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 behavior of gases, equation of state of ideal gas, real gas and its behavior
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

Chemical Engineering and Fuel technology

1) Principles of balancing, mass and mole balance; chemical reactors and bioreactors – basic types, balance
2) Bernoulli equation, transport of fluids, pumps, flow of fluid through pipes, flow of fluid through porous medium, filtration, types of filters, filtration rate
3) Balance of enthalpy, heat transfer, transfer coefficient, heat exchange by conduction and convection, heat exchangers – types and design
4) Diffusion separation processes, mass transfer equipment, equilibrium plate; liquid extraction of immiscible solvents – equipment, single stage, repeated and countercurrent extraction
5) Drying of solids, enthalpic humidity chart, batch and continual dryers; evaporators – types and design; flash and differential distillation of binary mixtures, rectification in staged column
6) Origin, exploration, processing, transport and utilization of crude oil, natural gas and coal
7) Desalination of oil, atmospheric and vacuum distillation of crude oil, production and properties of LPG, heating and mineral oils
8) Thermal cracking, catalytic cracking and catalytic hydrocracking – usage, conditions
9) Reforming and isomerization of naphtha, production of gasoline components by alkylation and polymerization, production of ethers
10) Combustion of coal, coal energy, CO_2 issues
11) Pyrolysis of coal and solid fuels, processing and use of products of pyrolysis and coking
12) Gasification of fuels, production of hydrogen, processing of hydrogen sulfide
13) Natural gas as energy source and commodity for synthesis
14) Fuel gases – classification and use, unconventional fuel gases