

**Harcourt Butler Technical University, Kanpur**

**Syllabus of Written Examination for the Faculty Recruitment**

**Assistant Professor (on Contract)**

**Biotechnology / Forensic Sciences**

**UNIT I: General Biotechnology**

Biomolecules (carbohydrates, proteins, lipids, nucleic acids, vitamins and cofactors); biological membranes and transport mechanisms; glycolysis, TCA cycle, oxidative phosphorylation, electron transport chain; photosynthesis and photophosphorylation; enzymes, enzyme classification, kinetics, regulation and inhibition.

Microbial structure, growth, nutrition and metabolism; sterilization, disinfection and aseptic techniques; microbial diseases, host–pathogen interactions; antibiotics and antimicrobial resistance. Microbial genetics (transformation, transduction and conjugation).

Organization of the immune system; innate and adaptive immunity; humoral and cell-mediated immunity; antigens and antibodies; antigen–antibody interactions; complement system; major histocompatibility complex (MHC); antigen processing and presentation; T-cell and B-cell activation; cytokines; vaccines and immunization.

Structure and organization of prokaryotic and eukaryotic cells; chromosome organization; cell cycle and growth regulation; Structure and organization of genes and genomes; DNA replication; transcription and RNA processing; translation; regulation of gene expression in prokaryotes and eukaryotes; operon concept; mutations and mutagenesis.

**UNIT II: Bioprocess Technology and Fermentation Biotechnology**

Principles of bioprocess engineering; microbial growth kinetics; media formulation and optimization; sterilization and aseptic processing; enzyme technology; immobilized enzymes and cells; bioreactor design and operation; process monitoring and control; upstream and downstream processing; product recovery and purification; scale-up and scale-down of bioprocesses; quality assurance and Good Manufacturing Practices (GMP).

Principles and types of fermentation (batch, fed-batch and continuous); aerobic and anaerobic fermentation; fermentation kinetics; strain improvement; industrial production of antibiotics, enzymes, organic acids, amino acids, vitamins, alcohols and recombinant products; biopharmaceutical production; single-cell protein; probiotics and fermented products; biofuels and industrial bioproducts.

**UNIT III: Analytical Techniques and Bioinformatics**

Principles and applications of light, fluorescence, confocal and electron microscopy; UV-Visible, fluorescence, IR, FT-IR, NMR and mass spectroscopy; electrophoretic techniques; chromatographic principles and applications; microarray technology; enzymatic assays; immunoassays including ELISA, RIA and immunoblotting; Polymerase chain reaction (PCR), DNA/RNA isolation and labeling; DNA sequencing technologies; Southern, Northern and in situ hybridization techniques; DNA fingerprinting, RAPD and RFLP markers, biosensors.

Biological databases and search tools; sequence and structure databases; sequence alignment and scoring matrices; phylogenetic analysis; gene prediction and functional annotation; genomics, proteomics and metabolomics; protein secondary and tertiary structure prediction; molecular docking.

#### **UNIT IV: Plant, Animal and Environmental Biotechnology**

Plant tissue culture; micropropagation; somatic hybridization; transgenic plants; animal cell culture; stem cell technology; transgenic animals; applications in agriculture, medicine and industry.

Sources and types of environmental pollution; environmental monitoring and impact assessment; wastewater treatment systems; solid waste management; biodegradation of pollutants; bioremediation of contaminated environments; bioleaching and biomining; biofertilizers and biopesticides; renewable bioresources; bioenergy production; biosafety; environmental legislation; sustainable development and circular bioeconomy.

#### **UNIT V: Forensic Biotechnology**

**Forensic Biotechnology:** Principles and scope of forensic science; crime scene management; collection, preservation and chain of custody of biological evidence; forensic serology; blood stain pattern analysis; forensic anthropology; forensic entomology; wildlife forensics; forensic toxicology; forensic pathology; medico-legal aspects of biological evidence; quality assurance in forensic laboratories; legal and ethical issues in forensic investigations.