

Final Examination

Two topics from the list below – 15 min each

The student has to randomly select two topics and both answers are graded with the same weight.

The student presents the Diploma Thesis at a session of the Institute of Chemistry prior to the examination. The final grade of the thesis is the average of three grades: one is given by the supervisor, another one by the referee, and the third one obtained for the presentation of the thesis (this grade is proposed by members of the Final Examination Committee present at the session, and is decided by the session chair with the consent of all instructors of the Institute of Chemistry present).

The final grade of the diploma is calculated as (the average grade of the compulsory subjects + grade received for the answer on topic 1 in the Final examination + grade received for the answer on topic 2 in the Final examination + the grade of the Diploma thesis)/4. The grade of the Final Examination is failing (insufficient, 1) if any of the component grades is failing (insufficient, 1).

The preparation time is 120 min. For students with documented challenges of dyslexia, discalculia or disgraphia, the preparation time is increased to 160 min.

Topic list

- (1) The crystal field theory (one-electron case), the effects of crystal field splitting on the physico-chemical parameters, the MO description of the transition metal complexes.
- (2) The chelate effect and its applications. Substitution and direct electron transfer redox reactions of square-planar and octahedral complexes.
- (3) Metallo-organic compounds of the transition metals: classification, the most important reactions and the homogeneous catalytic properties.
- (4) Atomic and molecular spectroscopy methods in analytical chemistry.
- (5) Separation techniques and coupled chromatographic instruments.
- (6) Principles and analytical features of methods used for the characterisation of chemical structures (NMR, EXAFS, XRD, IR, MS, MB).
- (7) Chemical analysis with miniaturised, automatic instruments or instruments capable of remote sensing.
- (8) Thermodynamic potential functions and their changes in various physical and chemical processes.
- (9) Kinetics of complex reactions, methods of investigation, reaction rate theories.
- (10) Transport processes and their characteristic features. Interfacial phenomena.
- (11) Formation of carbon-carbon bonds: pericyclic and cross-coupling reactions.
- (12) Organic compounds of the main group elements of the periodic table. Structural features and chemical properties.

- (13) Nucleophilic substitution and elimination reactions of alkyl halides, comparison of their characteristics and reaction conditions. Nucleophilic addition and condensation reactions of carbonyl compounds. Nucleophilic acyl substitution reactions of carboxylic acid derivatives.
- (14) Synthesis of polymers: polymerisation, polyaddition and polycondensation.
- (15) Fundamental concepts of unit operation in the chemical industry: concepts and laws. Material, energy and impulse balances and their applications. The fundamental concepts of treating chemical reactions.
- (16) Operations without phase change: sedimentation, sieving, centrifugation, stirring, fluidisation, membrane units.
- (17) Operations with phase change: distillation, extraction, adsorption, absorption, crystallisation.

Textbooks available during the preparation time:

- J. Clayden, N. Greeves, S. Warren, P. Wothers: Organic chemistry
- P.W. Atkins: Physical chemistry I-II-III.
- A. Earnshaw, N.N. Greenwood: Chemistry of the elements I-III.
- R. Kellner, J.-M. Mermet, M. Otto, H.-M. Widmer: Analytical chemistry
- J. McMurry: Organic chemistry
- D.F. Shriver, P.W. Atkins: Inorganic chemistry