

504. BIOTECHNOLOGY

Unit 1: Principles of Genetics: Mendel's Laws, Incomplete dominance, Co-dominance, Penetrance and Expressivity, Pleiotropism, Phenocopy, Epistasis, Multiple Allelism, Pseudoallelism, Inheritance of quantitative traits, Sex determination in *Drosophila*, Birds, Man, *Bonellia*, Pedigree analysis, X-linked inheritance, Y-linked inheritance, Chromosome morphology, Karyotyping, polytene and Lamp brush chromosomes, Euchromatin and Heterochromatin, Chromatin organization, Features of centromere and telomere, Variation in chromosome number and structure, Linkage and recombination, Tetrad analysis in *Neurospora*, Genetic mapping.

Unit II : Cell biology : Structure and functions of cell organelles; Structure and properties of cell membrane and transport mechanisms; prokaryotic and eukaryotic Cell cycle, check points and CDK's; Abnormalities in Cell Cycle – Cancer ; Mechanism Cell Division- Mitosis and Meiosis; Recombination; Necrosis, Senescence; Apoptosis.

Unit III: Biochemistry : Bioenergetics: Law of thermodynamics, Biological oxidation, free energy changes redox potential and phosphate potential, Entropy, K_{eq} , Gibbs free energy, and energy of activation, Nomenclature, classification and properties of enzyme, isolation methods and purifications. Metals and cofactors, Catalytic RNA, Activate substrate, catalytic efficiency, enzyme regulation, allosteric and cooperative interactions, Factors affecting the rate of the reaction, Michaelis-Menton equation and kinetics, Binding isotherms and transformation to Hill equation, cooperativity, Multiple sites on an enzyme, Chemistry, Configuration, structural properties, conformation and reactions of carbohydrates, aminoacids, lipids and nucleic acids; Metabolism of biomolecules carbohydrates, proteins, lipids and nucleic acids: Glycolytic Pathway, TCA Cycle Oxidative Phosphorylation, Photophosphorylation, Electron Transport Chain, Glyoxylate Cycle, Pentose Phosphate Pathway, Gluconeogenesis, Photosynthesis – Photosystems- Light and Dark Phases - C_3 and C_4 and CAM Pathways-Bioluminescence, Fatty acid Metabolism - β - Oxidation of fatty acids.

UNIT IV: Microbiology : Historical developments in Microbiology and Microbial Biotechnology, Identification methods of microorganisms, Structure, characters, classification of Bacteria, Archaea, Fungi, Algae, virus, structure and replication of Bacteriophage (T2), Lambda, Retroviruses, TMV, HIV, SV40, Prions – Kuru, Methods of cultivation of viruses, Methods of sterilization and application in industry, pure culture, Methods of preservation of microbial cultures of industrial application, Nutritional groups of microorganisms and their importance in fermentation, Microbiological media and their application, Methods and isolations of cultures, Microbial growth curve, Exponential growth and synchronous growth

UNIT V: Immunology: Acquired and Innate Immunity, Cells involved in immunity, Organs of the immune system- Types, structure and function of Immunoglobulin, organization of

immunoglobulin genes, HLA complex- Structure of MHC class I and class II molecules, HLA typing in organ transplantation, Antigen processing and presentation, B-cells and T cell mediated immune response, Hypersensitivity and Auto-immunity

UNIT VI: Molecular biology : DNA and RNA as genetic material , Enzymes involved in the replication of DNA and their features, Replication of circular and linear DNA, Regulation of eukaryotic genome replication, Mutagens and Molecular mechanisms of mutagenesis, Repair mechanisms, Transformation, Conjugation, Transduction and mapping, Homologous and Non- homologous recombination, Transposon and rearrangements, Prokaryotic and eukaryotic genes and genome organization, c-value paradox, Kinetics of DNA re-association, gene families, Organization of mitochondrial and chloroplast genomes, genetic code , transcription, translation and regulation in Prokaryotes and eukaryotes

UNIT VII: Statistics, laboratory management and safety entrepreneurship: Sampling techniques, Methods of Measures of central tendency and dispersion, Graphical representation of the data, Probability and probability distributions, Test of significance, Correlation and regression, Laboratory Information management system (LIMS), Laboratory safety and Safety policies, Operation of Hazardous compound, concept of entrepreneurship and projects, Intellectual property rights.

UNIT VIII: r-DNA Technology: Restriction endonucleases, cloning and expression vectors, genomic and cDNA libraries, Blotting and Hybridization techniques, DNA sequencing, PCR technology.

UNIT IX : Industrial Biotechnology: Industrial cultures, Primary and secondary screening of microorganisms for industrial products, Isolation and preservation of microorganisms for industrial products, overview of aerobic and anaerobic fermentation process, Fermentor systems
– types, Fermentation process, Organic acids , Amino acids, Alcohols, Enzymes, Antibiotics –
penicillin, streptomycin and erythromycin, Vaccines, Dairy products.

UNIT XI : Bioinformatics : Foundations to bioinformatics; Bioinformatics data and databases; Basics of sequence alignment; Pair wise alignment algorithms, database searching algorithms (Blast/Fasta); Bioinformatics for genome sequencing, genome variation studies, proteomic research and transcript profiling; Bioinformatics for metabolic reconstruction; Medical application of Bioinformatics.

UNIT XII: Bioprocess Engineering: Fundamentals of Bioprocess Engineering, Bioreactors, Transport phenomenon in bioprocess system, Design of sterilization process, Down stream process and product recovery, Bioprocess control measurement and automation.

UNIT XIII: Medical Biotechnology: Chromosomal disorders, Chromosomal instability syndromes, Gene controlled diseases, Identification of disease genes, Molecular basis of human diseases - Pathogenic mutations , Gain of function mutations, Loss of function mutations, Gene Dosage Effect , Genomic Imprinting, Dynamic Mutations, Mitochondrial diseases, Prenatal diagnosis – invasive and Non invasive methods, Diagnosis using DNA/RNA/ protein based diagnosis, Therapy- Gene, stem cell, tissue engineering, Nanomedicine, Gene products in medicine.

UNIT XIV: Animal Biotechnology : Culture media, sterilization, Development and maintenance of cell line, Cell hybridization, hybridoma and monoclonal antibodies production, In vitro culture and cryopreservation of germ cells and embryo, Stem cell – isolation and culture, Conventional and non conventional methods of animal Improvement, Development of Transgenic animal- methodology and Application.

UNIT XV: Agriculture Biotechnology: Introduction to totipotency of plant cells, Callus and suspension cultures, Micro propagation of ornamental, horticulture and forest plants, Somatic embryogenesis, embryo rescue, somaclonal variation, Production of commercially important compounds using plant cell culture techniques, Protoplast culture and fusion, somatic hybrids Development of transgenic plants – methods and applications, Biosafety issues.

UNIT XVI: Environmental Biotechnology : Plant, Animal and Microbial biomass, single cell proteins, probiotics and their applications, Biomass feed stocks to fermentations, Microbial production of fuels, polymers, Bioremediation and Bio-leaching, Sources of pollution and Environmental impact, Xenobiotics, Microbial leaching of ores, Biofertilizers and Biopesticides, Genetic Engineering in Environmental Biotechnology.