Department of Biochemical Engineering and Biotechnology
Indian Institute of Technology Delhi

SYLLABUS FOR FIRST ROUND OF INTERVIEWS FOR PhD SELECTIONS 2026, Sem-I

SYLLABUS FOR BIOSCIENCES

BIOCHEMISTRY

- Basic physical chemistry: Properties of gases, chemical equilibrium, pH, ionization of weak acids and bases; solubility and precipitation
- Carbohydrates: structure and function (monosaccharides, disaccharides and common polysaccharides – starch and cellulose)
- Proteins – primary, secondary, tertiary & quaternary structures; Ramachandran plots
- Enzyme: chemical and functional nature of enzymes, Enzyme kinetics
- Structure and function of nucleotides, DNA and RNA
- Basic metabolic pathways (Glycolysis, TCA cycle, Glyoxalate cycle, Pentose Phosphate pathway)
- Biological Membrane: structure and function

MOLECULAR BIOLOGY

- Prokaryotic and eukaryotic genome organization
- Basic mechanisms in replication, transcription and translation
- Gene regulation in prokaryotes: lac, ara and trp operons
- Mutations: Types of mutations, Isolation of mutants
- Enzymes used in molecular cloning and their applications
- DNA sequencing: chemical and enzymatic methods
- Southern, Northern and western blotting and hybridization
- Vectors: types and characteristic features
- Directed evolution

MICROBIOLOGY

- Structure and function of prokaryotic and eukaryotic cell
- Microbial Growth – Measurement techniques; growth kinetics
- Energy transduction (fermentation, aerobic respiration and anaerobic respiration)
- Genetic recombination; basic features of transformation, transduction and conjugation
- Bacteriophages

SYLLABUS FOR BIOCHEMICAL ENGINEERING

- Fundamentals of growth: Monod growth kinetics; growth cycle phases for batch cultivation.
- Fundamentals of sterilization: Thermal death kinetics of cells and spores. Media sterilization: Concept of degree of sterility and decimal reduction time. Batch sterilization.
- Enzyme kinetics: Kinetics of enzyme catalyzed reactions: Michaelis-Menten equation; Lineweaver-Burk plots; Eadie-Hofstee plots; substrate inhibition kinetics; competitive, non-competitive and uncompetitive inhibition; effect of pH and temperature.
- Bioreactor kinetics: Batch, fed-batch and continuous (CSTR and PFR) reactors; conditions for “wash-out” and maximum cell production in chemostat cultures.
- Analysis of rate data for batch/continuous flow reactors and development of rate equation; Introduction to the concept of yield, titer and productivity;

- Principles of recovery operations: filtrations, centrifugation, solvent extraction, chromatography.

Suggested Reading

a) Molecular Biology of the Cell, 4th Edition, by Bruce Alberts, Alexander Johnson, Julian Lewis, Martin Raff, Keith Roberts, and Peter Walter, New York: Garland Science; 2002.
b) Lehninger Principles of Biochemistry, 5th Edition, by David L. Nelson, Michael M. Cox, W. H. Freeman 2008
c) Microbiology, 7th Ed., by L.M. Prescott, J.P. Harley and D.A. Klein, McGraw-Hill, 2008.
d) Bioprocess Engineering: Basic Concepts", M.L. Schuler and F. Kargi, Prentice Hall, 1992
e) Bioprocess Engineering Principles, Pauline Doran, Academic Press, 2013.