

AURCET - 2013 SYLLABUS
TEST No. – 3, BIOTECHNOLOGY - PAPER

1: CELL BIOLOGY

Structure of typical bacterial, plant and animal cells and functions of cell organelles, cell division, cell cycle check points and their role in cell cycle regulation. Classification, structure, properties, functions of Biomolecules-carbohydrates, lipids, aminoacids, proteins, nucleic acids and vitamins. Cytoskeletal elements. Cell – cell interaction. Mitochondria - structure, biogenesis and enzymatic compartmentation. respiratory chain, mechanism of oxidative phosphorylation. Ultrastructure of the chloroplast. Photosynthesis - photophosphorylation. Electron transport, Transport processes - Genetics: Transcription, translation., Genotype and phenotype, Mendel's experiments, Dominance relationships, Types of mutations, Multiple alleles, Pedigree analysis

2: BIOMOLECULES

Laws of thermodynamics, concepts of free energy, entropy and enthalpy. Activation energy, rate of reaction, order of reaction and factors influencing the rate of a reaction. Properties and importance of water, intra and intermolecular forces, and bonding,. Disulphide bridges. pH, pK, acid base reactions and buffers. Physiological role structure and function of biomolecules: Lipids, Carbohydrates, Enzymes, Proteins, Deoxyribonucleic acids, Ribonucleic acids, Cholesterol, haemoglobin, and hormones.

Types of RNA and covalent structure of t-RNA. Classification, structure and physiological roles of Vitamins. MicroRNAs. Hormones- action of steroid and protein hormones. Signal transduction Cascade by cyclic AMP, Phosphoinositide and calcium (Ca^+), Calmodulin, G- proteins. Phytohormones and their physiological roles.

Classification of bacteria, bacterial reproduction and growth Clinically important bacteria. classification of bacteriophages, plasmids. Extra chromosomal inheritance.

Clinically important viruses, retroviruses, HIV, Hepatitis B Virus and viral infections. Economic importance of algae and fungi. Recombination in prokaryotes,. Regulation of gene expression - The operon concept, lac & trp operons.

3. ANALYTICAL TOOLS AND TECHNIQUES IN BIOTECHNOLOGY

Techniques of chromatography, electrophoresis, centrifugation, spectroscopy and microscopy. Radio labelling techniques. Southern Blotting, Northern Blotting techniques.

Scanning and transmission electron microscopy. Applications of UV, visible, infrared, ORD, CD, NMR spectroscopy. Spectrofluorimetry and mass spectrometry, X-ray diffraction. Flow cytometry. Principles and applications of PCR and RFLP/ SSCP; gel-filtration, ion-exchange and affinity chromatography. TLC, GLC and HPLC. Basic principles of sedimentation. Applications of preparative and analytical ultra centrifuges.

Colony and Fluorescent in situ hybridization, Nucleic acid probes and probe construction. DNA micro array technology. Immunodiffusion, Immunoelectrophoresis and Antibody generation, detection of molecules using ELISA, RIA, Western blot, immunoprecipitation, flowcytometry and immunofluorescence microscopy, detection of molecules in living cells, in situ localization by techniques such as FISH and GISH

4. ENZYMOLOGY & METABOLISM

Nomenclature and classification of Enzymes. Factors affecting enzyme activity, Temperature, pH, substrate concentration. Enzyme inhibition, Coenzymes, metalloenzymes, allosteric enzymes, and isoenzymes. Methods for measurement of k_m and V_{max} .

Metabolic pathways and disorders of carbohydrates, lipids, amino acids, proteins and nucleic acids and vitamins. Glycolysis, Glycogenolysis, glycogenesis, gluconeogenesis, Biosynthesis of Heme and chlorophylls. Inborn errors of amino acid metabolism.

5. MOLECULAR BIOLOGY

Organization of genetic material - DNA replication – apparatus, enzymes (polymerases) involved and mechanism. DNA damage and repair mechanism. Mitochondrial & plastid genomes Mechanism of transcription, transcription factors, Maturation and processing of m-RNA, splicing, 5' end capping & 3' end tailing. RNA editing and transport. RNAi and small RNAs. Translation in prokaryotes and eukaryotes: Genetic code - properties of the genetic code, deciphering of the genetic code. Ribosome as a translation factory. Post translational modifications. DNA methylation and gene expression

6. BIOLOGY OF IMMUNE SYSTEM

Types of immunity. Organisation and structure of lymphoid organs – bone marrow, thymus, spleen and lymphnodes. Cells of the immune system – structure and function. Macrophages. Types of cell mediated immunity and lymphokine activated killer cells. Clonal nature of immune response, Immunological memory. Immuno regulation. Adjuvants and immunological tolerance.

Nature of antigens and antibodies. Isotypes, Allotypes and Idiotypes. Antigen – antibody interactions. Major Histocompatibility Complex (MHC). Human leukocyte antigens (HLA), MHC restriction and typing. Lymphokines, effector cell mechanisms, genetic control of immune response. Complement system.

7. MEDICAL BIOTECHNOLOGY

Cancer-Genetic rearrangements in progenitor cells, oncogenes, tumor suppressor genes, cancer and the cell cycle, metastasis, interaction of cancer cells with normal cells, apoptosis, therapeutic interventions of uncontrolled cell growth. Cellular communication-Regulation of hematopoiesis, general principles of cell communication, cell adhesion and roles of different adhesion molecules, gap junctions, extracellular matrix, integrins, neurotransmission and its regulation. Cell signaling-Hormones and their receptors, cell surface receptor, signaling through Gprotein coupled receptors, signal transduction pathways, second messengers, regulation of signaling pathways. Mutations. Mendelian genetics in Humans and pedigree analysis. Hardy-Weinburg law in genetic analysis.

8. BIOINFORMATICS AND BIOSTATISTICS

Computers in biological research.. Organization, languages, binary number system. The soft side of the computer – Different operating systems – Windows, Linux. Perl, programming in C. Biological databases. Types of data bases – Gen bank, Swiss port, EMBL, NCBL, and PDB. Database searching using BLAST and FASTA. Multiple sequence alignment and Dynamic programming. Gene and Genome annotation – Tools used. Physical map of genomes. Molecular phylogeny - Concept methods of tree construction. Protein secondary structure prediction. Protein 3D structure prediction. Protein docking. Introduction to homology modeling, Computer Aided Drug Design (CADD) in Drug discovery..

Statistics:Computational methods employed in Biology- Mean, Median, Mode, Range, Standard deviation, Variance, ANOVA, F & t-test, Chi square test, Correlation and Linear Regression analysis. Nucleic acid and protein sequence databases; data mining methods for sequence analysis, web-based tools for sequence searches, motif analysis and presentation. SPSS software