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| **Study program** Chemistry | | | | |
| **Course title** Physical Chemistry 2 (H116C) | | | | |
| **Name of lecturer/lecturers** Snežana B. Tošić | | | | |
| **Type of course** Obligatory | | | | |
| **Number of ECTS allocated** 6 | | | | |
| **Course objectives**  Acquiring knowledge about fundamental physico-chemical concepts and laws in the field of chemical equilibria, phase equilibria, phenomena on the phase boundary, colloid systems, kinetics, and electrochemistry, necessary for monitoring and acquiring knowledge from other scientific disciplines in the field of chemistry. Developing the ability to apply the acquired knowledge to concrete systems through the association with the acquired knowledge of physics and mathematics. | | | | |
| **Course outcomes**  The student can:  - apply the acquired knowledge of chemical thermodynamics in any system,  - based on experimental results, construct and interpret state diagrams of various heterogeneous systems,  - apply the knowledge of phase boundary phenomena to practical problems (adsorption, colloidal state),  - based on the kinetic and thermodynamic parameters of the chemical reaction, draw conclusions about the speed,  order, possible mechanisms, and spontaneity of the reaction,  - based on acquired fundamental knowledge in electrochemistry, follow and understand electrochemical  processes and phenomena, especially their application in practice,  - process experimentally obtained data with special emphasis on the connection between obtained results, mathematical relations, and their graphic representation. | | | | |
| **SYLLABUS**  *Lectures*  Open system. Gibbs equations. Equilibrium in open systems. Partial molar volumes, enthalpy, Gibbs free energy. Influence of pressure and temperature on chemical potential. Gibbs-Helmholtz equation for an open system. Chemical equilibrium. Thermodynamic consideration of chemical equilibrium. Equilibrium constant. Van Hoff reaction isotherm. Influence of pressure and temperature to the equilibrium constant. Le Chatelier's principle. Complex balances. Composition of system in equilibrium. Reaction amount and reaction yield. Phase balance. Gibbs rule. Phase diagrams. One-component system. Clausius-Clapeyron equation. Types of phase transitions. Two-component systems with solid phase separation. Phase diagram of eutectic mixture. Phase diagram of a system with congruent melting point. Phase diagram of the cooling system. Phase diagram of a system in which one component appears in two crystal states. Liquid vapor equilibrium. Ideal and real mixtures. Raoult’s law and deviations. Distillation diagrams. System composed of two components with limited miscibility. System of two immiscible liquids. Steam distillation. Law of distribution and extraction. Colligative properties of dilute solutions. Boiling point elevation. Decreasing the freezing point. Osmosis and osmotic pressure. Colligative properties of real solutions and electrolyte solutions. Solubility of gases in liquids - Henry's law. Surface phenomena. Surface tension. Adsorption. Adsorption on the liquid surface. Adsorption on a solid surface. Adsorption equilibrium. Adsorption isotherms - Gibbs, Freundlich and Langmuir isotherm. Colloid systems. Lyophilic and lyophobic colloids. Structure of lyophobic colloids. Double electrical layer. Electrokinetic potential. Coagulation of colloids. Stability of lyophilic colloids. Specific properties and behavior of colloids. Speed, order, and molecularity of the reaction. Chemical reaction rate law. Half-time of reaction. Zero order reactions. Reactions of the first order. Reactions of the second order. Pseudo-first-order reactions. Methods of determining the order of reaction. Complex reactions. Effect of temperature on the rate of chemical reaction. Thermodynamics of transition state. Catalytic reactions. Electrochemical reaction. Electrolytic conductors. Mass transfer. Specific resistance and specific conductivity. Measurement of electrical conductivity. Molar electrolyte conductivity. Influence of dielectric constant, temperature, viscosity. Kohlrausch's rule of independent travel of ions. Weak electrolytes-Ostwald's law of dilution. Strong electrolytes. Kohlrausch's square root equation. Debye-Hickel-Onsager equation. Boundary area of contact metal-electrolyte. Double electrical layer. Electrode potential. Diffusion potential. Electrodes. Electrode potential expressions. Electromotive force. Thermodynamics of galvanic elements. Types of galvanic elements.  *Laboratory work*  Determination of the partial molar volumes of the components of a liquid two-component mixture. Determination of the equilibrium constant and thermodynamic parameters of the reaction of salt dissolution reaction in water. Determination of the distribution coefficient. Determination of the phase diagram of simple eutectic system. Determination of the surface tension coefficient with the stalagmometer. Determination of the Freundlich adsorption isotherm. Determination of the constant rates of the sucrose inversion reaction using polarimeter. Determination of hydrolysis activation energy reactions of ethyl ester of acetic acid conductometrically. Determination of molar conductivity at infinite dilution of a strong electrolyte solution. | | | | |
| **References**  1. Ivanka Holclajtner-Antunović, Opšti kurs fizičke hemije, Zavod za udžbenike i nastavna sredstva Beograd, 2000.  2. Spasoje Đ. Đorđević, Vera J. Dražić, Fizička hemija, Univerzitet u Beogradu, Tehnološkometalurški fakultet, Beograd, 2000.  3. Dragica Minić, Ankica Antić-Jovanović, Fizička hemija, Fakultet za fizičku hemiju Beograd, 2005.  4. Mirjana Obradović i grupa autora, Zbirka zadataka iz fizičke hemije, Univerzitet u Nišu, Filozofski fakultet Niš, 1995.  5. Ljiljana Vračar i grupa autora, Eksperimentalna fizička hemija, Tehnološko-metalurški fakultet Beograd, 1990. | | | | |
| **Active teaching classes** | **Lectures** 45 | | **Laboratory work** 30 | |
| **Teaching mode**  Lectures, theoretical exercise, laboratory work | | | | |
| **ASSESSMENT METHODS AND CRITERIA (Max 100 points)** | | | | |
| **Pre exam duties** | **Points** | **Final exam** | | **Points** |
| Activity during lectures | 5 | Written examination | | 20 |
| Practical teaching | 15 | Oral examination | | 30 |
| Teaching colloquia | 30 |  | |  |
| Seminar |  |  | |  |