and industry and to solve the problems using natural process and to earn income by recycling the waste **K6**

CO5: identify the environmental problems and find the solution for chemical usage of pesticides and fertilizer **K4**

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.

E-book links

1) https://www.pdfdrive.com/environmental-biology-the-conditions-of-life-environmental-selection-extinction-creation-e116415545.html
2) https://www.pdfdrive.com/environmental-biotechnology-biodegradation-bioremediation-and-bioconversion-of-xenobiotics-for-sustainable-development-e158141796.html

Mapping of COs with POs &PSOs:

CO	PO								PSO					SCORE
	1	2	3	4	5	6	7	8	1	2	3	4	5	
CO1	S	S	S	S	S	S	S	S	S	S	S	S	S	3.0
CO2	S	S	S	S	S	S	S	S	S	S	S	S	S	3.0
CO3	S	S	S	S	S	S	S	S	S	S	S	S	S	3.0
CO4	S	S	S	S	S	S	S	S	S	S	S	S	S	3.0
CO5	S	S	S	S	S	S	S	S	S	S	S	S	S	3.0

													MEAN SCORE	3.0

The Mean Score is 3.0, which is moderately correlated

Course Title & Code	**PRACTICAL III: LAB IN IMMUNOLOGY & RECOMBINANT DNA TECHNOLOGY & LAB IN ENVIRONMENTAL BIOTECHNOLOGY – PBTP22**		
Semester	Semester-II	Credits:5	Hours/weeks: 5
Cognitive Level	K1: Recall K2: Understand K3: Apply K6: Create		

Learning Objective	• To introduce students to different techniques that are commercially used in molecular diagnosis of diseases. • To give a broad overview of molecular therapy and exposure to immunology techniques. • To give an account of different diseases that are routinely diagnosed using molecular and immunological testing. • To know about the latest techniques in recombinant DNA technology, which is a powerful tool needed for modern biotechnology research. • To practice remediation of contaminated environments (land, air, water), and for environment-friendly processes such as green manufacturing technologies and sustainable development.

COURSE OUTCOMES

Upon completion of this course the students will be able to

CO1: gain practical knowledge about immunological techniques **K1**
CO2: understand and identify the health issues and report very easily **K2**
CO3: learn about protein research, gene and gene transformation **K3**
CO4: gain knowledge about analysis of water quality and solve the problem of the society **K6**
CO5: identify the environmental problems and to find solution using biotechniques **K6**

LAB IN IMMUNOLOGY & RECOMBINANT DNA TECHNOLOGY

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

Mapping of COs with POs &PSOs:

CO	PO								PSO					SCORE
	1	2	3	4	5	6	7	8	1	2	3	4	5	
CO1	S	S	S	S	S	S	S	S	S	S	S	S	S	3.0
CO2	S	S	S	S	S	S	S	S	S	S	S	S	S	3.0
CO3	S	S	S	S	S	S	S	S	S	S	S	S	S	3.0
CO4	S	S	S	S	S	S	S	S	S	S	S	S	S	3.0
CO5	S	S	S	S	S	S	S	S	S	S	S	S	S	3.0
													MEAN SCORE	3.0

The Mean Score is 3.0, which is strongly correlated

Course Title & Code	**ELECTIVE II: OTHER DEPARTMENT ELECTIVE – PBTE22** **Option 1: BIOINFORMATICS – PBTE22**		
Semester	Semester-II	Credits:5	Hours/weeks: 5
Cognitive Level	K1: Recall K2: Understand K3: Apply K5: Evaluate		

	K6: Create
Learning Objective	• To understand and learn the technical details of current experiments used in the field of biology. • To understand system biology and large-scale data collection and its analysis. • To give the students comprehensive training in the emerging area of Systems Biology, which will help students to get a career in both industry and R&D. • To learn about biochemical interaction networks, cell interactions during development, and organism response to environmental stimuli • To acquire knowledge on tools to predict bio macromolecules structure and its interaction and to analyze the genomics and proteomics data and drug designing process.

COURSE OUTCOMES

Upon completion of this course the students will be able to

CO1: gain practical knowledge about computer **K1**
CO2: learn MS office, MS power point and software tool SPSS which is useful in research purpose **K2**
CO3: perform research in protein and genes present in Biological database**K3**
CO4: gain knowledge about analysis of Phylogenetic trees. **K5**
CO5: learn about the submission of DNA and protein sequence to the biological database **K6**

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.

Mapping of COs with POs &PSOs:

CO	PO								PSO					SCORE
	1	2	3	4	5	6	7	8	1	2	3	4	5	
CO1	S	S	S	S	S	S	S	S	S	S	S	S	S	3.0
CO2	S	S	S	S	S	S	S	S	S	S	S	S	S	3.0
CO3	S	S	S	S	S	S	S	S	S	S	S	S	S	3.0
CO4	S	S	S	S	S	S	M	S	S	S	S	S	S	2.92
CO5	S	S	S	S	S	S	M	S	S	S	S	S	S	2.92

													MEAN SCORE	2.96

The Mean Score is 2.96, which is moderately correlated

Course Title & Code	**ELECTIVE II: OTHER DEPARTMENT ELECTIVE – PBTE22** **Choice 2: NANOTECHNOLOGY AND CANCER BIOLOGY**		
Semester	Semester-II	Credits:5	Hours/weeks: 5
Cognitive Level	K1: Recall K2: Understand K3: Apply K4: Analyze K6: Create		
Learning Objective	• To provide the students with knowledge and the basic understanding of nanotechnology and cancer. • To know about the properties of materials at the nanometer scale, and the principles behind advanced experimental and computational techniques for studying nanomaterials. • To give an idea about Synthesis of nanomaterials, characterization and their application • To give students an historical perspective on the most commonly studied topics in cancer biology. • To link specific cancer biology subjects with clinical aspects of the disease. • **To** understand the nanomaterials, its synthesis and application for almost all the field to the benefit of humankind.		

COURSE OUTCOMES

Upon completion of this course the students will be able to

CO1: know basics about nanomaterials and Nanoparticles **K1**

CO2: learn the application of nanotechnology in different field **K3**

CO3: update research in Nanotechnology for cancer research & therapy **K4**

CO4: gain knowledge about Epidemiology of cancer and its types and characteristics of cancer cells in molecular level **K2**

CO5: acquire knowledge about chemotherapy and chemoprevention in Tumor immunology **K6**

UNIT I

Nanotechnology – definition – Quantum dots, Nanowires & properties, 2D films. Nano scale materials. Nanopores . 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.
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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

Mapping of COs with POs &PSOs:

CO	PO								PSO					SCORE
	1	2	3	4	5	6	7	8	1	2	3	4	5	
CO1	S	S	S	S	S	S	S	S	S	S	S	S	S	3.0
CO2	S	S	S	S	S	S	S	S	S	S	S	M	S	2.92
CO3	S	S	S	S	S	S	S	S	S	S	S	M	S	2.92
CO4	S	S	S	S	S	S	S	S	S	S	S	M	S	2.92
CO5	S	S	S	S	S	S	S	S	S	S	S	S	S	3.0
													MEAN SCORE	2.95

The Mean Score is 2.95, which is moderately correlated

Course Title & Code	**CORE VII-PLANT BIOTECHNOLOGY – PBTT31**		
Semester	Semester-III	Credits:5	Hours/weeks: 5
Cognitive Level	K1: Recall K2: Understand K3: Apply K6: Create		
Learning Objective	• To equip students with theoretical knowledge regarding the techniques and applications of Plant Biotechnology and Genetic Engineering. • To give the students comprehensive training in the plant biotechnology and its application for increasing agricultural production, environment improvement, human, nutrition and health. • To learn about genome organization in plants, basic techniques in tissue culture and its applications. • To learn knowledge about Genetic transformation in plants, metabolic engineering, production of pharmaceuticals and industrial products known as plant molecular farming. • To become aware of various in vitro culture techniques, preservation of plant cells, gene transferring mechanism and transgenic plants.		

COURSE OUTCOMES

Upon completion of this course the students will be able to

CO1: know basic techniques and setup off plant tissue culture laboratory **K1**
CO2: understand the Application and techniques of germplasm conservation, hardening and green house technology. **K2**
CO3: trained and update research in plant transformation techniques **K3**
CO4: gain knowledge about Terminator seed technology and research advancement and its production of edible vaccines, plantibodies in transgenic plants **K6**
CO5: acquire knowledge about Biosafety guidelines for research involving GMO's and IPR **K2**

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.

REFERENCES:

1. An introduction to genetic engineering in plants, Mantel, Mathews and Mickee, 1985. Blackwell Scientific Publishers. London.

2. In Vitro culture of higher plants by Pierik, 1987. MartinusNijhoff Publisher, Dordrecht.

3. Plant cell culture. A practical approach. Second edition. Edited by R.A. Dixon and R.A. Gonzales.1994.Oxford University Press. Oxford.

4. Plants, genes and agriculture by Chrispeels and Sadava, 2000.The American Scientific Publishers, USA.

5. Plant Biotechnology by Hammond, Mc Garvey and Yusibov 2000, Springer Verlag, UK.

6. Plant Biotechnology and Transgenic Plants, Edited by Kirsi-MarjaOksman-Caldentey and Wolfgang Barz. 2002, Marcel Dekker, Inc. New York.

7. Plant Biotechnology: The genetic manipulation of plants by Slater, Scott and Fowler, 2008, Second edition, Oxford University press, UK.

8. Molecular Plant Biology: A practical approach (Vol. I and II), Edited by Gilmartin and Bowler, 2002, Oxford University press, UK.

E-book links

1) https://www.pdfdrive.com/plant-biotechnology-and-genetics-principles-techniques-e15853574.html
2) https://www.pdfdrive.com/plant-cell-and-tissue-culture-a-tool-in-biotechnology-e20389188.html
3) https://www.pdfdrive.com/principles-of-plant-biotechnology-e33514134.html
4) https://www.pdfdrive.com/plant-genomics-e28703875.html

Mapping of COs with POs &PSOs:

CO	PO								PSO					SCORE
	1	2	3	4	5	6	7	8	1	2	3	4	5	
CO1	S	S	S	S	S	S	S	S	S	S	S	S	S	3.0
CO2	S	S	S	S	S	S	S	S	S	S	S	S	S	3.0
CO3	S	S	S	S	S	S	S	S	S	S	S	S	S	3.0
CO4	S	S	S	S	S	S	S	S	S	S	S	S	S	3.0
CO5	S	S	S	S	S	S	S	S	S	S	S	S	S	3.0
													MEAN SCORE	3.0

The Mean Score is 3.0, which is strongly correlated

Course Title & Code	**CORE VIII - ANIMAL BIOTECHNOLOGY – PBTT32**		
Semester	Semester-III	Credits:5	Hours/weeks: 5
Cognitive Level	K1: Recall K2: Understand K3: Apply K4: Analyze K6: Create		
Learning Objective	• To understand the basics of Animal cell culture, transgenic animals, pest & animal management, Molecular markers and regulations about the use of Biotechnology. • To expose students to application of rDNA technology in various fields of biotechnology (medicine and research areas). • To learn about principles and methods in genetic engineering, vectors in gene cloning, transformation in higher organisms and gene therapy. • To understand animal tissue culture techniques and stem cell technology.		

COURSE OUTCOMES

Upon completion of this course the students will be able to

CO1: know the requirements to establish the cell culture laboratory **K1**
CO2: understand the procedure to do Primary cell culture techniques, mass production, storage methods, germplasm conservation and establishment of gene banks. **K2**
CO3: know the practical difficulties in sources of contamination in cell culture and importance of transgenic animals and Molecular pharming **K3**
CO4: know about advanced medical treatment methods using gene therapy for human diseases **K4**
CO5: learn the basic concept of Collection, processing, preservation and banking of stem cells for future generation free from genetic disorders **K6**

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.

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E-book links

1) https://www.pdfdrive.com/animal-cell-biotechnology-e22743665.html
2) https://www.pdfdrive.com/animal-biotechnology-1-reproductive-biotechnologies-e187110512.html
3) https://www.pdfdrive.com/animal-cell-biotechnology-e177857548.html
4) https://www.pdfdrive.com/molecular-biotechnology-principles-and-applications-of-recombinant-dna-4th-edition-e162050162.html
5) https://www.pdfdrive.com/biotechnology-plant-biotechnology-animal-cell-culture-immunobiotechnology-e186538297.html

Mapping of COs with POs &PSOs:

CO	PO								PSO					SCORE
	1	2	3	4	5	6	7	8	1	2	3	4	5	
CO1	S	S	S	S	S	S	S	S	S	S	S	S	S	3.0
CO2	S	S	S	S	S	S	S	S	S	S	S	S	S	3.0
CO3	S	S	S	S	S	S	S	S	S	S	S	S	S	3.0
CO4	S	S	S	S	S	S	S	S	S	S	S	S	S	3.0
CO5	S	S	S	S	S	S	S	S	S	S	S	S	S	3.0
													MEAN SCORE	3.0

The Mean Score is 3.0, which is strongly correlated

Course Title & Code	**CORE XI-BIOINSTRUMENTATION AND BIOSTATISTICS – PBTT33**		
Semester	Semester-III	Credits:5	Hours/weeks: 5
Cognitive Level	K1: Recall K2: Understand K3: Apply K6: Create		
Learning Objective	• To develop knowledge in handling the instruments for biological research. • To acquire knowledge on applications of statistics in research. • To gain knowledge in experimental design and data collection techniques. • To develop the technical art of writing research report and presentations.		

COURSE OUTCOMES

Upon completion of this course the students will be able to

CO1: know about the types of microscopy and its principles, working procedure and sample preparation techniques **K1**

CO2: understand the importance of centrifuge and chromatographic techniques in research aspects **K2**

CO3: know the advanced methods to study biomolecules using XRD, NMR, MADI-TOF, thermocycler, microarray. Principles and handling procedure of Electrophoresis techniques **K2**

CO4: develop skill in the aspects of collection and presentation of biological data through biostatics **K3**

CO5: learn the methods in statistics to solve the biological problems with accuracy **K6**

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.

E-book links

1. https://www.pdfdrive.com/biostatistical-methods-biostatistical-methods-e15213717.html

2. https://www.pdfdrive.com/biostatistics-e42988735.html

3. https://www.pdfdrive.com/introductory-biostatistics-e15112721.html

4. https://www.pdfdrive.com/introductory-biostatistics-e176105301.html

5. https://www.pdfdrive.com/bioinstrumentation-instructional-resources-technology-austin-e15581883.html

Mapping of COs with POs &PSOs:

CO	PO								PSO					SCORE
	1	2	3	4	5	6	7	8	1	2	3	4	5	
CO1	S	S	S	S	S	S	S	S	S	S	S	S	S	3.0
CO2	S	S	S	S	S	S	S	S	S	S	S	S	S	3.0
CO3	S	S	S	S	S	S	S	S	S	S	S	S	S	3.0
CO4	S	S	S	S	S	S	S	S	S	S	S	S	S	3.0
CO5	S	S	S	S	S	S	S	S	S	S	S	S	S	3.0
													MEAN SCORE	3.0

The Mean Score is 3.0, which is strongly correlated

Course Title & Code	**PRACTICAL V- LAB IN PLANT BIOTECHNOLOGY & LAB IN ANIMAL BIOTECHNOLOGY – PBTP33**		
Semester	Semester-III	Credits:5	Hours/weeks: 5

Cognitive Level	K1: Recall K2: Understand K3: Apply K4: Analyze
Learning Objective	• 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. • 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.

COURSE OUTCOMES

Upon completion of this course the students will be able to

CO1: able to gain practical knowledge about plant cell culture techniques requirements **K1**
CO2: know and skill in transformation techniques in plant cells **K2**
CO3: learn culture media preparation and cell culture procedure **K2**
CO4: gain knowledge about Virus inoculation methods **K3**
CO5: check Cell viability test – MTT and storage of cells **K4**

LAB IN PLANT BIOTECHNOLOGY

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

Mapping of COs with POs &PSOs:

CO	PO								PSO					SCORE
	1	2	3	4	5	6	7	8	1	2	3	4	5	
CO1	S	S	S	S	S	S	S	S	S	S	S	S	S	3.0
CO2	S	S	S	S	S	S	S	S	S	S	S	S	S	3.0
CO3	S	S	S	S	S	S	S	S	S	S	S	S	S	3.0
CO4	S	S	S	S	S	S	S	S	S	S	S	S	S	3.0
CO5	S	S	S	S	S	S	S	S	S	S	S	S	S	3.0
													MEAN SCORE	3.0

The Mean Score is 3.0, which is strongly correlated

Course Title & Code	**ELECTIVE III** **Choice 1 : WOMEN STUDIES – PBTP44**		
Semester	Semester-III	Credits:5	Hours/weeks: 5

Cognitive Level	K1: Recall K2: Understand K3: Apply
Learning Objective	• **To** understand the role, rights and responsibility of women in society. • To know how to writing research paper and communication, Science indexed journals, impact factor, citation index, H- index. • Empowering youth in acquiring right soft skills required for their future. • To know the scope and opportunities for Biotechnology students • To learn about funding agencies, Proposal writing and Biodata, Resume and CV writing, References, Testimonials, cover letters

COURSE OUTCOMES

Upon completion of this course the students will be able to

CO1: gain knowledge about Government Organization for women and Child Development **K1**
CO2: know Indian women –Family and Social System and Health status of women in India **K2**
CO3: learn Women in organized and unorganized sector-Training, skills and income generation. **K3**
CO4: gain updates knowledge about Women Empowerment and Women Development **K2**
CO5: become aware of women -Labors Laws, Legal protection, Police and Judiciary and Human rights as women's Rights **K2**

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

Mapping of COs with POs &PSOs:

CO	PO								PSO					SCORE
	1	2	3	4	5	6	7	8	1	2	3	4	5	
CO1	S	S	S	S	S	S	S	S	S	S	M	S	S	2.92
CO2	S	S	S	S	S	S	S	S	S	S	M	S	S	2.92
CO3	S	S	S	S	S	S	S	S	S	S	M	S	S	2.92
CO4	S	S	S	S	S	S	S	S	S	S	M	S	S	2.92
CO5	S	S	S	S	S	S	S	S	S	S	M	S	S	2.92
													MEAN SCORE	2.92

The Mean Score is 2.92, which is moderately correlated

Course Title & Code	**ELECTIVE III** **Choice 2 : EMPLOYABILITY SKILL – PBTP44**

Semester	Semester-III	Credits:5	Hours/weeks: 5
Cognitive Level	K1: Recall K2: Understand K3: Apply K4: Analyze		
Learning Objective	• **To** get ready for achieving their goals • To know how to writing research paper and communication, Science indexed journals, impact factor, citation index, H- index. • To get empowered in soft skills required for their future. • To know the scope and opportunities for Biotechnology students • To learn about funding agencies, Proposal writing and Biodata, Resume and CV writing, References, Testimonials, cover letters		

COURSE OUTCOMES

Upon completion of this course the students will be able to

CO1: able to take Career Decision making **K3**
CO2: know how to take Career Plan **K1**
CO3: gain knowledge and aware how to collect relevant materials **K2**
CO4: think and take Steps taken to achieve the Goal **K4**
CO5: prepare and qualifying themselves for that carrier with good resumes **K3**

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.

Mapping of COs with POs &PSOs:

CO	PO								PSO					SCORE
	1	2	3	4	5	6	7	8	1	2	3	4	5	
CO1	S	S	S	S	S	M	S	S	S	S	S	M	S	2.84
CO2	S	S	S	S	S	S	S	S	S	S	S	M	S	2.92
CO3	S	S	S	S	S	M	S	S	S	S	S	M	S	2.84
CO4	S	S	S	S	S	S	S	S	S	S	S	M	S	2.92
CO5	S	S	S	S	S	M	S	S	S	S	S	M	S	2.84
													MEAN SCORE	2.87

The Mean Score is 2.87, which is moderately correlated

Course Title & Code	**Core X: BIOETHICS, BIOSAFETY AND IPR – MBTC415**		
Semester	Semester-IV	Credits:5	Hours/weeks: 5
Cognitive Level	K1: Recall K2: Understand K3: Apply		

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

COURSE OUTCOMES

Upon completion of this course the students will be able to

CO1: become aware of bioethics in gene cloning and its application in agriculture **K1**
CO2: know about Ethical, legal and Socio economic aspects in medicines and Human rights **K2**
CO3: gain knowledge and aware of Biosafety levels in the laboratory **K2**
CO4: understand the principles of IPR and its types, procedure about patentable and non-patentable **K2**
CO5: acquire knowledge on patenting procedure in India and Indian patent act **K3**

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

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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.

E-book links

1) https://www.pdfdrive.com/bioethics-and-biosafety-in-biotechnology-e52867075.html
2) https://www.pdfdrive.com/bioethics-medicine-and-the-criminal-law-volume-1-the-criminal-law-and-bioethical-conflict-walking-the-tightrope-e176230762.html

3) https://www.pdfdrive.com/patents-and-standards-a-modern-framework-for-ipr-based-standardisation-e45986739.html

Mapping of COs with POs &PSOs:

CO	PO								PSO					SCORE
	1	2	3	4	5	6	7	8	1	2	3	4	5	
CO1	S	S	S	S	M	S	S	M	S	S	S	S	M	2.76
CO2	M	S	S	S	M	S	S	S	M	S	S	S	S	2.76
CO3	S	S	S	S	M	S	M	S	M	S	S	S	S	2.76
CO4	S	S	S	M	M	S	S	S	S	S	S	S	S	2.84
CO5	S	S	S	M	M	S	S	S	S	S	S	S	S	2.84
													MEAN SCORE	2.79

The Mean Score is 2.79, which is moderately correlated

Course Title & Code	**Core XI: BIOPROCESS TECHNOLOGY – MBTC425**		
Semester	Semester-IV	Credits:5	Hours/weeks: 5

Cognitive Level	K1: Recall K2: Understand K3: Apply
Learning Objective	• To understand about food production, pest control, and the development of new drug. • To exploit knowledge in microbes and to study the downstream processes for product recovery in fermentation. • To learn about commercially valuable biochemical and genetic resources in plants, animals and microorganisms. • To understand the basics of industrial Biotechnology and requirements for large scale productions.

COURSE OUTCOMES

Upon completion of this course the students will be able to

CO1: identify the industrially important organisms **K1**

CO2: know about principles and techniques in Designing and types of fermentor **K2**

CO3: gain knowledge on bioreactor usage and fermentation process **K2**

CO4: know about the fermentation products, purification and its characterization **K2**

CO5: know about commercial production of bio products **K3**

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.

Mapping of COs with POs &PSOs:

CO	PO								PSO					SCORE
	1	2	3	4	5	6	7	8	1	2	3	4	5	
CO1	S	S	S	S	S	S	S	S	S	S	S	S	S	3.0
CO2	S	S	S	S	S	S	S	S	S	S	S	S	S	3.0
CO3	S	S	S	S	S	S	S	S	S	S	S	S	S	3.0
CO4	S	S	S	S	S	S	S	S	S	S	S	S	S	3.0
CO5	S	S	S	S	S	S	S	S	S	S	S	S	S	3.0
													MEAN SCORE	3.0

The Mean Score is 3.0, which is strongly correlated

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.