Course Outcomes of Biotechnology

SEMESTER I

Subject Code: BT-501

Course Title: Cell and Molecular Biology

Evolution of cell and biological macromolecules, general features of

CO 1. Give introduction to prokaryotic and eukaryotic cells

CO 2. Describe structure and function of plasma membrane, molecular organization of cytoskeleton and functions of different cell organelles.

CO 3. Explain Chromosome organization, chromatin structure, complexity of eukaryotic chromosome, cot curve.

CO 4. Explain cell division and cell cycle

CO 5. Describe DNA replication in prokaryote and eukaryotes.

CO 6. Describe transcription process in prokaryote and eukaryotes

CO 7. Give a detailed account of translation process of prokaryote and eukaryotes.

Subject Code: MICRO-511

Course Title: General Microbiology

CO 1. Write down history and scope of microbiology

CO 2. Explain characterization, classification and identification of microorganisms, microscopic examination of microorganisms.

CO 3. Describe fine structure and morphology of bacteria, reproduction and cultivation, mixed and pure culture.

CO 4. Explain Microbial physiology and bacterial genetics.

CO 5. Describe viruses, bacteriophages and control of microorganisms (physical and chemical agents

CO 6. Explain biological fixation of nitrogen.

CO 7. Explain the different, resistance and defense mechanisms in host pathogen interactions.

Subject Code: BIOCHEM-511

Course Title: General Biochemistry

CO 1. Give fundamental principles that governs life.

CO 2. Explain structure and function of biomolecules.

CO 3. Explain enzyme classification and enzyme kinetics in detail.

CO 4. Give a detailed account for photosynthesis and photorespiration.

CO 5. Explain glucose metabolism in plants.

CO 6. Describe Lipid metabolism.

CO 7. Write down the nutritional aspects of carbohydrates, lipids, proteins and minerals, hormones.

Subject Code: BT-504

Course Title: General Genetics

CO 1. Give chromosome structure and organization, gene structure in detail.

CO 2. Explain concepts of inheritance, Mendelian principles of genetics, applications of Mendelian principles.

CO 3. What are chromosomal basis of inheritance and linkage?

CO 4. Describe replication of genetic material and central dogma.

CO 5. What are numerical and structural chromosomal changes?

CO 6. What do you understand by population and evolutionary genetics.

CO 7. Explain different types of genetic disorders and genetic counseling.

Subject Code: BT-505

Course Title: Computational Biology & Biostatistics

CO 1. Explain the concepts of variables in biological systems, collection, classification, tabulation, graphical and diagrammatic representation of numerical data.

CO 2. Explain the measure of central tendency, measure of dispersion, correlation and regression.

CO 3. Explain test of significance based on Z, $\chi 2$, t and F statistics, correlation.

CO 4. Describe Laboratory Information management systems (LIMS).

CO 5. Describe different different protein data bases and hteir functions.

CO 6. Give details regarding sequence analysis using bioinformatics toosl.

CO 7. Explain gene finding algorithms and models.

CO 8. Describe Protein-Protein interactions and microarrays chips and data analysis.

Subject Code: BT-506

Course Title: Techniques in Biotechnology-I

CO 1. Perform experiments for the detection of carbohydrates, amino acids, and proteins.

CO 2. Perform SDS-PAGE for protein separation

CO 3. Perform the isolation of bacteria from different sources (soil, water and air)

CO 4. Identify the isolated bacterial colonies using microscopic and staining techniques, plotting growth curve from isolated bacterial strain.

CO 5. Prepare slides and observe different stages for Mitosis and meiosis.

CO 6. Explain the inheritance and linkage analysis

CO 7. Solve the given numerical of ANOVA and chi square test.

SEMESTER II

Subject Code: BT-507

Course Title: Plant and Animal Biotechnology

CO 1. Write down about historical perspectives of plant biotechnolgoy.

CO 2. Explain various methods of *in vitro* propagation in plants.

CO 3. Describe Protoplast isolation, culture and applications of somatic hybridization.

CO 4. Describe the significance of plant cell suspension culture in p production of secondary metabolites.

CO 5. Describe various methods if gene transfer.

CO 6. Give a detailed account of various molecular markers used in crop improvement.

CO 7. Give different types of culture media and cell cultures.

CO 8. Explain *in vitro* fertilization and embryo transfer technique in detail.

Course No. BT 508

Course Title: Cell Communication and Cell Signaling

CO 1. What do understand by Host parasitic relationship?

CO 2. What are different Polar/Non Polar Signaling molecules?

CO 3. Enumerate the role of different kind of receptors present on Cells.

CO 4. Explain the different Cell –Cell, Cell Matrix and Cell Basal Lamella interactions.

CO 5. Give a detailed account of Cancer, Types of Cancer, Tumour suppressor Genes and Oncogenes

CO 6. Explain Apoptosis, Necrosis and Cell Cycle and relate them with Cancer.

Subject Code: BT-509

Course Title: Instrumental methods of Analysis

CO 1. Explain different types of microscopy.

CO 2. Describe different aspects of radioisotopy and its applications.

CO 3. Explain different types of chromatography and its applications.

CO 4. What is electrophoresis and expalin the principle and functioning of 2D PAGE.

CO 5. Explain different methods of DNA sequencing.

CO 6. What is Spectroscopy and expalin different types of spectroscopy.

Subject Code: BT-510

Course Title: Immunology

CO 1. Describe different types of immunity and cells associated with immune system.

CO 2. Explain different aspects of antibody, structure and functions.

CO 3. Write down the role of different MHC in immune system and

CO 4. Describe different types of Hypersensitivity reactions and regulation of IgE, mast

cells, basophils and allergy.

CO 5. Describe the complement system- and its different pathways.

CO 6. Describe hybridoma technology and production of monoclonal antibody production.

CO 7. Describe different immunological techniques to stduy antigen antibody reactions.

CO 8. Explain different autoimmune disorders.

Subject Code: BT-511

Course Title: Bioprocess Engineering and Technology

CO 1. Describe isolation, preservation and maintenance of industrial microorganisms and their kinetics.

CO 2. Write down about analysis of batch, fed-batch and continuous bioreactions, stability of microbial reactors, analysis of mixed microbial populations.

CO 3. Describe neural networks, mathematical modeling, role of computers in bioprocess control and applications.

CO 4. What is whole cell immobilization and their industrial applications.

CO 5. Give detailed account of industrial production of ethanol, citric and acetic, glycerol, butanol and penicillin.

CO 6. amino acids (lysine, glutamic acid), vitamins and single cell proteins- algal, fungal and yeast biomass.

CO 7. Describe the applications of microorganisms in mineral and oil recovery

Subject Code: BT-512

Course Title: Techniques in Biotechnology-II

CO 1. Perform the isolation of genomic and plasmid DNA

CO 2. Perform quantification of DNA through agarose gel electrophoresis techniques and spectrophotometer based DNA quantification

CO 3. Perform PCR and molecular marker analysis

CO 4. Perform Restriction enzyme digestion

CO 5. Selection of recombinants using blue/white colony selection.

CO 6. Perform cell and explant culture, subculturing and regeneration, Embryo rescue, Anther culture

Genetic transformation through particle bombardment, GUS assay.

CO 7. Perform Immunoelectrophoresis;,Enzyme immunoassays including ELISA.

CO 8. Isolate industrially important microorganisms for microbial processes.

CO 9. estimate production and estimation of alkaline protease.

SEMESTER III

Subject Code: BT-513

Course Title: Genetic Engineering

CO 1. Define artificial chromosomes. Draw a well labeled diagram of YAC and explain its functioning.
CO 2. Explain the extraction of RNA from plants using a flow chart.
CO 3. What is protein-protein interaction? Explain its different methods.
CO 4. Explain heterologous expression in *E.coli and* Yeast.
CO 5. Distinguish between genomic DNA and cDNA library.
CO 6. Explain different methods of next generation sequencing with the help of suitable diagrams.
CO 7. Give an introduction to various components and steps of PCR.
CO 8. How would you check success of a PCR reaction and in case of undesired results what

kind of changes in reaction and process conditions should be tried for further reactions?
CO 9. Give various examples of genetic manipulation in animals and plants. Explain the risk and safety aspects associated with genetic engineering.

Subject Code: BT-514
Course Title: Enzymes and Enzyme Technology
CO 1. Explain nomenclature and classification of enzymes
CO 2. Describe various aspects of enzymology.
CO 3. Describe enzyme extraction, purification, assay and analysis of enzymes
CO4. Describe enzyme kinetics in detail.
CO 5. Explain mechanism of enzyme catalysis.
CO 6. What is cooperativity and its role in enzymology.
CO 7. Give a detailed account regarding clinical aspects of enzymes.

Subject Code: BT-515
Course Title: Biosafety, Bioethics & IPR
CO1. Expalin the role of biosafety in human health and environment.
CO 2. Describe biosafety and risk assessment issues, biosafety guidelines and regulatory framework,
CO 3. What is National biosafety policies and law, The Cartagena Protocol on biosafety, WTO and other international agreements related to biosafety, risk management issues- containment.
CO 4. What are general principles for the laboratory and environmental biosafety.
CO 5. Explain regulatory affairs for drugs and biologicals.
CO 6. what are the different effects of GMOs on biodiversity and human health.
CO 7. What are the different aspects of IPR.

Subject Code: BT-516
Course Title: Techniques in Biotechnology-III
CO 1. Perform isolation of plasmid DNA.
CO 2. Perform restriction digestion of plasmid DNA and electrophoresis.
CO 3. Perform ethidium bromide staining and gel documentation.
CO 4. Perform cloning DNA in a pBlueScript vector.
CO 5. Perform Polymerase chain reaction and resolution of amplicons Sequencing methods.
CO 6. Study the effect of pH and temperature on enzyme activity and stability Enzyme kinetics analysis.

Optional Subject Code: BT-518
Course Title: Food Biotechnology
CO 1. explain the microbial spoilage of different food types and agents responsible for the spoilage.milk, meat, plant products.
CO 2. Describe different fermented and microbial foods in detail.
CO 3. Describe various techniques for microbiological examination of foods.
CO 4.. What are different food preservation techniques.
CO 5. What are the different measures taken for quality control of food products.

CO 6. Describe different myths and facts associated with food biotechnology,
CO 7. Explain about recombinant DNA technology derived food benefits and safety guidelines.

Optional Subject Code: BT-519
Course Title: Plant Molecular Breeding
CO 1. Write down the methods of breeding in P self and cross- pollinated crops.
CO 2. Give a detailed account for sequence based markers.
CO 3. what are the advanced methods of genotyping?
CO 4. What is QTL mapping? Describe AB-QTL analysis and fine mapping of gene/QTL.
CO 5. Describe the complete mechanism and principle associated with TILLING and Eco-TILLING
CO 6. What are the different aspects of marker assisted selection.

Optional Subject Code: BT-523
Course Title: Environmental Biotechnology
CO 1. Explain the different types of pollutions and their impact on environment.
CO 2. Describe waste water management and different treatment system associated with it.
CO 3. Describe solid waste management and different treatment schemes associated with it.
CO 4. Explain various bioremediation and phytoremediation strategies for biodiversity and its conservation.
CO 5. What are different renewable and non-renewable resources of energy.
CO 6. What is environmental protection act and different environmental laws and policies.

Optional Subject Code: BT-524
Course Title: Microbial Biotechnology
CO 1. Explain isolation and preservation of industrially important microorganisms.
CO 2. Describe different aspects of genomics and transcriptomics of microorgansims.
CO 3. Explain metagenomics and systems biology study in micororganisms.
CO 4. Describe production of proteins and enzymes in different microorganisms.
CO 5. Explain the role of microorganisms as biocontrol agent.
CO 6. Describe biological nitrogen fixation.
CO 7. What are applications of microbes in environmental biotechnology.

Subject Code: BT-600
Dissertation
CO1 Writing synopsis and objectives for proposed research work.
CO2 Study of Literature, generation of data.
CO3 Presenting the data and outcomes at different platforms.
CO4 Writing thesis/report.
CO5 Writing research articles and conference presentations. '

Subject Code: BT-701
Dissertation
CO1 Writing synopsis and objectives for proposed research work.
CO2 Comprehensive examination and Viva Voce
CO3 Study of Literature, generation of data.

CO4 Presenting the data and outcomes at different platforms.
CO5 Writing thesis/report.
CO6 Writing research articles and conference presentations. '

2.6.1 Program Outcomes (M.Sc. and Ph.D. Biotechnology):

P01: Trained Manpower: The post graduate in biotechnology is trained in array of biotechnological tools and techniques including molecular biology and genetic engineering for their intended applications.

P02: Plant tissue culture based germplasm conservation: The micropropagation techniques can be used for germplasm conservation, rapid multiplication of plants, production of secondary metabolites, making synthetic seeds etc.

P03: Quality control:Knowledge of microbiological criterias through food biotechnology and microbiological techniques along with biosafety principles are useful in development of skills for quality control in biotechnology/pharmaceutical industry.

P04: Research aptitude: The specific training through intensive research work for six months during masters' dissertation (and 3 years for doctoral dissertation) and a continuous research exposure in state of art research laboratories is boon for understanding key research activities and developing a positive attitude towards research. The research methodology course is considered as a value addition to it.

P05: Designing experiments and troubleshooting: The research training based on specific objectives includes designing and performing experiments leading to data generation. The problems encountered during experimentation needs to resolved thus generating troubleshooting skills.

P06: Team work: Ability to work in matrix environment (both PG and Ph.D. Students) not only increases the knowledge but also leads to the development of team spirit among researchers.

P07: Knowledge and use of advanced techniques: With major emphasis on tools and techniques this course provides an in depth understanding about their principles and application. Further, the hands on training on these techniques generate confidence and develop skills for employability.

P08: Data analysis and Literature survey: As an integral part of curricula the literature survey for proposed research work and given assignments followed by analysis of generated research data provides a good and useful training as a life long learning experience for its utilization.

2.6.1 Program specific outcomes:

PSO1 Understanding the molecular biology concepts and their application in various biotechnological investigations.

PSO2 Knowledge of bio-molecules and their utility in biological systems.

PSO3 In depth knowledge of genetics and molecular breeding for its application in crop improvement and other biotechnological interventions.

PSO4 To understand and apply genetic engineering tools and techniques for sustainable development.

PSO5 To gain the knowledge regarding biosafety guidelines, ethical issues and intellectual property in biotechnology industries.

PSO6 To develop skill for analyzing the data and sequence outcomes of the biotechnological research using modern bioinformatics and statistical tools.

PSO7 Utilization of microbes for beneficial applications.

PSO8 understanding about enzymes, their characteristics features and applications in biotechnology.

2.6.2 Attainment of PO, PSO and CO:

The methods for measurement of the PO.PSO and CO are as follows:

1. Conducting and evaluating first and second sessional examinations
2. Giving assignments based on specific COs or POs followed by presentation and

evaluation.

3. Designing a research problem and writing a synopsis for proposed work for approval by research committee.

4. Presentations through class seminars and credit seminar.

5. Internal assessment based on daily performance in practical classes

6. Pre- thesis seminar for presenting the research outcome during dissertation.

7. Writing a thesis and its external evaluation by expert in the subject (for PG and Ph.D. Students).

8. For Doctoral students comprehensive examination followed by Viva-Voce by an external examiner is mandatory during the research period.