Ph.D. Entrance Test Syllabus (Biotechnology)

Unit 1: Microbiology

- Microbial Structure & Physiology – Classification, cell structure, nutrition, and growth factors.
- Antimicrobials & Resistance – Types, mechanisms of antibiotic action, and AMR development.
- Bacteriophages – Structure, types, lytic/lysogenic cycles, and applications.
- Microbial Techniques – Aseptic handling, sterilization, cultivation, and staining.
- Microbial Interactions & Pathogenesis – Host–pathogen interaction, virulence, and epidemiology.
- Applied Microbiology – Food and water microbiology, probiotics, biofilms, and microbiome significance.

Unit 2: Cell Biology

- Cell Structure – Prokaryotic and eukaryotic cell organization.
- Membrane & Organelles – Structure and functions of membranes and organelles.
- Cytoskeleton & Junctions – Microtubules, microfilaments, and adhesion molecules.
- Cell Cycle & Division – Mitosis, meiosis, and checkpoint regulation.
- Apoptosis & Signaling – Programmed cell death and basic signaling pathways.
- Cancer Biology – Oncogenes, tumor suppressors, and cancer progression.

Unit 3: Biochemistry

- Biomolecules – Carbohydrates, lipids, proteins, nucleic acids, and vitamins.
- Biophysical Chemistry – pH, buffers, and reaction kinetics.
- Bioenergetics – Energy production and oxidative phosphorylation.
- Enzymology – Enzyme kinetics, regulation, and inhibition.
- Metabolism – Overview of carbohydrate pathways (glycolysis, TCA, PPP).

- Biochemical Techniques – Chromatography, electrophoresis, and enzyme assays.

Unit 4: Genetics

- Principles of Inheritance – Mendelian laws, linkage, recombination, and pedigree analysis.
- Genetic Material – Discovery and experiments proving DNA as genetic material.
- Chromosomal Organization – Structure, mutations, and abnormalities.
- Genetic Mapping – Linkage maps, banding, and molecular markers (RFLP, DNA fingerprinting).

Unit 5: Molecular Biology

- DNA Replication – Enzymes, modes, regulation, and telomeres.
- Transcription – Gene structure, operon model, and RNA synthesis.
- Gene Regulation – Epigenetic control: methylation, histone modification, RNAi.
- Translation – Genetic code, ribosomes, synthesis steps, and post-translational control.

Unit 6: Genomics, Proteomics & Bioinformatics

- Sequencing – DNA/protein sequencing, alignment, and databases.
- Genomics – NGS, RNA-seq, ChIP-seq, and microarray basics.
- Proteomics – Mass spectrometry and protein quantification (SILAC, etc.).
- Bioinformatics – Primer design, qPCR, and database analysis of genes/proteins.

Unit 7: Immunology

- Types of Immunity – Innate and adaptive immunity, immune cells, and mechanisms.
- Immune Components – Antigens, antibodies, MHC, B/T cell activation.

- Immune Reactions – Inflammation, allergy, hypersensitivity, and tolerance.
- Immunotechniques – ELISA, Western blot, flow cytometry, and immunofluorescence.

Unit 8: Recombinant DNA Technology & Genetic Engineering

- Nucleic Acid Techniques – DNA/RNA isolation, cloning, vectors, and gene libraries.
- Cell & Tissue Engineering – Growth factors, biomaterials, IVF, and embryo transfer.
- Animal Biotechnology – Cloning, transgenic animals, and applications.
- Biosafety & Ethics – GMO regulation, biosafety guidelines, and ethical issues.

Unit 9: Bioprocess & Microbial Technology

- Microbial Metabolism – Primary/secondary metabolites and growth kinetics.
- Bioreactor Design – Basics, biosensors, and scale-up principles.
- Transport & Downstream Processes – Mass/heat transfer, filtration, and chromatography.
- Applications – Industrial products (enzymes, antibiotics, alcohols) and agricultural uses.
