

Department of Biotechnology

B.Sc. Part – I

Semester – I

Paper – I: (Biochemistry)

Unit – I:

Water :Structure, physical and chemical properties. Weak interactions in aqueous solutions. Non-covalent interactions. Water as a solvent.pH and buffers; Functional groups; Hydrophobic and hydrophilic groups and their interaction in stability of membrane.

Unit – II:

Outline structure and biological functions of monosaccharide, oligosaccharides, polysaccharides. Peptidoglycans and glycoproteins. Structure and classification of amino acids and their laboratory test for identification .

Unit – III:

Biological functions and four level structure of protein; Ramachandran Plot; laboratory test for proteins. Classification and biological functions of lipids.

Unit – IV:

Molecules involved in storage of information – Evidences (Griffith Experiment; Avery Macleod and Mac Corty and Harshey& Chase Experiment)indicating that DNA is genetic material; Structure of DNA; Types of DNA; Basic difference in DNA & RNA.

Department of Biotechnology

B.Sc. Part – I

Semester – I

Paper – II: (Microbiology)

Unit – I:

History and scope of microbiology ; Spontaneous generation ; conflict recognition of role of microorganisms and disease ; Sterilization techniques – The concept of sterilization ; Study of Dry Heat, Wet Heat, Radiation, Filtration, Chemical and Gaseous sterilization techniques.

Unit – II:

Fine structure of prokaryotic and eukaryotic microbial cell ; Study of structure of cell surface of Gram - positive and Gram - negative bacteria.

Unit – III:

Microbial growth – Different types of culture media . Phases of bacterial growth ; Growth in culture ; Effect of Temperature ; Nutrient Concentration ; Oxygen Concentration ; Water Activity; Pressure ; pH & Light on growth of bacteria.

Study of various specific strategies developed by microbes to cope with above factors.

Extremophilic Microbes – General awareness of thermophilic bacteria and their biotechnological potential. Thermozyms ;Elementary knowledge of Acidophiles, Barophiles, Alkalophiles, Halophiles and Psychrophiles.

Unit – IV:

An overview of common microbial diseases in human; pets and plants.

Department of Biotechnology

B.Sc. Part – I

Semester – I

Paper – III: (Cell Biology)

Unit – I:

The cell theory ; Microscopy: General concept, Simple microscope , Modern compound microscope . General study of light microscope (Bright field, Dark field, Phase contrast, Fluorescence, Ultraviolet and Interference Microscope); Working of Hemacytometer and Camera lucida.

Unit – II:

General structure of cell- Viruses, bacterial cell, Mycoplasma, Fungal cell, Animal and Plant cell. Membrane structure- Lipid Bilayer, Membrane and Proteins, Carbohydrates, Fluid mosaic model. Mechanism of Membrane Transport (Active, passive).

Unit – III:

General Study of Cell Signaling- Chemical signals and cellular receptors (G-Protein, Linked receptor and Enzyme linked receptors) and Mechanism of their action.

Unit – IV:

Beyond the Cell- Cell junctions in Plant and Mammalian cell membrane; Tight Junction, Adherens Junction, Gap Junction and Plasmodesmata; Composition and function of Extra cellular Matrix. Micrometry- Determination of size of cell. Staining Techniques- The chemistry and classification of Stains, Staining of Bacterial Plant and Animal cell.

Department of Biotechnology

B.Sc. Part – I

Semester – II

Paper – I: (Introductory Enzymology)

Unit – I:

Nomenclature, classification and properties of Enzymes. Different models of Enzyme action. Elementary study of general themes in Enzyme mechanism- the Proximity Effect, General Base and General Acid Catalysis, Electrostatic interactions.

Unit – II:

Purification of Enzymes- Need for purification, objectives and strategies in Enzyme Purification (Method that depend on size and mass; Polarity; Change in solubility and specific binding site). Specific activity of Enzymes.

Unit – III:

Introductory knowledge of various enzymes Immobilization methods (Adsorption, Covalent binding , Entrapment, Membrane confinement). Effect of Immobilization on Enzyme; Advantages of Immobilization; Disadvantages; Various application of Immobilized Enzyme.

Unit – IV:

General study of clinical aspect of Enzymology- Enzyme and clinical diagnosis (Clinical Enzymology of liver diseases and heart diseases) Significance of Enzyme deficiency in genetic disorders. Application of Enzyme in treatment of diseases. Uses of enzyme to determine blood glucose, uric acid, urea and cholesterol. Uses of Enzymes in food processing- Beverage, juice clarification, Meat Tenderization, Sweeteners, cheese and breads.

Department of Biotechnology

B.Sc. Part – I

Semester – II

Paper – II: (Biotechnological Tools and Techniques)

Unit – I:

Separation techniques used for various macromolecules-

Centrifugation- Centrifuge, Types of Centrifugation, Principle of Centrifugation, Applications.

Chromatography- Theory of Chromatography, Types of Chromatography (Paper, Thin layer, Ion Exchange and Affinity) and their applications.

Unit – II:

Electrophoresis- Principle, Electrophoretic equipment, types of Electrophoresis, application in separation of DNA and Proteins .

Radiochemical Techniques-

(a) Radio isotopes, detection methods (Liquid scintillation counter); applications of Radio Chemical Techniques with safety measures.

(b) General knowledge of Auto Radiographic Techniques.

Unit – III:

Spectroscopic Techniques- principle, Instrumentation, Working and Application of visible and U.V. Spectrophotometer and basic understanding of NMR.

Unit – IV:

Physical techniques for imaging biological structures-

(a) Working and application of Ultrasound.

(b) Basic concept, Types and uses of Optical filters.

(c) Basic concept of EEG, ECG, CAT Scan.

Biosensors- concept, classes and applications of biosensors.

Department of Biotechnology

B.Sc. Part – I

Semester – II

Paper – III: (Genetics)

Unit – I:

Concept of Mendelian Genetics, Mendel Experiments, Symbols and Terminology, Monohybrid cross and di hybrid cross, Principle obtained . Allelic Variation and gene function (Incomplete dominance, co-dominance and multiple allele).

Unit – II:

Introductory knowledge of various process involved in bacterial recombination, mechanism of recombination, significance of Plasmid and episomes , viruses genetics (M13), Bacteriophages. Transduction – (General & Specialized).

Unit – III:

Mutation – Spontaneous vs. Induced Mutation, phenotypic effects of mutation, somatic and germinal , back mutation, suppressor mutation, molecular basis, radiation induced mutation, chemical induced mutation, Practical application of mutation, DNA repair.

Unit – IV:

Molecular Analysis of gene and gene product – general knowledge of methods for molecular analysis of gene and gene product (Colony hybridization, southern hybridization, Dot blot technique, DNA Sequencing, amino acid sequencing, Northern hybridization, Western blotting).

Department of Biotechnology

B.Sc. Part – II

Semester – III

Paper – I: (Molecular Biology)

Unit – I:

DNA Replication in prokaryote, type of DNA replication Mechanism, Transposons (Types of Transposons), mechanism of transposition (Replicative and Non- Replicative).

Unit – II:

Transcription in Eukaryotes and Prokaryotes- Mechanism in Prokaryotes, Concept of Post Transcription processing of primary transcript (m-RNA) in Eukaryotes, Promoters and its functions.

Unit – III:

Gene expression in Prokaryotes and Eukaryotes (Structure of Ribosome, t-RNA, Mechanism of initiation, elongation, termination).Genetic Code.

Unit – IV:

Regulation of Gene expression in Prokaryotes, Concept of Operon, Lac Operon and trp operon of E.Coli.

Department of Biotechnology

B.Sc. Part – II

Semester – III

Paper – II: (Introductory Immunology)

Unit – I:

Historical Prospective in immunology; Component of immunity; Mechanism of Innate & Adaptive Immunity; Anatomical Barrier; Physiological Barrier; Inflammatory Barrier; Humoral & Cellular immunity.

Unit – II:

Cell and Organ of Immune system, Study of various types of cells of immune system, Primary lymphoid Organ, secondary lymphoid organ.

Unit – III:

Antigens : Properties of antigens, Epitopes, Immunogenicity vs. Antigenicity, Adjuvants, haptans, Basic structure of Antibody molecules, Immunoglobulin classes and their biological activities.

Unit – IV:

Antigen- Antibody interaction, Precipitation reaction (Ouchterlony and Mancini method), Cross reactivity,; Immunodiffusion; immunoelectrophoresis & agglutination reaction.

Department of Biotechnology
B.Sc. Part – II
Semester – III
Paper – III: (Plant Tissue Culture)

Unit – I:

Lab requirement and general technique, structure and utilities, Media, Room, Culture-Vessel, Growth Room, Green House, Glassware and Plasticware washing; Sterilization Technique for media, wares, Instruments and Plants materials.

Tissue Culture Media – Importance of inorganic nutrients, organic nutrients, growth regulators.

Unit – II:

Micro propagation – General techniques of micro propagation, Advantages and Application of micro propagation, Limitations of micro propagation techniques.

Somatic Embryogenesis; General method, factors effecting somatic embryogenesis, large scale production of somatic embryo, synthetic seed.

Unit – III:

Haploid production – Various Techniques (Anther Culture, Pollen Culture); Androgenesis and Gynogenesis.

Triploid production, Methodology of production, Application of Endosperm culture.

Unit – IV:

General knowledge of Embryo rescue technology, virus free plant production technology.

General knowledge of Germplasm storage technique, Secondary Metabolite production technique.

Department of Biotechnology

B.Sc. Part – II

Semester – IV

Paper – I: (Applied Immunology)

Unit – I:

MHC-MHC haplotype, MHC peptide interaction, MHC and disease susceptibility. Introductory knowledge of immune effector mechanism-Cytokines(Properties and Functions). Cytokines related disease. Complement systems, their activation cascade and function.

Unit – II:

Cell mediated effector responses – General properties of effector T-cells. Destruction of target cell by Cytotoxic T-cells and functions of T-helper cells. A general account of antibody dependent cell mediated cytotoxicity (ADCC).

Unit – III:

Vaccines- Active and Passive immunization, various types of vaccines, National immunization schedule. Immune response mechanism in viral , bacterial and protozoon diseases.

Unit – IV:

General knowledge of various immunological techniques- ELISA, RIA, FACS, Immunofluorescence and immune blotting techniques.

Department of Biotechnology

B.Sc. Part – II

Semester – IV

Paper – II: (Animal Cell and Tissue Culture)

Unit – I:

Aseptic technique- Preparation and Sterilization of glass wares, apparatus, reagents and media; preparation of animal materials. Types of contaminants, animal cell culture environment- Substrates Gas phase, Feeder layer, temperature, buffer, contaminant and precautions in animal cell culture.

Unit – II:

Animal tissue culture media- Natural ingredients containing culture media, complex natural media, chemically defined media. Advantages and disadvantages of serum in media. Serum free media. Primary culture of Animal cell- Isolation of tissue, Enzymatic and mechanical disaggregation, separation of viable and non- viable cells.

Unit – III:

General concept of secondary animal cell culture, maintenance of culture cell line. Procedure of cloning and selection of specific cell types. Cryopreservation. Culture of specific cell types- Epithelial, Hematopoietic cell and stem cell technology.

Unit – IV:

Applications of Animal cell culture- Drug development, Vaccine development, Toxicity testing.

Department of Biotechnology
B.Sc. Part – II
Semester – IV
Paper – III: (Genetic Engineering)

Unit – I:

Concept of gene cloning. Use of Plasmids and bacteriophages as a vehicle. Cosmid. General study of isolation of DNA from living cells.

Unit – II:

Manipulation of isolated and purified DNA- Use of various enzymes (Restriction enzyme, Alkaline phosphatase, Klenow fragment, Reverse Transcriptase, Ligase, Endonuclease, etc.)
Introduction of DNA into living cell- Transfection, Electroporation, Transformation. Identification of Recombinants.

Unit – III:

Cloning vectors for Prokaryotic and Eukaryotic cells- Plasmid vectors, Bacteriophage, M13, PUC, Cosmids, Shuttle vector & Yac vectors.
Application of Gene cloning in medicine and biotechnology. DNA finger printing.

Unit – IV:

General features of different types of Polymerase Chain Reaction (PCR).

Department of Biotechnology

B.Sc. Part – III

Semester – V

Paper – I: (Plant Biotechnology)

Unit – I:

Transgenic techniques- Brief outline of steps, bacteria nature's genetics engineers. Gene cloning; cloning in bacteria and Eukaryotes; Amplification by PCR.

Unit – II:

Gene transfer technology, Biological delivery systems, Particle bombardment technique, Microinjection technique, Silicon whiskers, sonication, Electroporation, Polycation Mediated uptake. Ultrasonication, Microbeam, Gene transformation in Monocot, Problems involved in Gene transfer.

Unit – III:

A general study of expression of induced Gene.

A general study of Gene silencing technology- types PTGS (Post Transcriptional Gene Silencing), Various examples.

Unit – IV:

Study of some examples of useful Gene transfer-Bt cotton, Stress tolerant crop. Herbicides resistant plant. Fungi and Virus resistant.

Department of Biotechnology

B.Sc. Part – III

Semester – V

Paper – II: (Animal Biotechnology)

Unit – I:

Transgenesis: Definition, method of transgenic animal development, Viral vectors, transfection, Markers, Promoters Gene as various strategies of Gene integration.

Unit – II:

Specific application of Transgenic animal in therapeutics, Xeno transplantation, industrial and value added food production. Knockout mice (steps & application), transfectogenic and somatotransgenic animals.

Unit – III:

General study of Livestock breeds and their productivity in India, Germ cell storage, Artificial insemination, Ectogenesis, Amniocentesis.

Unit – IV:

General study of causes of infertility, In Vitro fertilization, Embryo transfer, Ethical issues.

Department of Biotechnology

B.Sc. Part – III

Semester – V

Paper – III: (Environmental Biotechnology)

Unit – I:

Natural resources- Classification of natural resources, conservation of natural resources (Various methods used for conservation of atmosphere, water and soil).

Unit – II:

Bioremediation and phytoremediation; definition, their types and various applications.

Bioabsorption and bioleaching of heavy metals. Concept of bioventing.

Application, advantage and disadvantage of bioremediation. Use of bioaugmentation for bioremediation.

Unit – III:

General concept of waste water treatment. Use of Biological process for waste treatment.

Aerobic treatment: activated sludge process.

(a) Carrier.

(b) Advance

Biological filter, expanded bed reactors , FBR (Fluidized bed reactors), IFBR (inverse Fluidized bed reactors). Anaerobic treatment: Contact digester, packed column reactors, membrane bioreactors.

Unit – IV:

Vermitechnology and pollution control, Bioplastic. Use of Biotechnology in pulp and paper industry. Tannery industry. Introductory knowledge of Biotransformation.

Department of Biotechnology

B.Sc. Part – III

Semester – V

Paper –IV: (Agricultural Biotechnology)

Unit – I:

Biofertilizers – Definition, Types of Biofertilizers, Nitrogen fixing microorganisms process of nodule formation, Azotobacter, Azospirillum and Cyanobacteria as biofertilizer. Mass culture production of microorganisms.

Unit – II:

Phosphate mobilizing bacteria, various symbiotic associations, Mycorrhizal symbiosis, ECM and VAM Leguminous plants and Non Leguminous plants, nitrogen fixing tree.

Unit – III:

General study of various control practices for control of plant pathogens and Integrated pest management.

Unit – IV:

General study of steps involved in production of transgenic fish and application of transgenic fish in biotechnology.

Department of Biotechnology
B.Sc. Part – III
Semester – VI
Paper – I: (Health Care Biotechnology)

Unit – I:

Role of Biotechnology in disease prevention - Vaccines.

Role of Biotechnology in disease diagnosis & therapy (Genetic disease & cancer) – Probe, monoclonal antibody.

Unit – II:

General study of forensic science, Preparation of DNA sample, analysis, data collection and processing & application. Role of Biotechnology in Gene Therapy.

Unit – III:

Disease treatment by using recombinant organisms. Interferons, Toxoids, Human Insulin. Erythropoietin & Somatotropins.

Unit – IV:

Antimicrobial drugs – General characteristics.

General study of antibiotics – Classification, mode of action, sensitivity test, determination of MIC & MBC, demerits of antibiotics.

Department of Biotechnology
B.Sc. Part – III
Semester – VI
Paper – II: (Bio Fuel Biotechnology)

Unit – I:

A study of general composition of biomass, nature of various type of biomass (forest agricultural, industrial and municipal waste).

Unit – II:

Conventional fuel – Different types of conventional fuels, (fire, wood, plant and animal waste, coal crude oil and natural gas), pollution caused by conventional fuel.

Unit – III:

Modern fuel – Different types of modern fuel, study of methodology involve in production of Hydrogen, Ethanol and Plant based petroleum product by using various substrate.

Unit – IV:

Biogas – Microbiology of biogas production, steps involved in biogas production technology, types of biogas plant.

1. Indian floating drum biogas plant
2. Chinese fixed dome biogas plant

Beneficial role of biogas plant, environmental aspects of biogas production

Department of Biotechnology
B.Sc. Part – III
Semester – VI
**Paper – III: (Introductory Bioinformatics &
Biostatistics)**

Unit – I:

General study and scope of Bioinformatics, bioinformatics and internet, bioinformatics software (RASMOL). Concept of world wide web internet (Browsing, HTML, URL).

Unit – II:

Useful Bioinformatics site on web, NCBI, EMBL and other public database. Data acquisition for DNA, RNA and protein.

Unit – III:

General study of use of biological (DNA) Database .

File formats, annotated sequence database.

Various applications in Drug discovery, pharmaceutical industry, phylogenetic analysis software (Phylip), BLAST, (Pair wise alignment).

Unit – IV:

Mean, median, mode, standard deviation & standard calculation, coordination, regression, analysis and test of significance in array of data.

Department of Biotechnology
B.Sc. Part – III
Semester – VI
Paper – IV: (Applied Microbiology)

Unit – I:

Isolation of Microorganisms from nature, Methods of culture preservation, Different types of culture media, Introductory knowledge of various techniques, used for strain improvement (Mutation, Recombination, Protoplast, fusion and Gene Technology).

Unit – II:

An overview of diseases caused by Bacteria, Fungi and Protozoa in Humans, Pets and Plants. Study of different types of fermentors.

Unit – III:

Nitrogen fixation – Symbiotic and Asymbiotic Nitrogen fixers, Mechanism of Nitrogen fixation, Process of nodule formation.

Unit – IV:

Various role played by microorganism in –

- (a) Crop production – Bacterial Biofertilizer, Green manure, algal biofertilizer, Mycorrhizal Biofertilizer.
- (b) Crop protection – Microbial herbicide, bacterial insecticide, entomopathogenic fungi.