



OPJU



Department of Biotechnology  
School of Science  
O.P. Jindal University, Raigarh.  
**Ph.D. Biotechnology Entrance Exam Syllabus**

---

**Unit 1: Molecular Biology**

DNA replication, repair, and recombination. Transcription and translation in prokaryotes and eukaryotes. Gene regulation (lac operon, trp operon, enhancers, silencers). RNA processing and interference. CRISPR and genome editing tools.

**Unit 2: Cell Biology**

Structure and function of cellular organelles. Membrane dynamics, transport, and signal transduction. Cell cycle regulation, apoptosis, and cancer biology. Stem cells and differentiation.

**Unit 3: Genetics**

Mendelian and non-Mendelian inheritance. Linkage, recombination, gene mapping. Chromosomal aberrations and mutations. Population genetics and Hardy-Weinberg principle.

**Unit 4: Biochemistry**

Enzymes: kinetics, inhibition, and regulation. Carbohydrate, lipid, protein, and nucleic acid metabolism. Bioenergetics: glycolysis, TCA cycle, oxidative phosphorylation. Vitamins and coenzymes.

**Unit 5: Microbiology & Immunology**

Microbial diversity and growth. Bacterial genetics and plasmids. Antibiotics and resistance mechanisms. Innate and adaptive immunity. Antigen-antibody interactions, vaccines.

**Unit 6: Biotechnology Techniques**

PCR, RT-PCR, qPCR. Electrophoresis, ELISA, Western blot. Chromatography (HPLC, affinity), spectrophotometry. DNA/RNA sequencing (Sanger, NGS). Fermentation and bioprocess principles.

**Unit 7: Genetic Engineering & Genomics**

Cloning vectors (plasmid, phage, BAC, YAC). cDNA library, genomic library. Recombinant DNA technology. Transgenic organisms and biosafety regulations. Functional genomics and proteomics.

**Unit 8: Bioinformatics & Biostatistics**

Sequence alignment (BLAST, FASTA). Phylogenetic trees and gene annotation. Genomic databases (NCBI, EMBL, KEGG). Probability, statistical tests, p-value, ANOVA.

### **Unit 9: Plant and Animal Biotechnology**

Plant tissue culture and genetic transformation. Agrobacterium-mediated transformation. Animal cell culture and applications. Transgenic plants and animals.

### **Unit 10: Environmental and Industrial Biotechnology**

Bioremediation and biosensors. Wastewater treatment. Enzyme technology and immobilization. Production of antibiotics, alcohol, and enzymes. Downstream processing and scale-up. Concept and scope of nanotechnology in biology. Physical and chemical properties of nanomaterials. Top-down and bottom-up approaches of synthesis.

### **Recommended Books & References**

1. Lehninger's Principles of Biochemistry
2. Molecular Biology of the Cell – Alberts
3. Molecular Biology of the Gene – Watson
4. Genetics – Benjamin A. Pierce
5. Biotechnology – U. Satyanarayana
6. Principles of Gene Manipulation – Old & Primrose
7. Immunology – Kuby or Abbas
8. CSIR-NET Life Sciences Books (Arihant / Trueman's)