



MGM INSTITUTE OF HEALTH SCIENCES

(Deemed University u/s 3 of UGC Act, 1956)

Grade 'A' Accredited by NAAC

PhD CET Syllabus

Paper II - Subject Specific Test Biotechnology

DNA replication, repair and recombination (Unit of replication, enzymes involved, replication origin and replication fork, fidelity of replication, extrachromosomal replicons, DNA damage and repair mechanisms, homologous and site-specific recombination).

RNA synthesis and processing (transcription factors and machinery, formation of initiation complex, transcription activator and repressor, RNA polymerases, capping, elongation, and termination, RNA processing, RNA editing, splicing, and polyadenylation, structure and function of different types of RNA, RNA transport).

Protein synthesis and processing (Ribosome, formation of initiation complex, initiation factors and their regulation, elongation and elongation factors, termination, genetic code, aminoacylation of tRNA, tRNA-identity, aminoacyl tRNA synthetase, and translational proof-reading, translational inhibitors, Post-translational modification of proteins)

Control of gene expression at transcription and translation level (regulating the expression of phages, viruses, prokaryotic and eukaryotic genes, role of chromatin in gene expression and gene silencing).

Conformation of nucleic acids (helix (A, B, Z), t-RNA, micro-RNA).

Principles of catalysis, enzymes and enzyme kinetics, enzyme regulation, mechanism of enzyme catalysis, isozymes

Genetics and Genetic Engineering

Mendelian principles: Dominance, segregation, independent assortment, Concept of gene : Allele, multiple alleles, pseudoallele, complementation tests

Gene mapping methods: Linkage maps, tetrad analysis, mapping with molecular markers, mapping by using somatic cell hybrids, development of mapping population in plants.

Extra chromosomal inheritance: Inheritance of Mitochondrial and chloroplast genes, maternal inheritance.

Microbial genetics: Methods of genetic transfers – transformation, conjugation, transduction.

Mutation: Types, causes and detection, mutant types – lethal, conditional, biochemical, loss of function, gain of function, germinal versus somatic mutants, insertional mutagenesis.

Structural and numerical alterations of chromosomes: Deletion, duplication, inversion, translocation, ploidy and their genetic implications.

Transgenic animals and plants, molecular approaches to diagnosis and strain identification, Genomics and its application to health and agriculture, including gene therapy

Expression of recombinant proteins using bacterial, animal and plant vectors. Isolation of specific nucleic acid sequences Generation of genomic and cDNA libraries in plasmid, phage, cosmid, BAC and YAC vectors. In vitro mutagenesis and deletion techniques, gene knock out in bacterial and eukaryotic organisms.

Immunology

Innate and adaptive immune system Cells and molecules involved in innate and adaptive immunity, antigens, antigenicity and immunogenicity. B and T cell epitopes, structure and function of antibody molecules. generation of antibody diversity, monoclonal antibodies, antibody engineering, antigen-antibody interactions, MHC molecules, antigen processing and presentation, activation and differentiation of B and T cells, B and T cell receptors, humoral and cell-mediated immune responses, primary and secondary immune modulation, the complement system, Toll-like receptors, cell-mediated effector functions, inflammation, hypersensitivity and autoimmunity, immune response during bacterial (tuberculosis), parasitic (malaria) and viral (HIV) infections, congenital and acquired immunodeficiencies, vaccines.

Host parasite interaction Recognition and entry processes of different pathogens like bacteria, viruses into animal and plant host cells, alteration of host cell behavior by pathogens, virus-induced cell transformation, pathogen-induced diseases in animals and plants, cell-cell fusion in both normal and abnormal cells.

Programmed cell death, aging and senescence and Cancer

Bioinformatics

Bioinformatics resources and search tools; Sequence and structure databases; Sequence analysis - sequence file formats, alignment, phylogeny; Genomics, proteomics, metabolomics;

Gene prediction; Functional annotation; Secondary structure and 3D structure prediction; Knowledge discovery in biochemical databases; Meta-genomics.

Animal tissue culture Plant tissue culture

Plants: Totipotency; Regeneration of plants; Plant growth regulators and elicitors; Tissue culture and cell suspension culture system - methodology, kinetics of growth and nutrient optimization; Production of secondary metabolites; Hairy root culture; Plant products of industrial importance; Artificial seeds;

Somaclonal variation; Protoplast, protoplast fusion - somatic hybrid and cybrid; Transgenic plants - direct and indirect methods of gene transfer techniques; Selection marker and reporter gene; Plastid transformation.

Animals: Culture media composition and growth conditions; Animal cell and tissue preservation; Anchorage and non-anchorage dependent cell culture; Kinetics of cell growth; Micro & macro-carrier culture; Hybridoma technology; Stem cell technology; Animal cloning; Transgenic animals; Knock-out and knock-in animals.

PHYSICO-CHEMICAL PRINCIPLES OF LAB TECHNIQUES used in Biotechnology

Chromatography: Gel Filtration chromatography, TLC/Gas chromatography, Ion exchange and Affinity chromatography.

Spectroscopy: Principles and Methods of UV visible spectroscopy (Nanodrop), Fluorescence spectroscopy, Mass Spectrophotometry, Circular dichroism, Nuclear magnetic resonance

Electrophoresis: Brief Introduction to types of electrophoresis Paper, Starch and Gel

Nucleic Acid Analysis: Principles for Gel Electrophoresis- Agarose and Polyacrylamide. Brief Introduction to Northern, Southern and Western Blotting, PCR- Types of PCR: Hot-Start PCR, Touch Down, Long and Accurate PCR (LA), Inverse PCR; Nested PCR; Real Time PCR. RNA Analysis: RNA Sequencing, In situ RNA hybridization; Karyotyping, FISH. Genome Analysis: Microarrays; NGS; DNA methylation Studies; Chromatin immunoprecipitation.

Bimolecular Interaction Studies: Protein-Protein- Yeast two hybrid system systems. Protein DNA: DNA foot printing/ EMSA.

Microscopy: Types of Microscopy Light, Phase Contrast, Fluorescence, FRET (fluorescent anisotropy); FRAP and FLIP; Confocal, Electron Microscopy-Transmission and Scanning; Differential Interference Contrast Microscopy

Flow Cytometry: Principles, methods and applications of flow Cytometry, Fluorescence activated Cell sorting, BrdU Incorporation, Immunophenotyping, Cells cycle analysis, Cell Sorting.

Immunological analysis: Immunofluorescence, ELISA, Magnetic sorting.

Histopathology

Cell Culture Techniques: Isolation of Primary Cultures; Embryonic Stem Cell Derivation; Generation of iPSCs, Organoid Cultures, Hybridoma Technology

Genetic Manipulation: Cloning (Nuclear Transfer; SCNT). Generation of Cell Lines (Transformation of primary cells to cell lines, Report Constructs; Selectable Markers). Gene Editing (Homologous Recombination -Cre/loxP system; CRISPR Cas9 system, RNA Interference using siRNA, miRNA, Selection of Recombinants).

Animal Models - Types of Models (Spontaneous, Experimental, Humanized) Breeding Systems (Inbreed/outbreed). Transgenic Models: (Knock in, Knock Out). Mouse Handling Techniques

Stem Cell Technology and Regenerative Biology

Stem Cell Biology,

Cancer,

Regulation of Cell Death;

Apoptosis Circadian Rhythms,

Disease & Applications of Stem Cells
