2026

Final State Examination Topics

VALID FROM THE 2026/2027 ACADEMIC YEAR

BACHELOR'S STUDIES

AB308A Chemistry and technology - Biochemistry and Biotechnology

I. Chemistry

The scope is defined by the subjects General and Inorganic Chemistry I, Organic Chemistry I and II, Physical Chemistry I, Analytical Chemistry I.

1. Bonds in inorganic and organic compounds, hybridization, non-bonded interactions, polarity of molecules, hydrophilic, hydrophobic, and amphiphilic molecules.
2. Basics of the chemistry of biogenic elements (C, N, O, P, S).
3. Basic types of reactions of inorganic compounds. Stoichiometry and stoichiometric calculations, the law of conservation of mass, substance quantity, and expression of concentration.
4. Alcohols, aldehydes, ketones, acids, amino acids and their derivatives, properties, reactions.
5. Structure of organic compounds, isomers, stereochemistry, conformation, configuration. Inductive and the mesomeric effect, tautomerism.
6. State behaviour of gases, equation of state of the ideal gas. Real gas and its behaviour.
7. Laws of thermodynamics. Enthalpy, heat of reaction, entropy.
8. Phase equilibria in single-component systems. Gibbs phase law, vapour-liquid equilibrium in ideal systems, phase diagrams.
9. Core concepts of chemical kinetics: reaction rate, rate equations, order of reaction.
10. Core concepts of analytical chemistry: equilibria in aqueous solutions, pH, volumetric analyses.

II. Biology and Biochemistry

The scope is defined by the subjects Biology I, Biochemistry I, Microbiology, Unit Operations of Chemical Engineering.

1. Living systems, their composition and organization (different types of cells)
2. Amino acids (properties) and peptides
3. Structure and function of large biomolecules and biopolymers (proteins, peptides, carbohydrates, lipids), their basic characteristics and mutual interactions.
4. Enzymes: structure, function, kinetics, inhibition.
5. The principles of metabolism and energy conversion; bioenergetics
6. Basic metabolic pathways.
7. Taxonomy, isolation, cultivation and identification of microorganisms.
8. Microbial metabolism and its importance for biotechnology.
9. Principles of balancing. Balance of mass and energy.
10. Flow of fluid through pipes. Transport of fluids, pumps. Flow of fluid through porous medium.

IIIa. Compulsory-elective part

in the context of study subjects Molecular genetics and DNA analysis, Biochemistry II, and Bioanalytical Methods

1. Core concepts of replication, transcription and translation in prokaryotic and eukaryotic cells.
2. Mutations and repair mechanisms. Recombination, gene segregation.
3. Role of oxygen in living organisms. Oxidative stress, antioxidants.
4. Biological membranes, membrane transport.
5. Regulation of enzyme activity. Hormones and transfer of information across biological membranes.
6. Application of enzyme methods in clinic analyses and food industry.
7. Imunochemistry: principle of immunochemical methods, antibodies and antigens. ELISA, immunoprecipitation methods.
8. Chromatographic methods: LC, GC, principals of separation, instrumentation.
9. Electromigration methods: gel electrophoreses, immunoelectrophoresis, immunoblot, isoelectric focusation, capillary electrophoreses.
10. Mass spectrometry in the analysis of biomolecules.

IIIb. Compulsory-elective part

in the context of study subjects Molecular genetics and DNA analysis, Biochemistry II, and Fundamentals of Bioengineering

1. Core concepts of replication, transcription and translation in prokaryotic and eukaryotic cells.
2. Mutations and repair mechanisms. Recombination, gene segregation.
3. Role of oxygen in living organisms. Oxidative stress, antioxidants.
4. Biological membranes, membrane transport.
5. Regulation of enzyme activity. Hormones and transfer of information across biological membranes.
6. Biotechnological process structure. Important parameters influencing and describing bioprocess (process yield, productivity, specific growth rate determination, inhibition, limitation, diauxic growth, metabolic effects.)
7. Types of cultivations – batch, fed batch and continuous (characteristics, implementation, mass balance, application).
8. Upstream processes (preparation of inoculum, preparation and sterilization of liquid media, sterilization of reactor, filtration and sterilization of gases).
9. Bioreactors (types, design, construction, use), aeration and oxygen transfer (implementation of aeration, oxygen transfer mechanism, K_La determination) and mixing (specifics of mixing in bioreactors).
10. Basics of bioprocess control (measured and controlled variables in bioprocess, control loops, types of controllers, variables in control).