Bio-Technology

Unit 1

Cell Biology, Genetics and Molecular Biology.

1. Organisation of Prokaryotic and Eukaryotic cells, comparison of plant and animal cells, structure of cell membranes, cell walls, fungal and bacterial cell walls, cell permeability and different types of transport across membranes
2. Structure and functions of cell organelles, techniques of cell, fractionations, organisation of viruses, bacteria and fungi. Microtubules, cilia, flagella and cuticles, receptors, ligands and messengers, cell communication and junction between cells, cell adhesion.
3. Structure of nuclear components/organisation of prokaryote and eukaryote chromosomes, hetero and euchromatin, introns, exons, transcription, replication and cell cycle mechanisms, mutations , transposons, abnormalities in chromosomes, mutagens
4. Oncogenes, Tumor inducers and suppressers, induction of Cancers, role of viruses in carcinogenesis, apoptosis, aging and senescence, Ras, Raf, MAP Kinase and JAK/STAT pathway
5. Theories of genetics and heredity, Laws, punnett square, dosage compensation, sex determination, alleles Epistasis and epigenetics, mitochondria and chloroplast genes. Karyotyping, pedigree analysis and application linkage and crossing over, polyploidy, mosaicism
6. Gene mapping – (Fist, deletion mapping, hybridisation experiments) DNA Sequencing molecular markers for mapping, mapping of bacterial genomes by conjugation, cuterrupted mating, transformation etc, genetics of drosophila
7. Population genetics – Natural selection, Hadry – weigberglw of generic drift, migration, molecular evolution and specification, molecular clock, punctuated equilibrium.
8. Error in DNA replication, repair mechanism SOS repair, proteins, enzymes and processing involved in DNA repair, DNA recombination, effects of mutation, control of cell cycles – cyclin dependant kinases, types and function of polymerases, reverse transcriptases telomeres and telomerases,
9. Mechanism and process of gene expression transcription, post transcription processing, translation , post –translational modification, chaperones and functional proteins, regulation of protein synthesis, structure of ribosomes,
10. Genomes of and proteins, oncogenes, operon systems, Avery –McCarty, MCLeod, Hershy – chase, Frnklin-Conrat Experiments, Watson & Crick and Hoogsteen base pairing, supercoiled DNA

Unit 2

Biochemistry, Enzymology and Biophysics and Instrumentation

1. Structure, classification and properties of carbohydrates, proteins, Lipids and Nuclearic acids
2. Metabolism of carbohydrate – glycolysis, TC A cycles, gluconeogenesis, pentose phosphate pathway, glycogenesis and glycogenolysis, Biosynthesis of glucose, starch and glycogen, photosynthesis.

3. Metabolism of Proteins. – Digestion and absorption, biosysnthesis and degradation, urea cycle, metabolism of nucleosides and nucleotide biosynthesis (including ATP,NAD, NADP, FAD and creatin phosphate), Metabolism of Lipids, Beta-oxidation, Ketone bodies, Biosynthesis of lipids.
4. Muscle physiology, generation and transmission of nerve impulses, photo chemical reactions, photosynthesis
5. Classification of enzymes, active sites, co-enzymes, co-factors, mechanism of catalysis, Michaelis –Menten constant, Lineweaver- Burke plot, Eadie-Hoft see plot, scatchard plot, factors affecting activity.
6. Types of enzymes inhibitation, feedback and ping –pong mechanism. Regulators of enzyme activity, Zymogens and Isozymes. Enzyme technology – Techniques involved in enzyme immobilisation and their application, biosensors, enzymes in therapeutics, Synzymes, Enzyme engineering, isolation of enzymes, criteria for purity
7. Bioenergetics, principles of thermodynamics, physico-chemical molecular interaction, polar and non-polar molecules, role of ATP, GTP, creatin phosphate in biological energy transfer.
8. Electromagnetic spectrum, bio-receptions of radions, Biophysics of vision, and photosynthesis.
9. Beer- Lambert Law, Spectrophotometers, spectroscopy – mass and NMR spectroscopy, X-ray diffraction, Principles and application of different types of chromatography (Adsorption, Paper TLC, GC , ion exchange, affinity, partition gel permeation chromatography, HPLC and GC, Flow cytometry
10. Principles and application of centrifugation, pH meter, application of radio-isotopes in research, diagnostics and therapeutics.

Unit 3

Microbiology, Immunology, Pharmaceutical Biotechnology

1. Characteristic features, ultra structure and classification of (including molecular taxanomy) of bacteria, fungi, algae, protozoa and viruses.
2. Microbial culture, nutrition and growth kinetics of microbes
3. Human microbe interaction, control of micro organism – Physical and chemical methods, disinfectants, Antibiotics and Antibiosis.
4. History and Scope of Immunology, Types of immunity, Antigen and Antibody interaction. Structure/types and function of immunoglobulins, T & B Cell differentiation.
5. Antigen recognition, activation of macrophages, cytokines, interleukins, HLA in human health, transplantation, Tumor immunology
6. Autoimmune disorder, vaccine development, immune diagnostics (ELISA, RIA, Immuno electrophoresis, immuno diffusion, Blotting Techniques)
7. Hybridoma technology, mono and polyclonal antibody production
8. Principles of phamacokinetics, drug-reception interaction dose-response curves, agonist and antagonist, reception driving interaction
9. Drug delivery, absorption/metabolism and excretion.
10. Pharmacogenomics, synthetic drugs, computer aided drug designing, major enzymes involved drug metabolism toxicity analysis.

11. Drugs from natural sources – nutraceuticals, drugs and medicines produced by biotechnology (Humulin, alteplase, Hep-B Vaccine, Human growth Hormone etc.)

Unit 4

Genetic Engineering, Plant and Animal Bio Technology, Biosafety, Bioethics and Regulation

1. Molecular tools in genetic engineering – vectors, restriction nucleases, ligases, DNA Modifying enzymes polymerases, Blunt and sticky – end DNA DNA adapters, restriction sites RFLP, cDNA and reverse transcription, (PCR types and application)
2. DNA Libraries gene cloning, recombination DNA and expression of recombinant proteins, chromosome, and DNA Sequence analyses, methods of sequencing DNA Fingerprinting, principles and application, site directed mutagenesis, knock outs and knock in
3. Application of genetic engineering – recombinant protein, forensic and health science, in agriculture and animal husbandry, diagnostics and gene therapy, molecular markers and reporters AFLP,STS,EST, GFP
4. Animal Cell culture – Techniques of isolation of cells, primary and secondary culture, establishment of cell lines, cell viability cytotoxity, nutrients and culture media, contact inhibition
5. Stem cells – types and applications, animal cloning, therapeutic cloning, micromanipulation transgenic animals – development and uses, ethical issues, cancer cells and cell lines, Bioreactors for animal cells.
6. Plant tissue culture – media – Techniques for mircropropagation, callus, induction of shoot and root – organogenesis – hardening – application in agriculture, cells suspension culture, embryo culture and rescue
7. Somatic hybridization, cybrids, protoplast fusion, somaclonal variants, anther and pollen culture, selection and development of plants for agriculture
8. Genetic Engineering in plants – role of vectors and mutants – Shuttle vectors, Agrobacerium and T1 Plasmid, Secondary metabolites and their uses, chloroplast transformation.
9. Good manufacturing practice, safety means in laboratory, Hazards in Laboratory practices. Bio hazards and risks of handling microbes and genetically altered organisms, Biosafety cabinets and LAF Chamber, First aid,
10. Bioethics and ethical issues in genetic engineering plant and animal bio technology, increase of transgenic organisms, gene therapy, cloning , prenatal testing, eugenics, therapeutic cloning

UNIT 5

<u>Bioinformatics, Biostatistics Bioinformatics and computational biology, IPR , Patent laws in Biotechnology</u>

1. Algebra of complex numbers, geometrical representation, arguments of complex numbers, cube roots of unity, Logarithm, Arithmetic and geometric progression, Quadratic equation, Binomial expression, Permutation and combination
2. Basic Concepts of co-ordinate geometry, Cartesian, co-ordinate, LOCI, Circles, SET Theory, Trigonometry, calculus

3. Principles of Biostatistics – Sampling techniques, mean – Median and mode standard deviation and standard error, normal binomial and poison distribution, probability
4. Bar diagram, Pie charts, Histogram, frequency curves , tents of significance – T test, Chi-Square correlation and regression analysis
5. Basics of computers – MS.DOS, Windows, Linux, algorithm and Programming binary language, programming and machine languages C++ and Perl, Biological database, uses of internet
6. History and development of Bio information, application of Bioinformatics tools and software in bioinformatics sequence analyser and interpretation, structure prediction and applications
7. Structural Genomics- sequence analysis, gene finder, Human genome project
8. Intellectual property and IPR, Origin of IPR invention and discoveries, Criteria of patenting, copyrights, copy left, trademarks, geographical indicators.
9. Patenting of natural materials, products, patent ability of living organisms and genetically modified organism and plant breeders and farmers right, Licensing and protection of patenting rights.
10. Types of patents, patent laws, WTO patents advantages and disadvantages of patenting, impact on third world counties, ethics of imposing patents.

UNIT 6

Environmental Biotechnology Food and Diary Biotechnology, Bio Process Engineering, Nano bio Technology, Environmental microbiology

1. Scope of environmental biotechnology, role of pollutants and human activities in environmental degradation, pollution of air/water and land, types of pollution, impact of pollution and environmental degradation on man and nature, role of industries, BOD, COD
2. Water and waste water management, characteristic of water quality, organism, Inorganic solid and biological components of water bodies, Treatment of waste water activated sludge, fluidized beds & fillers role of microbes in waste water management.
3. Biodegradation and bioremediation – mechanism and process involved, degradation process of organic and inorganic compounds, dyes and microbial pollutants, Techniques of bioremediation use of beneficial microbes, biostimulation and bioaugmentation , uses of GMOs, remediation of polluted air, types of filler
4. Application of biotechnology in food processing, modifying enzymes – amylases, proteases, lipases, flavours and coloring agents, food preservation
5. Process involved in bowing, canning, sterilization, pasteurization and packing of foods, quality assessment and preservation, analysis of microbial content in milk, use of microbes in producing dairy products such as Cheese, butter, Yoghurt curd and other value added products
6. Microbial products from starch, processing of meat, value addition of foods using microbes, fermented food and beverages
7. Designs and requirements in Bioreactors, methods of sterilisation of fermentors, sensors and devices for maintaining ideal culture condition, control of growth characteristic, media formulation, preparation of inoculum, scale up of cultures

8. Types of reactors, stirred tank, airlift , fluidised bed, packed bed, batch, fed batcher, downstream processing to isolate products of interest, disposal of effluents, products of antibiotics, enzymes, organic acids, bioplastics alcohol, wine, SCP
9. Scope of nano biotechnology, biochips, microarrays implants and scaffolds for tissue regeneration, nano bioscience in pharmaceuticals, sunscreens and drug and gene delivery systems, characteristics of nano structures, composites, nanotubes and nanofibres, building blocks and templates.
10. Bio pesticides, Biofilms, Biogeotechnology, microbial enhancement of soil fertility, role of microbesin bio-geo cycles, nano-fertilizers.