Pt. Ravishankar Shukla University
Raipur 492 010, Chhattisgarh

Syllabus

Entrance Test
for
Ph.D. in Biotechnology

Session: 2025-2026

Approved by

Board of Studies : Biotechnology

Date : 21/05/2025

Name of Chairman : Prof. Keshav Kant Sahu

Name of Members : Prof. Ajaque Ahmad Qureshi

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Ph.D. Entrance Test Syllabus for Biotechnology

1. **Cell Biology**
   Cellular organelles – Plasma membrane, cell wall, their structural organization; Mitochondria; Chloroplast; Nucleus and other organelles and their organization.
   Cell cycle – molecular events and model systems
   Mechanisms of signal transduction.

2. **Biomolecules**
   Amino acids and peptides – classification, physical properties and chemical reactions
   Proteins – Protein structure; primary, secondary, tertiary and quaternary structures of proteins, Protein folding, biophysical and cellular aspects.
   Enzyme- Kinetics and thermodynamic analysis, enzyme immobilization
   Ribozyme: Types and applications
   Carbohydrates-classification and reaction: monosaccharide, disaccharides & polysaccharides
   Lipids – classification, structure and functions, Simple, compound & derived lipids

3. **Microbiology**
   Microbial Growth – The definition of growth, mathematical expression of growth, growth curve, measurement of growth and growth yields; Synchronous growth; Continuous culture; Growth as affected by environmental factors like temperature, acidity, alkalinity, water availability and oxygen.
   Metabolic Diversity among Microorganisms – Photosynthesis in microorganisms; Calvin cycle; Chemolithotrophy; Methanogenesis and acetogenesis; Fermentations – diversity, syntrophy, Nitrogen fixation.
   Microbial diseases –Infectious disease transmission; Respiratory infections caused by bacteria and viruses; Tuberculosis; Sexually transmitted diseases including AIDS; Diseases transmitted by animals (rabies, plague), insects and ticks (Rickettsia's, Lime disease, malaria)
   Food and water borne diseases

4. **Molecular Biology**
   DNA Replication – Prokaryotic and eukaryotic DNA replication, Mechanics of DNA replication. Enzymes and accessory proteins involved in DNA replication.
   DNA Repair and Recombination.
   Transcription – Prokaryotic transcription, Eukaryotic transcription,
   Translation – Prokaryotic and Eukaryotic translation, the translation machinery, Mechanisms of initiation, elongation and termination, Regulation of translation,
   Co-and post-translational modifications of proteins, Protein transport and trafficking.
   Oncogenes and Tumor Suppressor Genes – Viral and cellular Oncogenes, tumor suppressor genes from humans, Structure, Function and mechanism of action of pRB and p53 tumor suppressor proteins. Antisense and Ribozyme technology.

Ankita BSahu 21/5/25

Molecular Mapping of genome. Genome Sequencing-Genome sizes, organelle genomes, Genomic libraries, YAC, BAC libraries.

5. **Immunology**

Phylogeny of immune system, innate and acquired immunity, Clonal nature of immune response.
Organization and structure of lymphoid organs.
Nature and biology of antigens and super antigens.
Antibody structure and function; antibody engineering.
Antigen – antibody interactions.
Cells of immune system – Hematopoiesis and differentiation, Lymphocyte trafficking, B – lymphocyte, T – lymphocyte, Macrophages, Dendritic cells, Natural Killer and lymphokine activated killer cells, Eosinophils, Neutrophils and Mast cells. Hypersensitivity, Autoimmunity. Hybridoma Technology and Monoclonal antibodies.

6. **Genetic Engineering**

Gene cloning vectors: Plasmids, bacteriphages, phagemids, cosmids, Artificial chromosomes
Restriction Mapping of DNA Fragments and Map Construction, Nucleic acid sequencing.
cDNA synthesis and cloning: mRNA enrichment, reverse transcription, DNA primers, linkers, adaptors and their chemical synthesis, Library construction and screening.
Gene therapy: Vector engineering, gene augmentation, gene correction, gene editing, gene regulation and silencing.

7. **Bioprocess Engineering**

Isolation, Preservation and Maintenance of industrial Microorganisms.
Media for industrial fermentation
Types of fermentation processes: Bioreactors-Analysis of batch, Fed – batch and continuous bioreactors,
Downstream processing: Introduction, Removal of microbial cells and solid matter, foam reparation, precipitation, filtration, centrifugation, cell disruption, liquid – liquid extraction, chromatography, Membrane process, Drying and crystallization, Effluent treatment: BOD and COD treatment and disposal of effluents.
Industrial production of chemicals: Alcohol (ethanol), Acids (citric acetic and gluconic), solvents (glycerol, acetone, butanol), Antibiotics (penicillin, streptomycin, tetracycline), Amino acids (lysine, glutamic acid), Single cell protein. Use of microbes in mineral beneficiation and oil recovery.

8. **Plant Tissue Culture**

Introduction to cell and tissue culture, tissue culture as a technique. Tissue culture media (composition and preparation)
Initiation and maintenance of callus and suspension culture; single cell clones.
Organogenesis; somatic embryogenesis; transfer and establishment of whole plants in soil.

Protoplast isolation, culture and fusion; Cryopreservation DNA banking for germplasm conservation.
Application of plant transformation for productivity and performance: herbicide resistance, insect resistance, Bt genes.
Molecular Marker –RFLP maps, linkage analysis, RAPD markers, STS, microsatellites, SCAR (Sequence characterized amplified regions), SSCP (Single strand conformational polymorphism), AFLP, QTL, map based cloning, molecular marker assisted selection.

9. Animal Tissue Culture

Application of animal cell culture
Primary and established cell line cultures.
Stem cell cultures, embryonic stem cells and their applications.
Cell culture based vaccines
Somatic cell genetics.
Transgenic animals: Mice, Sheep, Birds and Fish .Tissue engineering.

10. Environmental Biotechnology

Environmental Pollution: Types of pollution, Methods for the measurement of pollution; Methodology of environmental management – the problem solving approach, its limitations.
Treatment schemes for wastewaters of dairy, distillery, tannery, sugar, antibiotic industries.
Bioremediation of contaminated soil and waste land.
Microbiology of degradation of Xenobiotics in Environment, Biopesticides in integrated pest management.
Solid wastes: Sources and management (composting, vermi-culture and methane production).
Global Environmental Problems: Ozone depletion, UV – B, green house – effect and acid rain, their impact and biotechnological approaches for management.

11. Techniques in Biotechnology

Electrophoresis, Chromatography, Microscopy, Spectroscopy, PCR, Biosensors: Types and application, Protein and DNA sequencing, Flowcytometry, Radioisotope Techniques, NMR and XRD.