Subject name: The chemistry of aqueous solution

Teaching professor: Prof. Dr. Biljana Petrović, full professor

Subject status: Elective subjects

Number of ECTS: 15

Conditions: None

Subject's goal:

The acquiring of certain theoretical knowledge, which will be very helpful for students in the process of preparation of their doctoral dissertation. Taking into account that this subject is an upgrade on previously acquired knowledge on undergraduate and master studies, mastering of subject will enable better understanding of the processes in aqueous solution, primarily hydrolysis process, hydration, acid-base equilibrium, complexation reactions, specific interactions in aqueous solution, changes of various thermodynamic parameters during dissolution and complexation process etc.

Outcome of the subject:

By mastering this subject, students will be theoretically empowered and will acquire ability to investigate various reactions in aqueous solution. They will be able to determine the hydrolyses constants as well as complexation constants of transition metal ions with appropriate ligands by various sophisticated experimental methods. Knowledge achieved within this subject will enable students a better approach when they study different systems in aqueous solution during the experimental work and discussion of the results.

Subject content:

Theoretical lectures

Hydration of metal ions. Models of water structure. Investigation of metal ion hydrate geometry by different methods: X-Ray, IR, NMR spectroscopy, computation methods (*ab initio, Monte Carlo*). Hydrolysis of transition metal ion complexes. Specific theoretical interactions of solvent and substances soluted in water. Acid-base equilibrium in solutions. Determination of hydrolysis constants by different experimental methods (potentiometric, spectrophotometric, NMR). Complexation. Stability constants. Methods for determination of the composition and stability of complexes. Thermochemistry of complex creation. Changes of enthalpy, entropy and Gibb's free energy. Measurement of water exchange by ^{18}O method and NMR method. Substitution and kinetics of water exchange. Eigen-Wilkins mechanism. Reactivity of hydroxo- and aqua- transition metal ion complexes. Scale of nucleophilicity. Theory of "hard" and "soft" acids and bases.

Seminary work:

Students need to deliver one seminary work in the field of hydration, hydrolyses or metal ions in accordance with the field of research within their doctoral dissertation.

Recommended literature:

1. Brown, P. L., Ekberg, C: Hydrolysis of Metal Ions, Wiley-VCH, Weinheim, Germany, 2016.
2. Richens, D. T.: The Chemistry of Aqua Ions, John Wiley and Sons Ltd, England, 1997.
3. Housecroft, C. E., Sharpe, A. G.: Inorganic Chemistry, Person Education Limited, Esseh, England, 2001.

Number of lectures of active teaching	Theoretical lectures: 6	Practical lectures: /

Teaching methods

Lectures, seminary work, exam.

Knowledge mark (maximal number of points 100)

Seminary work: 30 points

Oral exam: 70 points