

## Details of the final exam

The student is randomly assigned two topics from list A and B. After 2 hours of preparation time (or 160 minutes in cases of certified dislexia, dysgraphia or discalculia), the student will have to present knowledge in both topics::

Discussion of topic A – 15 min.

Discussion of topic B – 15 min.

Both topics are graded with equal weights by the committee.

Calculation of the final grade of the diploma:  $(\text{average grade of the compulsory colloquia} + (\text{grade of topic A} + \text{grade of topic B} + \text{grade of the thesis work})/3)/2$ . If any component grade is a „fail”, the final grade is also „fail”.

### Topic list A

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. Study of the physico-chemical properties and structure of chelate complexes.
3. Substitution and direct electron transfer redox reactions of square-planar and octahedral complexes.
4. Organo-metallic compounds of the transition metals: classification, the most important reactions and the homogeneous catalytic properties.
5. Trace and microanalytical sample preparation procedures.
6. Atomic and molecular spectroscopy methods in analytical chemistry.
7. Advances chromatographic and electrophoretic separation methods in analytical chemistry.
8. Sensors, automatic measurement systems, remote/stand-off analytical measurements.
9. Principles and main analytical features of methods used for the characterization of chemical structures.
10. Formation of carbon-carbon bonds: pericyclic and cross-coupling reactions.
11. Organic compounds of the main group elements of the periodic table. Structural features and chemical properties.
12. Nucleophilic substitution and elimination reactions of alkyl halides, comparison of their characteristics and reaction conditions.
13. Nucleophilic addition and condensation reactions of carbonyl compounds. Nucleophilic acyl substitution reactions of carboxylic acid derivatives.
14. Synthesis of polymers: polymerisation, polyaddition and polycondensation.

## **Topic list B**

1. Thermodynamic potential functions and their changes in various physical and chemical processes.
2. Kinetics of complex reactions. Enzyme kinetics. Photochemistry.
3. Methods for the investigation of the kinetics of complex reactions. Reaction rate theories.
4. Transport processes and their characteristic features. Charge transfer, dynamic electrochemistry.
5. Interface phenomena. Thermodynamics and kinetics of S/L and S/G interfaces.
6. Fundamental concepts of unit operation in the chemical industry. Concepts of treating chemical reactions.
7. Material, energy and impulse balances and their applications in chemical technology.
8. Operations without phase change and their applications: sedimentation, centrifugation, filtration.
9. Operations without phase change and their applications: mixing, fluidization.
10. Operations with phase change and their applications: distillation, extraction.
11. Operations with phase change and their applications: adsorption, absorption.
12. Homogeneous and heterogeneous catalysis.

## **Textbooks available during the preparation time:**

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