DURESET-2015
BIOTECHNOLOGY SYLLABUS

UNIT – I

Chemistry of carbohydrates – Definition and classification of carbohydrates. Outlines of structures of important mono di, and polysaccharides. Chemical reactions of sugars and carbohydrates.

Chemistry of proteins – classification of amino acids and proteins, structures of amino acids, chemical reaction of amino acids and proteins. Peptide bond. Composition and sequence of amino acids of proteins. Structural organization of proteins. Classification of Enzymes, and animal hormones (insulin and human growth hormone). Outline structures and biological functions of auxins, gibberellins, cytokines and abscisic acid.

Chemistry of Nucleic acids – structure of purines and pyrimidines, modified bases nucleosides and nucleotides; structural polymorphism of DNA and RNA types. Identification of DNA and RNA molecules.

Chemistry of lipids – classification of lipids, outline structures of saturated and unsaturated fatty acids, fats and waxes, phospholipids and glycolipids, cholesterol, prostaglandins. Outline structures and biological functions of penicillin, vincristine, lignin, cinamic acid, linalol.

UNIT – II

Characterization of biological macromolecules, Hydrodynamic properties of biomolecules – viscosity, diffusion, osmosis and Donnan effect. Buffers and measurement of pH and pKa.

Microscopy – light, phase contrast, fluorescent and electron microscopy. Preparation of specimen for microscopy. Centrifugation – preparative and analytical centrifuges, rotors, rate-zonal and equilibrium density gradient centrifugation. Isolation of cell organelles.

Chromatography – paper, thin layer, gas-liquid, HPLC, molecular sieve and affinity chromatography techniques. Electrophoresis – types of electrophoresis, paper and gel (starch, acryl amide and agarose) electrophoresis, SDS-PAGE, gradient gel electrophoresis, 2-D PAGE, Isoelectric focusing, pulse field and field inversion electrophoresis, immuno–electrophoreis, blotting techniques.

Spectroscopy – Electromagnetic spectrum of light, simple theory of absorption of light by molecules, Beer-Lambert law, types of detectors. UV – visible spectrophotomety, infrared spectroscopy, Raman spectroscopy, flame photometry, atomic absorption, ESR and NMR spectrophotometry. Mass spectroscopy, X-ray diffraction and X-ray crystallography.

UNIT – III

Organization of prokaryotic and eukaryotic cell. Plasma membrane – molecular organization, current model and function. Cytoskeleton – microtubules, cilia and flagella, Structure and function of cytoskeleton. Structure and function of endoplasmic reticulum Golgi apparatus, lysomes, peroxisomes.

Structure and functions of mitochondria and chloroplast Nucleus – structure and function of nuclear membrance, nucleolus, structure and role of ribosomes. Eukaryotic chromosome – chromatin, its chemical nature, nucleosome structure, polytene and lamp brush chromosomes.

Mechanism of cell division – mitiotic apparatus, cytokinesis, chromosome movement. Regulation of eukaryotic cell cycle. Mutation causing cell cycle control. Meiotic process – stages, chromosome pairing, chiasma formation molecular mechanisms of recombination, synaptonemal complex.

UNIT – IV

Identification of genetic material as DNA or RNA. Organization of genetic material in prokaryotes and eukaryotes; chromosomes and types, molecular organization of DNA and histone proteins.

Classical genetics – Mendelian Laws of inheritance, variability and inheritance. Linkage and crossing over, genetics of sex chromosomes, chromosomal aberrations.

Replication of DNA – models for replication of DNA, molecular mechanism of replication, enzymology of replication, DNA replication and reverse transcriptase. DNA damage and repair mechanisms.
Mutagenesis – Types of mutations, mutagens, molecular mechanism of mutations, spontaneous and induced mutation, isolation and analysis of mutants, reversion, suppression, role of mutagenesis in evolution and in improving the beneficial organisms.

Transcription – types of RNA and their role, mechanisms of transcription of prokaryotes and eukaryotes, RNA polymerases, introns and exons, biosynthesis and processing of different RNAs. Promoters and enhancers and factors affecting transcription.

Translation – central dogma theory and flow of genetic information, genetic code and its elucidation, wobble hypothesis, structure and composition of prokaryotic and eukaryotic ribosomes, structures of mRNA and rRNA, events of protein synthesis in prokaryotes and eukaryotes, post-translation modification of proteins, inhibitors of translation.

UNIT – V

Environmental Pollution: Types of pollution, Methods for the measurement of pollution; Methodology of environmental management - the problem solving approach, its limitations. Biomass measurement: Biochemical, molecular approaches for the measurement of density, diversity and phylogeny. Environmental monitoring using Biosensors. Air pollution and its control through Biotechnology- biofilters, bioscrubbers, biotrickling filters.
Water Pollution and its Control: Water as a scarce natural resource, Need for water management, Measurement of water pollution, sources of water pollution, Waste water collection, Waste water treatment - Physical, chemical and biological treatment processes. Microbiology of Waste Water Treatments, Aerobic Process: Activated sludge Oxidation ditches, trickling filter, rotating discs, rotating drums, oxidation ponds, Anaerobic Processes: Anaerobic digestion, anaerobic filters. Up flow anaerobic sludge blanket reactors. Treatment schemes for waste waters of dairy, distillery, sugar, antibiotic, paper and petroleum industries. Use of immobilize enzymes for waste water treatment.

Biofuels, biogas, Hydrogen, methane as natural fuels, Microbial groups involved in biogas production and interactions among them. Factors affecting biogas production, Design of digestors, feed stock, uses of spent slurry. Biodiversity- levels of biodiversity, reasons for loss of biodiversity, Biodiversity Conservation (in-situ & ex-situ) Role of biotechnology in conservation of biodiversity, Influence of transgenic plants on environment, Global Environmental Problems: Ozone depletion, UV-B, green - house effect and acid rain, their impact and biotechnological approaches for management. Environmental Safety guidelines and role of biotechnology in biodiversity conservation. Biofertilizers - Rhizobium, Azotobacter, Azospirillum, Vesicular - Arbuscular Mycorrhizal fungi, Azolla, blue green algae Biopesticides, Vermiculture.

UNIT – VI

Phycology: Classification of Algae; Cell ultra structure; general characters; Algae in diverse habitats (Terrestrial, Fresh water, Marine water And In Association); Thallus organization (Range of thallus structure and interactions in evolution of different groups: Cyanophyceae, Xanthophyceae, Bacellariophyceae, Phaeophyceae & Rhodophyceae); Pigmentation and Reserve food; Reproduction (Vegetative, Asexual & Sexual); Economic importance of Algae (Algal blooms, Algal Biofertilisers, Algae as food, Feed and Medicines; Algae in Industry; Algae as Biodiesel; Single cell protein.

Bryophytes: Origin, Distribution, Morphology, Structure, Reproduction and Evolution of Sporophyte; Life History, Classification. Fossil Bryophytes. General account of Marchantiales, Jungermaniales and Polytrichales; Economic and Ecological importance. Lichens: Types of Lichens, Anatomy, Biology and Ecological importance.

Pteridophytes: Origin, Morphology, Anatomy and Reproduction; Classification and Evolution of Stele. Heterospory and Origin of Seed habit; Apogamy and Apospory; Ecological importance, chemical factors controlling Gametophyte; Antheridia, Archegonia. Strobilus and Evolution of Sorus.
Fossil Pteridophytes: Introduction to Psilophytopsida, Psilopsida, Lycopsida, Sphanopsida and Pteropsida.

Gymnosperms: Introduction, Classification and Distribution of Gymnosperms. Structure and Reproduction in Cycadales, Ginkgoales, Coniferales, Ephedrales, Welwitschiales, and Gnetales. Evolution of Gymnosperms.

UNIT – VII

Invertebrata: Evolutionary time scale, Eras, Periods & Epoch - major events.
Species concept, International code of Zoological nomenclature, Taxonomical procedures, New Trends in taxonomy.
Patterns of feeding and digestion in lower metazoans: Holozoic nutrition , Pinocytosis, Saprozoic Nutrition, Myxotrophic nutrition, Nutrition of parasites.
Feeding in Polychaeta, Mollusca, Echinodermata.

Invertebrata: Acoelomata, Pseudocoelomata, Coelomata,Proterostomia and Dueterostomia.
Structure of Gill, lungs, trachea and Mechanism of Respiration.Circulatory system in Annelids, Arthropods & Molluscs.
Advanced nervous system- Annelida, Arthropoda and Mollusca.

Larval forms of Crustaceans: Larval forms: Nauplius, Metanauplius, Protozoea, Zoaea, Cypris, Mysis, Megalopa, Phyllosoma, Alima, Significance of larval forms;
Larval forms of Echinodermata: Asteroidea Bipinnaria Larva, Ophiuroidea, Echinoidea, Holothuroidea, Crinoidea Doliolaria Larva, Significance of Echinoderm larval forms.

Anatomy: Vertebrate integument and derivatives: - Skin structure and functions - glands, scales, horns, claws, nails, hoofs, feathers and hair.
Comparative anatomy of heart: - Types - structure- blood circulation-aortic arches and portal system.
Comparative anatomy of reproductive system: - Organs of male reproductive system – organs of female reproductive system –functions.
Comparative account of excretory system.

Organs: Comparative anatomy of respiratory organs: - Gills, trachea and lungs – types-structure- mechanism of respiration.
Comparative anatomy of brain and spinal cord: - structure, composition and functions
Organs of vision: structure of eye in different phyla - mechanism of vision, Photoreceptors-fishes, Amphibians, Reptiles, Birds and Mammals.
Organs of Gustatory hearing and tactile responses: - Structure of hearing organs in different Phyla - mechanism of hearing - tactile organs.

UNIT – VIII

Discovering the microbial world. Classification of micro organisms up to order lever – bacteria, algae, fungi, protozoa. Structure of prokaryotic and eukaryotic microorganisms. General and distinctive characteristics of the major groups of microorganism – bacteria, mycoplasma, chalmidae, rickettsias, actionomycetes, fungi, algae, protozoa and viruses. Outlines of characterization and identification of common bacteria, fungi, algae and protozoa.

Nutritional requirements to microorganisms – mode of nutrition – phototrophy, chemotrophy – methylotryphy, organotrophy, mixotrophy, saprophytic, symbiotic and parasitic, Interaction of microbes. Sampling, Isolation, enumeration and maintenance of cultures. Growth of microorganism (bacteria) – normal and biphasic growth curve, batch and continuous cultures, chemostates, shift up and shift down. Growth determination. Microbial metabolism – energy yielding and energy requiring processes.

Control of microorganisms – principles, physical and chemical agents, assay of antimicrobial action. Batch and continuous sterilization of media and air.

Viruses – nature, cultivation and assay methods, structure, physicochemical properties, classification, pathogenicity, replication of viruses. Biotechnological importance of – E.coli, Spirullina, Saccharomyces cerevisiae and baculovirus

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