

Part B - Syllabus

BIOTECHNOLOGY / MEDICAL BIOTECHNOLOGY (BMB)

Biochemistry, Cell and Molecular Biology: Structure and function of carbohydrates, lipids, proteins, nucleic acids; enzymes and kinetics; pH, buffers, bioenergetics and major metabolic pathways. Cell structure, membranes, transport, signalling, cell cycle and cell death. DNA replication, repair and recombination; transcription, translation, and gene regulation; epigenetics. Mendelian inheritance, linkage, mutations, chromosomal abnormalities and human genetic disorders; oncogenes, tumour-suppressor genes, hallmarks of cancer, metastasis, and cancer diagnosis and therapy. Human physiology, and pathology; neuroscience and neurodegenerative disorders.

Microbiology, Virology and Immunology: Microbial classification, growth, culture and control; medically important bacteria, fungi, parasites and viruses; pathogenesis, host–pathogen interactions and antimicrobial resistance; viral structure, replication, transmission and prevention; innate and adaptive immunity; antigens, antibodies, MHC, complement, hypersensitivity, autoimmunity, immunodeficiency, vaccines and basic immunodiagnostics.

Biotechnology, Bioprocess and Analytical Methods: Vectors, cloning, PCR, electrophoresis, blotting, sequencing and gene-transfer; CRISPR-Cas genome editing; animal and plant cell and tissue culture; transgenics, recombinant proteins, monoclonal antibodies, biosimilars and vaccines; stem-cell, gene and cell therapies, regenerative medicine. Fermentation; batch and continuous processes; bioreactors; upstream and downstream processing; production of enzymes, vaccines, biopharmaceuticals and recombinant products; quality-control concepts; bioremediation, biofuels, biomaterials, environmental biotechnology. Microscopy, centrifugation, chromatography, electrophoresis, spectroscopy, immunoassays, flow cytometry; concepts of accuracy, precision, calibration, controls, sensitivity, specificity and laboratory quality.

Omics, Computational and Translational Applications: Biological databases; sequence retrieval and alignment; BLAST/FASTA, phylogenetics and structure prediction; genomics, transcriptomics, proteomics, metabolomics and metagenomics; computational biology, data interpretation and artificial intelligence in biotechnology. Molecular diagnostics, biomarkers and precision medicine; biosensors and nanobiotechnology; pharmacology, pharmacokinetics and toxicology; adverse effects and drug delivery; neuroscience and neurodegenerative disorders; forensic biological evidence, DNA profiling and forensic toxicology; food microbiology, food safety, nutrition, probiotics, functional foods and nutraceuticals; medical devices and point-of-care diagnostics, biosafety and regulatory guidelines (CDSCO, ICMR).