Entrance Syllabus
for
3 Year Integrated Ph.D Programme in Biotechnology 2016

Cell Biology:

Biomolecules:

Microbiology:

Metabolism:
Lipid Metabolism: oxidation of fatty acids, Even, odd & unsaturated. Formation of ketone bodies and their oxidation. Biosynthesis of saturated fatty acids and prostaglandins. Regulation of lipid metabolism. Metabolism of circulatory lipids, Chylomicrons, LDL, HDL & VLDL.

Protein & Nucleic acid metabolism: General reactions in amino acid degradation, deamination and transamination reactions, Urea cycle, regulation of amino acid metabolism. Inborn errors of metabolism glycine, phenylalanine and Tyrosine Degradation and biosynthesis of Purine and pyrimidine nucleotides, Inter conversion and regulation of their biosynthesis Biological oxidation: electron transport chain, oxidative phosphorylation, uncouplers of oxidative phosphorylation.

**Bio techniques and Biostatics:**
Basic principles of centrifugation, types of centrifugation differential centrifugation density gradient centrifugation and material used for making density gradient. Materials used for making rotors of centrifuges. Ultra centrifugation and its applications for characterization of biomolecules (sedimentation equilibrium and sedimentation velocity method).

Basic principles & types of electrophoresis, Agarose gel electrophoresis, PAGE, SDS_PAGE and isoelectric focusing.


Brief description and tabulation of data & its graphical representation. Measures of central tendency & dispersion: mean, median, mode range, standard deviation, variance. Idea of two types of errors and level of significance, test of significance (F & t-test), Chi-square test. Simple linear regression and correlation.

**Molecular Biology**

Messenger RNA biosynthesis in prokaryotes-RNA polymerase and promoter specificity, initiation, elongation and termination of transcription. Transcriptional repression and de-repression, operon concept (Lac), complexity in regulation (Arabinose) and attenuation (Trp, His, Leu). Organization of lambda DNA and anti-termination.

Eukaryotic transcription, RNA polymerase, general and specific transcription factors, regulatory elements and mechanism of transcription regulation. RNA processing and stability, splicing, capping, polyadenylation and their effect on stability. Ribozyme technology.

Enzymology


Classification of multi substrate reactions with examples of each class. Kinetics of multi substrate reactions. Derivation of rate expression for ping-pong & ordered Bi -Bi reaction mechanism. Use of initial velocity, inhibition and exchange studies to differentiate between multi substrate reaction mechanism. Methods of examining enzymes-complex’s, trapping E-S Complex, Use of substrate analogs, chemical modifications and protease treatment, Site directed mutagenesis & effect of changing pH. Flexibility & conformational mobility of enzymes

Determination of rate constant for enzymes catalyzed reactions, Protein – Ligand binding including measurement, analysis of binding isotherm. Cooperatively phenomenon. Hill and Scatchard plots Allosteric enzymes, sigmodal kinetics and their physiological significance.

Symmetric and sequential modes for action of allosteric enzymes and their significance


Immunology:


Major histocompatibility complex BCR & TCR generation of diversity Complement system Cells of immune system, Macrophages, Dendritic cells, Natural killer cells and Lymphokine activated killer cells, Eosinophils, Neutrophils and Mast cells

Antigen processing, processing, generation of Humoral and cell mediated Immune response. Activation of B & T lymphocytes. Cytokines and their role in immune regulation. Immunological tolerance Cell mediated cytotoxicity, Mechanism ofT-cell & NK- cell mediated lysis. Antibody dependent cell mediated cytotoxicity, Macrophages mediated cytotoxicity Hypersensitivity Autoimmunity

Transplantation. Tumor Immunology AIDS and other Immunodeficiency Hybridoma Technology and Monoclonal Antibodies


Cell transformation: Properties of transformed cells. Immortalization and methods used to immortalize cells. Measurements of viability and cytotoxicity assay: Trypan blue, MTT, TUNNEL and ELISA based assays. Cell culture based vaccines: Subunit vaccines, peptide vaccines, recombinant vaccines, genetic vaccines and attenuated vaccines
Three dimensional cultures: Spheroid culturing techniques. Tissue engineering: Design criterion for tissue engineering Organ and Histotypic cultures: Advantages and limitations, factors affecting their growth. Stem Cell Culturing: Embryonic stem cells, Adult stem cells and their applications

**Genetic engineering:**
Source DNA/RNA for recombination technology: Genomic and plasmid DNA extraction, purification and analysis (agarose gel and absorbance). Total RNA isolation and m-RNA enrichment and determination of RNA purity. Gene cloning vectors: plasmids, Bacteriophages, phagemids, cosmids, YACs and BACs. Cloning of foreign DNA, klenow filling, ligation (blunt end and cohesive end), transformation and screening of recombinant vectors. Confirmation of the insert size and validation of orientation. Molecular tools and their application: restriction modification system 1, isocaudomers and isoschizomers. Restriction mapping of DNA fragments and map construction. RFLP.
Transcriptomics (Microarray), proteomics. Methodology and application. Site directed mutagenesis and protein engineering. Techniques for the study of gene expression:
Gene silencing technologies: anti-sense RNA, RNA caging, SiRNA.

**Plant Biotechnology**
Introduction to cell and tissue culture: Totipotency of Plant cells Tissue culture media (Composition & preparation) somatic embryogenesis, Synthetic seeds Micropropagation techniques. Protoplast isolation, Culture and fusion; Selection of hybrid cells and regeneration of hybrid plants; Symmetric & Asymmetric hybrids, Cybrids
Molecular mapping, Introduction to genetic and physical maps, physical mapping
Plant Transformation Technology; Basis of tumor formation, features of Ti Plasmids, Mechanism of T-DNA transfer, Role of Virulence gene, Use of TI Vectors, Binary vectors, use of 35S and other promoters, use of reporter genes and selectable markers, Excision of markers, Methods of nuclear transformation , Viral vectors and their applications, Multiple gene transfer; Vector less or direct DNA transfer (Particle bombardment, Electroporation, Microinjection). Transformation of monocots. Transgene Stability Application of plant transformation for productivity and performance with special example of herbicide resistance, disease resistance, long shelf fruit and flowers, Stress tolerance (water deficit stress and Oxidative stress)

**Bioprocess Engineering:**

Types of fermentation process: analysis of batch, fed-batch and continuous bioreactions, stability of microbial reactors, analysis of mixed microbial populations, specialized bioreactors (pulsed, fluidized, photo bioreactors etc). Measurement and control of bioprocess parameters.
