

UČNI NAČRT PREDMETA / COURSE SYLLABUS

Predmet:	IZBRANA POGLAVJA IZ EKSPERIMENTALNE FIZIKALNE KEMIJE
Course Title:	SELECTED TOPICS IN EXPERIMENTAL PHYSICAL CHEMISTRY

Študijski program in stopnja Study Programme and Level	Študijska smer Study Field	Letnik Academic Year	Semester Semester
DR Kemijske znanosti, 3. stopnja	/	1.	1. in 2.
Doctoral programme in Chemical Sciences, 3 rd Cycle	/	1 st	1 st and 2 nd

Vrsta predmeta / Course Type:

Univerzitetna koda predmeta / University Course Code:

Predavanja Lectures	Seminar Seminar	Vaje Tutorial	Klinične vaje Work	Druge oblike študija	Samost. delo Individual Work	ECTS
	30	15 LV /30 SV			75	5

Nosilec predmeta / Lecturer:

Jeziki / Languages:

Predavanja / Lectures:

Vaje / Tutorial:

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:

Prerequisites:

Vsebina:

Content (Syllabus outline):

teorija rentgenskega sipanja. Modelni izračuni: sferični, paličasti in ploščati delci. Eksperimentalni sistem. Analiza eksperimentalnih podatkov. Primeri uporabe.

- *Raziskava ergodijskih in neergodijskih sistemov z metodo SLS in različnimi inačicami metode DLS.* Splošna teorija sipanja laserske svetlobe. Specifične lastnosti eksperimentalnih sistemov običajne, 3D, 'echo' in 'multi-speckle' inačice DLS. Analiza eksperimentalnih podatkov. Primeri uporabe.
- *Termodinamske raziskave asociacijskih procesov v raztopinah.* Asociacija ionov v raztopinah elektrolitov. Termodinamika micelizacije ionskih in neionskih površinsko aktivnih snovi (izotermna titracijska kalorimetija, izotermna titracijska konduktometrija, Philipsov kriterij, psevdofazni separacijski model, ravnotežni model, določanje stopnje ionizacije micel).
- *Kompleksni koloidni sistemi.* Asociirajoči sistemi: surfaktanti, polimeri in polielektroliti ter mešani sistemi. Medmolekulska asociacija in geliranje. Fazno obnašanje in strukture. Eksperimentalne tehnike za študij asociacije.
- *Vodne raztopine polielektrolitov.* Sintezni principi in analiza vzorcev polielektrolitov. Osnovna karakterizacija polielektrolitov: določanje topnostnih krivulj, ionizacijske konstante, titracijske krivulje. Modelska analiza izmerjenih termodinamskih in transportnih lastnosti polielektrolitov v povezavi s strukturo polielektrolita.

calorimetric techniques in correlation with structure and function of biological macromolecules.

- *Structural investigation of nano-systems by small angle x-ray scattering.* General scattering theory. Model calculations: Spherical, rod-like and flat particles. Experimental setup. Data treatment and evaluation. Practical applications.
- *Investigation of ergodic and non-ergodic systems by SLS and various DLS methods.* General theory of light scattering. Specific properties of auto-correlation, 3D, echo, and multi-speckle DLS experimental systems. Practical applications.
- *Thermodynamics of the association processes in solutions.* Ion association in the electrolyte solutions. Thermodynamic of micelle formation of ionic and non-ionic surfactants (isothermal titration calorimetry, isothermal titration conductometry, Philips's criterion, pseudo-phase separation model, equilibrium model, degree of ionization of the micelles).
- *Complex colloid systems.* Associating systems: surfactants, polymers and polyelectrolytes, and mixed polymer-surfactant systems. Intermolecular association and gelation. Phase behavior and structures. Experimental techniques for studying associating systems.
- *Aqueous solutions of polyelectrolytes.* Principles of synthesis and analytics of polyelectrolytes samples. Basic characterization of polyelectrolytes: determination of solubility curves, ionization constants, titration curves. Model analysis of measured thermodynamic and transport properties of polyelectrolytes in correlation with the polyelectrolyte structure.

Temeljna literatura in viri / Readings:

Aktualna klasična in najnovejša literatura (monografije, članki) z izbranega študijskega področja. / Relevant classical and modern literature (books, scientific articles) from the chosen research field.

Cilji in kompetence:

V okviru tega predmeta študent pridobi specialistična znanja z ožjega področja. Ta znanja zadostujejo za samostojno vodenje

Objectives and Competences:

During the learning process students acquire high-level knowledge from a narrow focused scientific field. With the experience they gain

znanstvene raziskave na izbranem raziskovalnem področju.

they will be able to carry out research autonomously in a chosen research field.

Predvideni študijski rezultati:

Znanje in razumevanje

Predmet združuje teorijsko in praktično znanje z razumevanjem ter uporabo raznih eksperimentalnih tehnik v fizikalni kemiji: kalorimetrija, spektrometrija, meritve električne prevodnosti, statično in dinamično sipanje, itd. Študentje se seznanijo z analizo in interpretacije rezultatov meritev pri posamezni metodi.

Uporaba

Študentje se poglobljeno seznanijo z uporabo kalorimetričnih, spektrometričnih in osmometričnih metod, metod sipanja in drugih fizikalnih metod za določitev fizikalnih lastnosti raznih bioloških in koloidnih sistemov, raznih raztopin ter fizikalnih značilnosti kemijskih reakcij oziroma procesov.

Refleksija

Študent pridobi občutek za povezavo med teorijskim ozadjem določene metode, inštrumentom in eksperimentalno izvedbo meritev. S pridobljenim znanjem bo kritično presodil in ovrednotil eksperimentalne rezultate v okviru raziskovalnega dela.

Prenosljive spretnosti

Predmet nadgrajuje sistematičnost pristopov pri izvajanju raziskovalnih projektov z ovrednotenjem in poročanjem o rezultatih pridobljenih z različnimi eksperimentalnimi tehnikami.

Intended Learning Outcomes:

Knowledge and Comprehension

The course combines theoretical and practical knowledge to the understanding and application of various experimental techniques in physical chemistry: calorimetry, spectroscopy, electrical conductivity measurements, static and dynamic scattering, etc. . Students are introduced to the analysis and interpretation of experimental results at each method.

Application

Students are deeply introduced to the application of calorimetric and spectrometric method, osmometry, scattering and other physical methods to determine the physical properties of various biological and colloidal systems, solutions and various physical characteristics of chemical reactions and processes.

Analysis

Student obtains a sense for connection between the theoretical background of a specific method, instrument and experimental implementation of measurement. The gained knowledge will help him at critically assessment and evaluation of the experimental results in the context of research work.

Skill-transference Ability

The course upgrades systematic approaches in the implementation of research work by evaluating and reporting on the results obtained by different experimental techniques.

Metode poučevanja in učenja:

Metode so prilagojene študentu oziroma skupini: predavanja, študij ustrezne strokovne literature, laboratorijsko delo na izbranem področju in razprave v ožji skupini.

Learning and Teaching Methods:

Literature study, problem-based work in a laboratory, and discussions in the research group.

Delež (v %) /

Načini ocenjevanja:

Weight (in %) **Assessment:**

Način preverjanja znanja se dogovori individualno z vsakim študentom

The assessment method is determined in agreement with every single student

doktorskega študija in se lahko izvaja v obliki ustnega in/ali pisnega izpita, seminarja ali izdelave projekta oziroma pisanja znanstvenega članka.	50 % 50 %	and can be carried out as an oral and/or written exam, a seminar work, a project work, or writing a scientific article.
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Reference nosilca / Lecturer's references:

- A. Apelblat, M. Bešter-Rogač, J. Barthel, R. Neueder: "An analysis of electrical conductances of aqueous solutions of polybasic organic acids. Benzenhexacarboxylic (mellitic) acid and its neutral and acidic salts" *J. Phys. Chem. B* 2006, 110, 8893-8906.
- M. Bešter-Rogač, A. Stoppa, J. Hunger, G. Hefter, R. Buchner: "Association of ionic liquids in solution : a combined dielectric and conductivity study of [bmim][Cl] in water and in acetonitrile" *Phys. Chem. Chem. phys.* 2011, 13, 17588-17598.
- A. Kroflič, A. Apelblat, M. Bešter-Rogač: "Dissociation constants of parabens and limiting conductances of their ions in water" *J. Phys. Chem. B* 2012, 116, 1385-1392.
- A. Kroflič, B. Šarac, M. Bešter-Rogač: "Thermodynamic characterization of CHAPS micellization using isothermal titration calorimetry: temperature, salt, and pH dependence" *Langmuir* 2012, 28, 10363-10371.
- B. Šarac, G. Meriguet, B. Ancian, M. Bešter-Rogač: "Salicylate Isomer-Specific Effect on the Micellization of Dodecyltrimethylammonium Chloride: Large Effects from Small Changes " *Langmuir* 2013, 29, 4460-4469.