

FIZIKALNA KEMIJA TEKOČIN IN RAZTOPIN

UČNI NAČRT PREDMETA/COURSE SYLLABUS

Predmet:	Fizikalna kemija tekočin in raztopin
Course title:	PHYSICAL CHEMISTRY OF LIQUIDS AND SOLUTIONS
Članica nosilka/UL	UL FKKT
Member:	

Študijski programi in stopnja	Študijska smer	Letnik	Semestri	Izbirnost
Kemija, prva stopnja, univerzitetni	Ni členitve (študijski program)	2. letnik, 3. letnik		izbirni

Univerzitetna koda predmeta/University course code:	0086912
Koda učne enote na članici/UL Member course code:	KESI10

Predavanja /Lectures	Seminar /Seminar	Vaje /Tutorials	Klinične vaje /Clinical tutorials	Druge oblike študija /Other forms of study	Samostojno delo /Individual student work	ECTS
30	30	15 LV			75	5

Nosilec predmeta/Lecturer:	doc. dr. Bojan Šarac, prof. dr. Marija Bešter Rogač
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Vrsta predmeta/Course type:	izbirni/elective
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Jeziki/Languages:	Predavanja/Lectures:	Slovenščina
	Vaje/Tutorial:	Slovenščina

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

Študent oz. kandidat mora imeti predmet opredeljen kot študijsko obveznost.	The course has to be assigned to the student.
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Vsebina:

Tekočine: klasifikacija tekočin, medmolekulske sile, urejenost v tekočinah, enačbe stanja.
Osnovne fizikalne in kemijske lastnosti tekočin: molska masa in molski volumen, vrelišča in tališča.
Termodinamske lastnosti čistih tekočin: termodinamika faznih ravnotežij, enostavni fazni diagrami.
Tekoči kristali: urejenost in molekularna struktura v tekočih kristalih.
Polarne tekočine: dielektrične lastnosti, voda, strukturne lastnosti tekoče vode, nevodne polarne tekočine.
Nepolarne tekočine: klasifikacija, donorsko in akceptorsko število

Content (Syllabus outline):

The liquid state of matter: classes of liquids, order in liquids, equations of state. Basic physical and chemical properties of liquids: molar mass and molar volume, boiling and freezing points. Thermodynamic properties of pure liquids: thermodynamic of phase equilibria, single-component phase diagrams. Liquids crystals: order in liquid crystals, molecular structure in the mesophase. Polar liquids: dielectric properties, water, structural models of liquid water, non-aqueous polar solvents. Non-polar liquids: classification, donor and acceptor numbers. Solute-solvent interactions: electrostatic interaction, polarization, dispersion forces, repulsion interactions, hydrophobic ("solvophobic") interactions. Mixtures of non-electrolytes: thermodynamic properties of liquid mixtures, ideal and non-ideal mixing, solubility,

<p>Klasifikacija interakcij topljenec-topilo: elektrostatske interakcije, polarizacija, dispresijske sile, odbojne interakcije, hidrofobne («solvofobne») interakcije. Mešanice neelektrolitov: termodinamske lastnosti tekočih mešanic, idealne in neidealne mešanice, topnost, superkrično stanje. Fazni diagrami večkomponentnih sistemov: fazno pravilo, ravnotežje tekočina–para v binarnih sistemih, ravnotežje trdno-tekoče v binarnih sistemih, ternarni sistemi, porazdelitveni koeficient. Osnovni principi topnosti: parametri topnosti, Hansen-ovi parametri topnosti. Mešana topila: dielektrične lastnosti, viskoznost, vpliv mešanih topil na kemijsko ravnotežje (selektivna solvatacija, asociacija ionov), donor-akceptor lastnosti. Ionske tekočine: struktura, klasifikacija, lastnosti, mešanice ionskih in neionskih tekočin, uporaba.</p>	<p>supercritical state. Phase diagrams for multicomponent systems: phase rule, vapour-liquid equilibrium with two components, liquid-solid equilibrium with two components, three-component liquids, partition coefficients. Basic solubility principles: solubility parameters, Hansen parameters. Mixed solvents: dielectric properties, viscosity, the effect of mixed solvents on the chemical equilibria (selective solvation, ion association), donor-acceptor properties. Ionic liquids: structure, classification, properties, mixtures of ionic and non-ionic liquids, application.</p>
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Temeljna literatura in viri/Readings:

Osnovna literatura:

M. Bešter-Rogač, Zapiski predavanj, FKKT, 2018.

J.N. Murrell and A.D. Jenkins, Properties of Liquids and Solutions, 2nd Edition Wiley Interscience, 1997, 250 strani.

Dodatna literatura:

P. Atkins and J. de Paula, Physical Chemistry, 9th Edition, Oxford University Press, 2010, Chapter 17, pp 622-643.

C. Reichardt and T. Welton, Solvents and Solvent Effects in Organic Chemistry, 4th Edition, Wiley-VCH, 2010, Chapters 2 and 3, pp. 7-99.

R. Hayes, G. G. Warr, R. Atkin, Structure and Nanostructure in Ionic Liquids, Chem. Rev., 2015, 115, 6357–6426.

Cilji in kompetence:

Cilj predmeta je nadgradnja osnovnega znanje fizikalne kemije tekočin in raztopin. Kompetence: Poudarjeno je poznavanje specifičnih lastnosti tekočin in raztopin, ki določajo tudi njihovo uporabo.

Objectives and competences:

The objective of the course is to upgrade the basic knowledge of the physical chemistry of liquids and solutions. Competencies: The knowledge of specific properties, which also determines their use, is emphasized.

Predvideni študijski rezultati:

Znanje in razumevanje
Razumevanje lastnosti tekočin in raztopin na molekularnem nivoju ter povezava le-teh z makroskopskimi lastnostmi.
Uporaba
Večina reakcij (tudi v industrijskem merilu) poteka v tekočem mediju, biokemijski in naravni sistemi so povezani s tekočim stanjem. Predmet bo tako uporaben za različna področja (kemija, biokemija, farmacija, vede o materialih in okolju) pri obravnavi tekočin bodisi praktično v laboratoriju ali kot osnova za razumevanje.
Refleksija
Sposobnost razumevanja problematike in sposobnost kreativnega reševanja praktičnih problemov povezanih z tekočinami in raztopinami.
Prenosljive spretnosti

Intended learning outcomes:

Knowledge and Comprehension
Understanding properties of liquids and solutions at both the thermodynamic on molecular level and connection to their macroscopic properties.
Application
Ability to follow the current research in the field of liquids and solutions, to interpret the processes carried out in the liquid state (synthesis, separation) and to solve relevant problems in chemistry, biochemistry, pharmacy, environmental science.
Analysis
Ability of understanding and creative solving of practical problems connected with liquids and solutions.
Skill-transference Ability

Spretnosti izbiranja in uporabe strategij, metod in interpretacije rezultatov povezanih z tekočinami in raztopinami na različnih področjih.	The ability of choosing and application of the strategies, methods and interpretation of data of liquids and solutions in different fields
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Metode poučevanja in učenja:

Predavanja, seminarji z reševanjem problemov, seminarske naloge

Learning and teaching methods:

Lectures, seminars with solving of problems, seminar projects

Načini ocenjevanja:

Delež/Weight

Assessment:

- pisni izpit	50,00 %	written exam
- seminarska naloga	50,00 %	seminar project
ocene: pozitivno 6-10; negativno 1-5		marks: positive 6-10, negative 1-5

Reference nosilca/Lecturer's references:

1. TOMAŠ, Renato, TOT, Aleksandar, KUHAR, Jure, **BEŠTER-ROGAČ, Marija**. Interactions in aqueous solutions of imidazolium chloride ionic liquids [C_nCnmim][Cl] (n=0, 1, 2, 4, 6, 8) from volumetric properties, viscosity B-coefficients and molecular dynamics simulations. Journal of molecular liquids,.. 2018, 254, 267-271.
2. ZEC, Nebojša, **BEŠTER-ROGAČ, Marija**, VRANEŠ, Milan, GADŽURIĆ, Slobodan. Volumetric and viscosimetric properties of [bmim][DCA] + γ -butyrolactone binary mixtures. Journal of Chemical Thermodynamics, 2016, 97, 307-314.
3. **BEŠTER-ROGAČ, Marija**, FEDOTOVA, Marina V., KRUČININ, Sergej, KLÄHN, Marco. Mobility and association of ions in aqueous solutions : the case of imidazolium based ionic liquids. PCCP. Physical chemistry chemical physics .2016, 18, 28594-28605.
4. **BEŠTER-ROGAČ, Marija**, STOPPA, Alexander, BUCHNER, Richard. Ion association of imidazolium ionic liquids in acetonitrile. The journal of physical chemistry. B, Condensed matter, materials, surfaces, interfaces & biophysical, , 2014, vol. 118, no. 5, str. 1426-1435,
5. **ŠARAC, Bojan**, HADŽI, San. Analysis of protonation equilibria of amino acids in aqueous solutions using Microsoft Excel. J. Chem. Educ., 2021, 98, 1001-1007.
6. **ŠARAC, Bojan**, **BEŠTER-ROGAČ, Marija**. The influence of ionic liquids on micellization of sodium dodecyl sulfate in aqueous solutions. Acta Chim. Slov., 2020, 67, 977-984,
7. **ŠARAC, Bojan**, MEDOŠ, Žiga, COGNIGNI, Alice, BICA, Katharina, CHEN, Li-Jen, **BEŠTER-ROGAČ, Marija**. Thermodynamic study for micellization of imidazolium based surface active ionic liquids in water : effect of alkyl chain length and anions. Colloids Surfa. A, 2017, 532, 609-617.