Analytical Chemistry

1. Partial molar quantities, activity, chemical potential, standard states
2. Equilibria in aqueous solutions, Gibbs energy, equilibrium constant, pH
3. Volumetric and gravimetric analysis
4. Electroanalytical methods, polarography, electrophoresis
5. Faraday´s law, galvanic cells, Nernst equation
6. Principles of spectrometry, atomic, molecular and mass spectrometry, spectrometric instrumentation
7. Principles of chromatography, gas chromatography, liquid chromatography
8. Thermodynamic system, thermodynamic process, state properties, laws of thermodynamic
9. Enthalpy, heat of reaction, standard enthalpy of formation, Hess and Kirchhoff's laws
10. State behaviour of gases, equation of state of ideal gas, real gas and its behaviour
11. Solubility of gases in liquids
12. Phase equilibria in single-component systems, Clapeyron equation
13. Gibbs phase law, vapor-liquid equilibrium in ideal systems, phase diagrams
14. Basic terms of chemical kinetics, reaction rate
15. Errors of analytical measurement

Biochemistry and Organic chemistry

1. Oxidation numbers, bonding in organic chemistry, electronic effects, basic mechanisms
2. Alkanes, cycloalkanes, alkenes, dienes, alkynes – industrially important examples, physical and chemical properties, reactions
3. Arenes – structure, aromaticity, physical properties, reactions
4. Organometallic compounds – formation and applications
5. Alcohols, phenols, carbonyl compounds and ethers – structure and physical properties
6. Carboxylic acids, amines, structure acid-base properties, reactions
7. Amino acids, peptides and proteins (relation between structure and function)
8. Metabolism of nitrogenous substances
9. Enzymes, reaction kinetics of enzymatic reactions
10. Chemistry of nucleotides and nucleic acids, replication, transcription, translation
11. Chemistry and metabolism of lipids; bio membranes and membrane transport
12. The principles of metabolism and energy conversion, aerobic and anaerobic respiration, light phase of photosynthesis
13. Citrate and glyoxylate cycle
14. Chemistry and metabolism of carbohydrates

Environmental Engineering

1. Natural waters: qualitative and quantitative composition, physico-chemical properties, equilibria (pH, carbonic acid)
2. Inorganic pollutants in water; toxic metals; nutrients; radioactive contamination
3. Organic pollutants in water; micropollutants, plastics and microplastics; microbial contamination
4. Physical and chemical properties of atmosphere; major components and pollutants
5. Atmospheric inorganic and organic pollutants and their reactions
6. Greenhouse effect; greenhouse gases, their origin and reactions
7. Soil: composition, properties; physico-chemical processes in soil; geochemical cycles of main elements
8. Soil: main organic and inorganic pollutants; atmospheric deposition, acidification, eutrophication
9. Wastewater treatment: wastewater definition; classification of pollutants; water reuse and recycling
10. Wastewater treatment: wastewater treatment plant; biological processes in wastewater treatment
11. Air protection: basic terms, treatment processes in general; nitrogen oxides, prevention of formation, chemical reduction; particulates control
12. Air protection: sulphur oxides, desulfurization technologies; carbon dioxide, reduction of emissions
13. Waste management: basic terms; generation and types of waste, prevention of waste generation
14. Waste management: waste treatment – physical, chemical and biological methods