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| **Study program** Undergraduate Studies |
| **Course title** Physical chemistry of surfaces (H119C) |
| **Name of lecturer/lecturers**  Emilija Pecev Marinković |
| **Type of course** Elective |
| **Number of ECTS allocated 4** |
| **Course objectives** Expanding knowledge about processes at phase boundaries, with special emphasis on the solid/liquid phase boundary, deepening knowledge of thermodynamic analysis of surface phenomena and improving characterization skills processes at phase boundaries that are important for understanding numerous phenomena in the environment and adsorption-catalytic processes. Students are introduced to basic thermodynamic principles and concepts in consideration of the solid phase. Students gain knowledge about the basic thermodynamic quantities of states; balance and system stability; the theory of phase diagrams and their application in the control of the formation of individual phases specific composition and properties in heterogeneous systems and phase transformations through examples; basics thermodynamics of surfaces and interfaces. |
| **Course outcomes**. After completing the course, the student will be able to:- fully understands the processes that take place at the boundaries of phases,- independently plans and performs testing of the characteristics of the adsorbent and the adsorption process,- based on the obtained results, explain and interpret the observed surface phenomena by applying modern theory surface phenomena and processes. |
| **SYLLABUS***Lectures* Chemical and physical interactions between surfaces and particles. Surface tension of liquid. Determination methods. Laplace's equation. Vapor pressure of a spherical droplets. Kelvin's equation. Surface energy of crystals. Formation new phases. Condensation. Crystallization. Growth and structure of solid surfaces. Speed of processes on surfaces. Mechanism of heterogeneous catalysis. Catalytic activity on solid surfaces. Degree of adsorption. Speeds surface processes. Multilayer adsorption. Nature of adsorbents and adsorbed phase. Application of adsorption. Gas solution adsorption isotherm. Thermodynamic conditions of gas adsorption on a solid substance. Adsorption at the solid/gas interface. Adsorption of gases on solid bodies. Thermodynamics adsorption isotherms. Capillarity. Surface pressure and surface free energy. Young-Laplace equation. Capillary growth method. Maximum bladder pressure. Methods based on the static bubble drop shape. Dynamic method of surface pressure measurement. Adsorption at the solid/liquid interface. Nature and thermodynamics liquid boundary surfaces. Single-component systems. Surface tension in solutions. Thermodynamics of binaries system. Thermodynamics of surfaces. Surface pressure of the solution. Effects of pressure on surface tension. Kelvin equation. Thermodynamic conditions of liquid surface pressure. Thermodynamics on the boundary surface solid/liquid. Polymer adsorption. Irreversible adsorption. Adsorption in binary liquid systems. Adsorption on natural adsorbents (geosorbents). Geosorption and the concept of retardation. Electrical aspects of chemistry surface area. Electrolyte adsorption. Double electrical layer. Free energy of the double diffuse layer. Electrophoresis. Electroosmosis. Influence of ions on electrokinetic effects. Electrocapillary phenomena. Colloidal state. Surfaces and colloids. Thermodynamics of surfaces and between surfaces; Phenomena at the phase boundary as a consequence of anisotropy of surface tension and surface curvature. Phase transformations (nucleation). |
| **References**1. S. Đ. Đorđević, V. J. Dražić, Fizička hemija, Tehnološko-metalurški fakultet, Beograd, 1987.2. Holclajtner-Antunović, I.D., Opšti kurs fizičke hemije, Zavod za udžbenike – Beograd, 2012.3. G. M. Barrow, Physical chemistry 6th edition, The Mc Graw-Hill Companies, New York, USA, 1996.4. G. Woodbury, Physical Chemistry, Brooks/Cole Publishing Company, USA, 1997.5. Atkins Peter, Julio De Paula, Physical chemistry,9th edition, Oxford University Press, New York, 2010.6. Stevanović, M., Heterogena ravnoteža, Zavod za udžbenike, Beograd, 1998.7. Đaković, Lj., Koloidna hemija, Zavod za udžbenike i nastavna sredstva, Beograd, 2006. |
| **Active teaching classes** | **Lectures 30** | **Laboratory work 15** |
| **Teaching mode** Lectures, colloquiums, seminars, consultations |
| **ASSESSMENT METHODS AND CRITERIA (Max 100 points)** |
| **Pre exam duties** | **Points** | **Final exam**  | **Points** |
| Activity during lectures | 5 | Written examination | / |
| Practical teaching | 20 | Oral examination | 30 |
| Colloquiums | 40 |  |  |
| Seminars | 5 |  |  |