Syllabus for Paper I (Part A)

Basic physical chemistry: Properties of gases, chemical equilibrium, pH, ionization of weak acids and bases; solubility and precipitation.

Basic microbiology: Microbial Growth – Measurement techniques; growth kinetics.
Basic biochemistry and molecular biology: nucleic acid structure, Proteins – primary, secondary, tertiary & quaternary structures, Enzyme: chemical and functional nature of enzymes, enzyme kinetics.

Basic biochemical engineering: Batch growth kinetics, extraction, filtration and centrifugation.

Syllabus for Paper I (Part B) and Paper II Principles of Biochemistry, Molecular biology and Microbiology

BIOCHEMISTRY

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
Energy transduction (fermentation, aerobic respiration and anaerobic respiration).
Genetic recombination; basic features of transformation, transduction and conjugation.
Bacteriophages

Syllabus for Paper I (Part B) and Paper II 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.