

SYLLABUS FOR PH. D. ENTRANCE 2025

1.

Plant Biotechnology

Introduction to tissue culture, cell culture, meristem culture, somatic hybridization, production of haploids, germplasm conservation.

Plant transformation technology (vector mediated and vectorless), vectors and their applications, reporter genes, selectable and scorable markers, applications of genetic transformation, bar and barnase system, transgene stability

Chloroplast transformation, edible vaccines, Plant secondary metabolites, terminator gene technology, gene silencing, therapeutic proteins

Molecular markers, QTL mapping, Marker aided breeding, markers assisted selection, chromosome walking, Map based cloning

Genetics

Mendelian genetics, linkage and recombination, genetic system of Neurospora, Bacterial genetic system, gene tagging, gene mapping, restriction mapping, reverse genetics

Genetic fine structure, mutations and their molecular basis, DNA repair, transposons, mechanism of transposition, retrotransposons, transposable elements in eukaryotes and prokaryotes, transposon tagging

Human genetics, Role of genetics in medicine, Single gene inheritance, Multiple alleles, X-linked inheritance, Sex influenced pattern, Hemoglobinopathies

Cell division and errors. Structural and numerical abnormalities. Sex determination, Genetic recombination, FISH, GISH and Comparative genomic hybridization.

Biochemistry and Metabolism

Carbohydrates, their structure and metabolic pathways, glycogenesis, Krebs cycle, gluconeogenesis, pentose phosphate pathway, Photosynthesis, its pathways and regulations, ATP cycle and its regulations, Electron transport chain, chemiosmotic theory

Proteins, their structure and metabolism, biosynthesis of essential proteins, allosteric regulation, their degradation to TCA cycle, glucogenic and ketogenic amino acid metabolism, Urea cycle and inborn errors of amino acid metabolism

Major classes of lipids and their role, Biosynthesis of even and odd chain fatty acids, saturated and unsaturated fatty acids, prostaglandins and cholesterol, ketogenesis and its regulation

Structure of DNA and RNA, metabolism of purines and pyrimidines, purine salvage pathway, purine and pyrimidine biosynthesis, feedback control and genetic disorders

Immunology

Innate and acquired immunity-Clonal nature of immune response, Cells of the immune system: Hematopoiesis and differentiation, Nature and Biology of antigens and super antigens. Antibody structure, types and function, Antigen-antibody interactions, BCR & TCR, generation of diversity

Regulation of immune response-Antigen processing and presentation, generation of humoral and cell mediated immune responses, Complement system: Complement fixing antibodies and complement cascade, cytokines and their role in immune regulation, T-cell regulation, MHC molecules and restriction, Immunological tolerance

Hypersensitivity, Autoimmunity and auto immune disorders, Immunodeficiency disorders and their molecular mechanism, Transplantation immunology, Tumor immunology,

ELISA, RIA fluorescent IA, Agglutination and heamagglutination, Hybridoma Technology and Monoclonal antibodies application, Vaccines: Conventional vaccines, viral vaccines, peptide vaccines genetically engineered vaccines, interleukine therapy, overview of stem cell functions and its medical application

Molecular Biology and genetic Engineering

DNA as a genetic material, DNA structure and function: Physical and chemical structure of DNA, alternate forms of DNA A,B,Z; Alternate DNA structure, Elements and factors required for replication of core genome in eukaryotes, prokaryotes and viruses taking E. coli, yeast and phiX174 as models. Mechanism of transcription in prokaryotes: Elements and factors involved in prokaryotes; Promoter sequences and regulatory factors, Mechanism of transcription in Eukaryotes: Post transcriptional regulation: mRNA processing capping and polyadenylation splicing and editing, nucleo-cytoplasmic transport, mRNA stability and degradation, RNA as a regulatory molecule; RNAi and Antisense RNA;

Genetic Code: Universality and degeneracy of code and exceptions to code, Wobble hypothesis. Codon bias. Mechanism of translation in prokaryotes and Eukaryotes: Regulation of translation, co- and post translational modification of peptides, role of molecular chaperons.

Concept of cloning; gene centric cloning and genome centric cloning, restriction endonucleases. DNA, RNA ligases, kinases, terminal transferases, DN ases, DNA phosphates, polynucleotide kinases, Southern, Northern and Western blotting.

Polymerase chain reaction and nucleic acid amplification. Primer design, fidelity of thermostable enzymes; DNA polymerases Types of PCR-multiplex, nested, reverse transcriptase, real time PCR, touchdown PCR, hot start PCR, colony PCR, cloning of PCR products; T-vectors; proof reading enzymes, PCR in gene recombination. DNA sequencing; Chemical degradation and chain termination methods, automated sequencing methods, pyrosequencing: their applications. Site directed mutagenesis and protein engineering; methods strategies and application.

Cell Biology and Animal Biotechnology

Cellular organization

Membrane structure and function-Plasma membrane, cell walls, extra cellular matrix, cell-cell interactions,

Structural Organization and function of intracellular organelles-Nucleus, ER, Golgi complex, Lysosomes Mitochondria, Chloroplast, Peroxisomes, Actin filaments, microtubules, intermediate filaments,

CellSignalling: Signal molecules and receptors. Intercellular signal transduction, cell junctions, signal related hormones, protein kinases

Cancer-Types of cancer, causes, treatment, Oncogenes, Tumor suppressor genes, Tumor viruses Cell division and cell cycle-meiosis, mitosis, apoptosis, check points, cyclins and cyclin dependent kinases

Tissue culture techniques- Animal cell culture-cell separation, biology and characterization of cells, cell viability and toxicity, measuring parameter of growth, trypsinization, cryopreservation, manipulation of cultured cells and tissues

Enzymology and Bioprocess Engineering

Enzymes general characteristics, structure, nomenclature, classification, folding, unfolding

Mechanisms of enzyme based catalysis, Allosteric enzymes, role of enzymes in regulation of metabolism, kinetics of enzyme catalyzed reactions, enzyme-inhibition kinetics,

Enzyme technology: production purification and industrial applications of enzymes,

Concept of Fermentation and bioprocess, types of bioprocesses, Steps in development of bioprocess, microbial growth and product formation, design of media for bioprocess, design of sterilization, process scale up and scale down

Bioreactor types, design and operation, economics of bioprocess, process monitoring and control.

Bioprocess bases products: organics acids, antibiotics, SCP, amino acids, biofuel.

Principles of downstream processing, Effluent treatment and discharge, pollution load parameters: Fermentation bases food products, food safety and preservation, Hurdle technology, HACCP concept.

General and Applied Microbiology

Methods in microbiology, Microbial nutrition, growth and control, Prokaryotic cell structure and function, Eukaryotic cell structure and function, Prokaryotic diversity.

Methods in determining evolutionary relationships, Ribotyping and Ribosomal RNA sequencing, Microbial evolution, diversity and taxonomy, Metabolic diversity in prokaryotes, Nitrogen Fixation, Overview of Archaea and fungi.

Viruses: Discovery, classification, characteristics and structure, Viruses of prokaryotes and eukaryotes

Major microbial industrial products for health, food and beverage industry.

Overview of important microbial diseases in humans, antimicrobial chemotherapy.