



SMIMS SIKKIM
MANIPAL
UNIVERSITY
SIKKIM MANIPAL INSTITUTE OF MEDICAL SCIENCES

**Syllabus for Ph.D. Entrance Examination
Medical Biotechnology
SMIMS, SMU**

Academic Year 2025-2026

1. Cell Biology

Cell Membrane, Action potential, Cell cycle and cell division, Nucleus and Chromosomes: prokaryotic and eukaryotic, Cytoskeleton, Cytoplasmic organelles: Endoplasmic reticulum, Golgi complex, endocytic vesicles, coated pits, peroxisomes, mitochondria, Cell differentiation: Stem cell, stem cell in clinical medicine, Cell-cell and cell-matrix junctions, extracellular matrix, leukocyte extravasation, Signal transduction pathways, Apoptosis: pathways, regulation

2. Biochemistry

Chemical bonds, carbohydrate structure, classification and metabolism; Amino acids, Peptides and Proteins: Physicochemical properties of amino acids, structural classification of amino acids, Ramachandran Plot, Structure of proteins, Apoproteins, Conjugate proteins: Glycoproteins, Lipoproteins, Metalloproteins; Protein folding and diseases, chaperones metabolisms; Lipids and Fatty acids: structure, classification, biosynthesis of fatty acids, lipids classification, biosynthesis of cholesterol, clinical significance, steroid hormones and their synthesis and functions, bile acids: prostaglandins: synthesis and derivatives; Nucleic acids: structure, factors affecting DNA structure, RNA structure and functions, stability of RNA structure; Vitamins: chemistry and structure of water-soluble and fat-soluble vitamins,

3. Genetics and Biomedical genetics

Mendelism, gene interactions, environment factors affecting gene expression, polygenic inheritance, multiple alleles, polymorphisms, genetic mapping, mutations, mutagens, DNA damage and repair, dosage compensation, cytogenetic techniques: karyotyping, FISH, chromosomal aberrations & disorders of autosomes and sex chromosomes, cancer cytogenetics: Philadelphia chromosome, Burkitt lymphoma, model organisms; disease transmission: dominant and recessive disorders, population and evolutionary genetics: allele and genotype frequencies, Hardy-Weinberg equilibrium, elemental forces of evolution, linkage and linkage disequilibrium, molecular clock, VNTR, STR, Microsatellite, SNPs, blotting and hybridization techniques, genetic variation detection techniques: RFLP, PCR, RAPD, AFLP, SSCP, sequencing, cancer genetics: oncogenes, tumour suppressor genes, inherited cancer, multifactorial diseases.

4. Biostatistics:

Variables: quantitative and qualitative, discrete and continuous variable, primary and secondary data, mean, median, mode, standard deviation, probability, Test of Significance: Chi-Square test, Student's t-test, ANOVA.

5. Basic Laboratory Techniques

Sterilization techniques, centrifugation, electrophoresis, PCR, ELISA, microscopy and staining techniques, spectrophotometer, radioisotopes: types, detection, applications, cell line.

6. Developmental Biology

Spermatogenesis, Oogenesis, fertilization, cleavage, gastrulation, placenta formation, organogenesis, teratogens, structure of male reproductive organs, structure of female reproductive organs, Endocrine system

7. Human physiology

Bone marrow structure and function, haematopoiesis, regulatory factors, plasma proteins, blood clotting factors, coagulant, anticoagulants, lymph and tissue fluids, oedema, function of different parts of kidney, acid base balance and GFR, hormones.

8. Enzymes

Classification, co-enzymes, isoenzymes, factors affecting enzyme activity, regulation, inhibition, enzyme-based biosensors.

9. Molecular Biology

Replication, transcription, translation in pro- and eukaryotes, regulation of gene expression, epigenetics, miRNA, siRNA

10. Immunology

Cells and organs of the immune system, MALT, innate and adaptive immunity, TLRs, antigens and antibodies, haptens, adjuvants, generation of antibody diversity, generation of immune responses: complement activation pathways, inflammation, cytokines, B and T-cell receptors, B and T-cell generation, cell-mediated immune response, hypersensitivity reactions, MHC molecules and gene organization, antigen processing and presentation pathways, MHC polymorphism, HLA and disease association, transplantation, immune system and diseases: primary and secondary immunodeficiencies, influenza virus, HIV virion, viral, bacterial and fungal infection and therapy, autoimmune diseases, cancer and immune system: tumour antigens, immune response to tumour antigens, CAR-T therapy, vaccines: components of vaccines, types, edible vaccines, hybridoma and monoclonal antibodies, application of monoclonal antibodies, antibody engineering, immunochemistry, flow cytometry.

11. Recombinant DNA Technology

Enzymes used in recombinant DNA technology, cloning, vectors, expression vectors, reporter gene, expression systems, fusion protein, phage display, genome editing techniques, CRISPR-Cas9, TALENS, gene therapy, genetic recombination, cDNA cloning, reverse transcriptase PCR, qRT-PCR.

12. Bioinformatics

Bioinformatics Databases: NCBI, Ensembl, UniProt, PDB, Sequence Alignment: Global and Local, BLAST, Primers Design, Phylogenetics, Genomics: Sanger Sequencing, Next-generation Sequencing, metagenomics, single-cell RNA sequencing, Proteomics: levels of protein structure, folding, prediction, structure determination methods: X-ray Crystallography, Cry-electron microscopy, AlphaFold, mass spectrometry, Metabolomics: basic concept and applications, Cheminformatics basics, high-throughput screening, molecular modeling and drug design: pharmacophore, molecular docking, molecular dynamics (MD) simulations, computer-aided drug design: personalized and precision medicine, role of AI in drug design.