**2012-15**

**SYLLABUS**

**Structure of B.Sc. Programme with Specialization in Biotechnology**

**Maximum Marks : 70**
**CCE Marks : 30**
**Total : 100**

**I Year**

I Semester
BT 101 Bimolecules, Enzymology, Biochemical Techniques and Biophysics

II Semester
BT 201 Molecular Biology

**II Year**

III Semester
BT 301 Microbial Technology & Recombinant DNA Technology

IV Semester
BT 401 Immunology and Animal Biotechnology

**III Year**

V Semester
BT 501 Techniques and Applications of Animal Cell Biotechnology & Environmental Biotechnology

VI Semester
BT 601 Biostatistics, Computers and Plant Biotechnology

## I Semester

### BT 101 : Bimolecules, Enzymology, Biochemical Techniques and Biophysics

**UNIT I**

1. Nature of biological material.
2. general properties of organic compounds for generation of structure, storage of energy and information - Peptidoglycans, polysaccharides, membrane lipids , the nucleic acids and the proteins.
3. Classification, structure and roles of biomolecules in bioprocesses
   i. Carbohydrates
   ii. Proteins
   iii. Lipids
   iv. Nucleic Acids

**UNIT II**

1. Classification of Amino acids based on- solubility, shape, structure and R-groups
2. Physical and Chemical properties , Separation of amino acids
3. Protein structure-Primary, secondary, tertiary and quaternary , Denaturation and renaturation of proteins
4. Structure and functions of fibrous proteins, globular proteins, lipoproteins, metalloproteins, glycoproteins and nucleoproteins

**UNIT III**

1. Enzymes : Historical perspective, classification, nomenclature, E.C. number
2. Mechanism of enzyme action and properties of enzymes as catalyst
3. Subcellular localization and organization of enzymes
4. Effect of pH, temp, pressure on enzyme activity and enzyme inhibition.

**UNIT IV**

1. Expression of velocity of enzyme catalyzed reactions - activity, specific activity, turn over number and catalytic centre activity
2. Enzyme kinetics : Rate equation and determination of Km and Vmax
3. Enzyme inhibition
4. Energetics of living body, sources of heat limits of temperature, heat dissipation and conservation

**UNIT V**

1. Lambert Beer's, Spectrophotometry and colorimetry, primary events in photosynthesis .
2. Intra and intermolecular interactions in biological systems. Spatial and charge compatibility as determinant of such interactions.
3. Physical methods applied to find out molecular structure-X ray crystalluography and NMR
4. General spectroscopy-Uv vis, fluorescence, atomic absorption, IR, Raman spectra

**PRACTICALS**

**BT 102 : Laboratory I**

1. Qualitative estimation of carbohydrates
2. Qualitative estimation of lipids
3. Qualitative estimation of proteins
4. Qualitative estimation of RNA
5. Qualitative estimation of DNA
6. Extraction and separation of lipids
7. Assay of enzyme activity
8. Kinetic studies on enzymes
9. Chromatographic methods for separation of macromolecules B.Sc. Biotechnology

**II Semester**

**BT 201 : Molecular Biology**

**Unit-I**

1. General structure of nucleic acids; A form, B form, Z-form, H-form DNA.
2. Features of double helix denaturation & annealing of DNA.
3. Evidences of DNA & RNA as a genetic material.

**Unit-II**

1. DNA Replication- enzymes involved and their function.
2. DNA Replication machinery involved in replication of DNA both in prokaryotes and eukaryotes.
3. DNA Replication-machinery involved in replication of DNA both in prokaryotes and eukaryotes.
4. Differences in DNA replication in prokaryotes and Eukaryotes , Regulation of DNA replication.

**Unit-III**

1. Structure of prokaryotic & eukaryotic genes.
2. Transcription: Mode of initiation, elongation & termination in prokaryotes
3. Transcription in eukaryotes- initiation , elongation and termination and comparison to prokaryotes
4. Post transcriptional modifications 5'– capping, 3'–poly–A–tailing & RNA–editing. Regulation by small RNA molecular for cleavage of RNA–RNAi .

**Unit-IV**

1. Translation: Mode of initiation, elongation & termination ,
2. Operon–definition, structure & regulation (Lac, Gal, Trp).
3. Genetic code, wobble hypothesis, amino – acyl – tRNA synthetase.
4. Transposable elements in prokaryotes and eukaryotes – IS– elements, Tn – elements, Composite, p-elements, Ac – Ds elements, retrotransposons (LTRS).

**Unit-V**

1. Translation: Mode of initiation, elongation & termination , Translation- Comparison of prokaryotes vs eukaryotes.
2. Post–translational modifications acetylation, methylation.
3. Regulation of gene expression in eukaryotes – Chromatin structure, signal molecules
4. Molecular and environmental regulation- Transcription factors motifs, HLH, zing–finger, leucin–zipper; switching of cell type in yeast and floral morphology.

**PRACTICALS**

**BT 202 : Laboratory II**

1. Methods for cell lysis: osmotic/chemical lysis of cells followed by centrifugation.
2. Extraction of biomolecues - in saline buffers, in solvents
3. Precipitation from extracts- proteins by salt, solvents, acids, acetone
4. Precipitation of nucleic acids
5. Estimation of DNA by colorimetric method, UV Visible method
6. Testing of Purity of DNA and lamda max
7. Estimation of Proteins.
8. Determination of absorption maxima of DNA
9. Estimation of DNA in the sample

## B.Sc. III Semester

## BT-301: Microbial Technology & Recombinant DNA Technology

### UNIT I

1. Development of microscope (Optical, TEM and SEM)
2. The concept of sterilization, Methods of sterilization (dry heat, wet heat, radiation, chemical and filtration etc.)
3. Concept of microbial species and strain, Genetic homogeneity in clonal populations
4. Measurement of growth-growth curve. Staining methods-gram's staining

### UNIT II

1. Classification of microorganisms- by nutrition, shape, extreme environments (the thermophiles, alkalophiles)
2. Nature of the microbial cell surface. Gram positive and gram negative bacteria, kinds of flagella, serotypes
3. Spontaneous and induced variation arising in microbial population
4. Culture techniques, preservation methods.

### UNIT III

1. Prokaryotes & Eukaryotic microbial cells
2. Gene transfer in microorganisms
3. Microbial metabolism, fermentation products, a survey of products from microorganism.
4. Strain improvement by enrichment, selection and recombinant methods.

### UNIT IV

1. Recombinant DNA technology Principle and concept.
2. Features of Cloning vectors for recombinant DNA -
   - Plasmids, • Cosmids • Phagemids
   - Plant and animal viruses
3. RNA, cDNA, RT enzymes and other reagents techniques
4. Purification of and manipulation of DNA from bacteria, plants and animal cells

### UNIT V

1. Cloning vectors for E. coli, yeast, plants, plant viruses and animal viruses
2. Introduction of DNA into living cells- E.coli , plant and animal
3. Application of cloning in gene analysis - Studying clone of specific gene and gene location and structure
4. Gene cloning and expression of foreign gene -• Production of proteins from cloned genes, application of gene cloning in industry and Agriculture.

**PRACTICALS**

**302: Lab course III**

1. Cleaning of glassware
2. Preparation of media, cotton plugging and sterilization personal hygiene- microbes
3. Isolation from air, water and soil samples
4. Dilution and pour plating, colony purification
5. Enumeration of microorganisms, total vs viable counts
6. Identification of isolated bacteria, Gram straining, other staining methods
7. Growth curve of microorganisms
8. Antibiotic sensitivity of microorganisms
9. Test for antibodies against given bacteria
10. Isolation of DNA from *E.coli*
11. Agarose Gel electrophoresis
12. Transformation of *E.coi*

## B.Sc. IV Semester

## BT 401 : Immunology and Animal Biotechnology

### Unit-I

1. The immunity, immune system and immune response.
2. Anatomical organization of immune system. Cells & organs of immune system and their functions.
3. Antigen, antibody and their structures.
4. Antigen–antibody interactions *in vitro* and *in vitr*o.

### Unit-II

1. Immunodiagnostics–
   - Precipitation techniques
   - agglutination
   - fluorescence techniques
   - ELISA
   - RIA
   - Western blotting
   - Immunohistochemical techniques

### Unit-III

1. Major Histocompatibility complex, Recognition of antigen by T& B Cells.
2. T–cell receptor and B–cell receptor complex.
3. Basics of antibody diversity.
4. Vaccines–DNA, synthetic & natural.
5. Basics of autoimmunity. Effector mechanism.

### Unit-IV

1. History of development of cell culture. The natural surroundings of animal cells.
2. Importance of growth factors of the serum.
3. Primary cultures, anchorage dependence of growth, non–anchorage dependent cells.
4. Secondary cultures, transformed animal cells, established continuous cell lines. Commonly used animal cell lines their origin and characteristics.

### Unit-V

1. Organ culture.
2. Animal Cell fusion
3. Methods of transfection of animal cells (physical & chemical methods) and selection.
4. Transplantation of cultured cells

**PRACTICALS**

**402: Lab Course IV**

Purification of antigens
Raising polyclonal antibodies
Generation of ascetic fluid
ELISA,
Radial immunodiffusion
Diagnosis of an infectious disease by an immunoassay- typhoid,
Separation of the constituent molecules of the extract in aqueous buffer
Gel filtration chromatography
Ion exchange chromatography
Thin layer chromatography of extracted material
Cytological preparations: Fixation, dehydration and staining Embedding and sectioning
Squash in stain, cell counting methods- heamocytometer and other ideas
Measurement of cell size with the help of light microscopes Finding our average cell size
Chromosome lengths

## B.Sc. V Semester

## BT 501: Techniques and Applications of Animal Cell Biotechnology & Environmental Biotechnology

### Unit-I

1. Growth kinetics of animal cells in culture.
2. General metabolism–TCA, pentose, glycolysis.
3. Specific secondary metabolites–insulin, interferon, TPA, factor-VIII.
4. Growth hormones and growth factors proliferating animal cells–EGP, FGP, PDGF, IL-1, IL-2, NGF, erythropoietin.

### Unit-II

1. Expressing cloned gene in animal cells, overproducing and processing of chosen proteins.
2. Production of vaccines in animal cells.
3. Production of monoclonal antibodies.
4. Bioreactors for large scale culture of animal cells.

### Unit-III

1. Conventional fuels ( firewood, plant and animal waste, coal, gas, animal oils) and their environmental impacts
2. Renewable and non-renewable resources their applications
3. Modern fuels and their environmental impacts-
   Methanogenic Bacteria
   Microbiall hydrogen Production
   Conversion of sugars to ethanol
   Solar energy convertors- hopes from the photosynthetic pigments
   Plant based petroleum industry
   Cellulose degradation for combustible fuels

### Unit-IV

1. Thuringiensis toxin as a natural pesticide
2. Biological control of other insects harming the agriculture fields
3. Enrichment of ores by microorganisms.
4. Biofertilizers, nitrogen fixing microorganisms enrich the soil with assimiable nitrogen

### Unit-V

1. Microbiological quality of food and water
2. Treatment of municipal waste and industrial effluents
3. Degradation of pesticides and other toxic chemicals by microorganisma
4. Biosensors and biochips applications

**PRACTICALS**

**502: Lab Course V**

Isolation of microorganism from waste effluents
Estimation of COD, of effluent water
Estimation of DO of effluent water
Estimation of BOD of effluent water
Bioreactor and its parts and their applications
Model preparation- water treatment plant , Application of Solar energy, Biogas plant.

## B.Sc. VI Semester

## 601: Biostatistics, Computers and Plant Biotechnology

### Unit-I

1. Introduction to Biostatistics, common terms, notations and applications.
2. Methods of sampling and measurements of deviations.
3. Probability calculations.
4. Measurement of central tendencies.

### Unit-II

1. Computer-general introduction, organization of computers, digital and analogue computers.
2. Concept of hardware and software, internal and external commands.
3. Concept of file, folders, directories and their management.
4. Overview of bioinformatics, LAN, WAN internet Basics and E-mail.
5. Introduction to MEDLINE on PubMed system for accessing, Biological information, Entrez.

### Unit-III

1. Introduction to in vitro methods, terms and definitions, use of growth regulators.
2. Ovary and ovule culture, in vitro pollination and fertilization.
3. Embryo culture, embryo rescue after wide hybridization and its applications.
4. Introduction to the processes of embryo genesis and organogenesis and their practical application.

### Unit-IV

1. Clonal multiplication of elite species (Micro propagation, axillary bud, shoot tip, and meristem culture).
2. Haploids and somaclonal variations with the practical applications of both.
3. Endosperm culture and production of triploids and practical applications of tissue and organ culture.
4. Single cell suspension cultures and their application in selection of variants/mutants with or without mutagen treatment.
5. Introduction to protoplast isolation, testing viability of isolated protoplasts, various steps in the regeneration of protoplasts.

### Unit-V

1. Somatic hybridization and various methods for fusing protoplasts- chemical & electrical.
2. Use of markers for selection of hybrid cells and practical application of somatic hybridization (hybrids vs cybrids).
3. Introduction to *A. tumefactions* and turmor formation in plants by using A. tumefactions (Monocots vs dicots).
4. Root formation using *A. rhizogenes* and practical applications of genetic transformation.

**PRACTICALS**

**602: Lab Course VI**

1. Calculation of Mean, median and Mode
2. Calculation of SD and SE
3. $chi^2$ test , T-test
4. Preparation of bar, line and pie representation of given data
5. Computer program for additions, multiplication.
6. Preparation of MS medium.
7. Sterilization of Plant material
8. Inoculation of Leaf, Node , shoot tip, embryo and anther.
9. plant regeneration , transfer to soil
10. Protoplast isolation and culture.
11. Suspension culture