

## UČNI NAČRT PREDMETA / COURSE SYLLABUS

**Predmet:** MAKROMOLEKULARNA KEMIJA  
**Course Title:** MACROMOLECULAR CHEMISTRY

Študijski program in stopnja Study Programme and Level	Študijska smer Study Field	Letnik Academic Year	Semester Semester
UŠP Kemija, 1. stopnja	/	3.	6.
USP Chemistry, 1 <sup>st</sup> Cycle	/	3 <sup>rd</sup>	6 <sup>th</sup>

**Vrsta predmeta / Course Type:** izbirni strokovni / Elective Professional

**Univerzitetna koda predmeta / University Course Code:** KESI12

Predavanja Lectures	Seminar Seminar	Vaje Tutorial	Klinične vaje Work	Druge oblike študija	Samost. delo Individual Work	ECTS
45	30	/	/	/	75	5

**Nosilec predmeta / Lecturer:** izr. prof. dr. Miha Lukšič / Dr. Miha Lukšič, Associate Professor

**Jeziki / Languages:** slovenski / Slovenian  
**Predavanja / Lectures:** /  
**Vaje / Tutorial:** /

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

Študent oz. kandidat mora imeti predmet opredeljen kot študijsko obveznost.

**Prerequisites:**

The course has to be assigned to the student.

**Vsebina:**

**Osnove:** Klasifikacija makromolekul. Mehanizmi in načini polimerizacije. Pogosti naravni in sintetični polimeri. Prevodni polimeri, aplikacije v industriji elektronike.  
**Kinetika reakcij polimerizacije:** Radikalna in kondenzacijska polimerizacija. Vplivi na hitrost reakcije in povprečno kinetično stopnjo polimerizacije.  
**Statistika linearnih polimerov:** Porazdelitve in povprečja molskih mas polimerov, polidisperznost. Povprečne dimenzije polimerov v raztopini: razdalja od konca do konca, radij sukanja. Naključni klobčič, Kuhnov model. Porazdelitvena funkcija za razdaljo od konca do konca, izključeni volumen.

**Content (Syllabus outline):**

**Introduction:** Classification of macromolecules. Mechanisms and ways of polymerization. Common natural and synthetic polymers. Conductive polymers, applications in electronics industry.  
**Kinetics of polymerization reactions:** Radical and condensation polymerization. Influences on the reaction rate and average kinetic degree of polymerization.  
**Statistics of linear polymers:** Molecular weight distributions and averages, polydispersity. Average dimensions of polymers in solution: end-to-end distance, radius of gyration. Random coil, Kuhn model. Distribution function for end-to-end distance, excluded volume.

**Makromolekule v raztopini:** Vpliv interakcij segment-segment in segment-topilo na povprečne dimenzije, klasifikacija topil. Koncentracijski režimi. Raztopine nabitih makromolekul, Donnanovo ravnotežje. Fazna ravnotežja, točka zmotnitve.

**Eksperimentalne metode karakterizacije:** Analiza končnih skupin, viskoznost, sipanje svetlobe, osmometrija, sedimentacija in difuzija, kromatografija.

**Lastnosti polimerov:** Kristaliničnost, amorfnost. Temperatura steklastega prehoda. Osnovni principi razgradnje polimerov.

**Macromolecules in solution:** Influence of the segment-segment and segment-solvent interactions on the average dimensions, solvent classification. Concentration regimes. Solutions of charged macromolecules, Donnan equilibrium. Phase equilibria, cloud point.

**Experimental methods for characterization:** End-group analysis, viscosity, light scattering, osmometry, sedimentation and diffusion, chromatography.

**Properties of polymers:** Crystallinity, amorphousness. Glass transition temperature. Basic principles of polymer degradation.

#### Temeljna literatura in viri / Readings:

1. S. Lapajne in C. Pohar, *Makromolekulska kemija*, Ljubljana: Fakulteta za kemijo in kemijsko tehnologijo, 2000.
2. J. M. G. Cowie in V. Arrighi, *Polymers: chemistry and physics of modern materials*, Boca Raton: CRC Press, 2007.
3. S. F. Sun, *Physical chemistry of macromolecules: Basic principles and issues*, New York: John Wiley & Sons, 2004.
4. M. D. Lechner, K. Gehrke, E. H. Nordmeier, *Makromolekulare Chemie Ein Lehrbuch für Chemiker, Physiker, Materialwissenschaftler und Verfahrenstechniker*, Berlin: Springer-Verlag, 2014

#### Cilji in kompetence:

**Cilj** predmeta je poglobiti fizikalnokemijska znanja pomembna za aplikativno in osnovno raziskovalno delo na področju makromolekulske oziroma polimerne kemije.

**Kompetence:** Poznavanje in uporaba kinetike polimernih reakcij, termodinamskih lastnosti raztopin makromolekul, modernih eksperimentalnih tehnik za karakterizacijo in določanje fizikalnokemijskih lastnosti polimerov.

#### Objectives and Competences:

To obtain the knowledge in physical chemistry of macromolecules needed for further use in basic and applied research.

Toward understanding the kinetics of polymer reactions, physico-chemical properties of macromolecules in solution and experimental techniques for their determination.

#### Predvideni študijski rezultati:

##### Znanje in razumevanje

Slušatelj spozna glavne fizikalnokemijske značilnosti makromolekularnih sistemov, ki omogočajo razumevanje njihovih lastnosti.

##### Uporaba

Pridobljena znanja so pomembna in koristna

#### Intended Learning Outcomes:

##### Knowledge and Comprehension

Students learn basic principles of physico-chemical behaviour of macromolecules in solution and their experimental determination.

##### Application

The knowledge can be applied in further

za uspešno aplikativno in osnovno raziskovalno delo.	research or applicative work in this area of science.
<u>Refleksija</u> Študenti spoznajo tesno povezanost med strukturo in lastnostmi polimernih snovi in med teorijo in eksperimentom.	<u>Analysis</u> Students become aware of the connection between the structure of macromolecule and its properties in solution. The knowledge allows them to correlate theory and experiment.
<u>Prenosljive spretnosti</u> Sposobnost zaznavanja in reševanja problemov, ki zadevajo makromolekularne sistema. Sposobnost samostojnega študija in poročanja o svojem delu in rezultatih.	<u>Skill-transference Ability</u> The ability of problem-solving in chemistry. The experimental methods, used to study macromolecules in solution, can be applied in other areas of research. Increased capability of individual study and presentation of the results in form of the oral and written report.

**Metode poučevanja in učenja:**

Predavanja in seminarji

**Learning and Teaching Methods:**

Lectures and seminars.

**Načini ocenjevanja:**

Ustni in pisni izpit

Delež (v %) /

Weight (in %) **Assessment:**

**100 %**

Oral and written exam

**Reference nosilca / Lecturer's references:**

- **LUKŠIČ, Miha**, BONČINA, Matjaž, VLACHY, Vojko, DRUCHOK, M. Isothermal titration calorimetry and molecular dynamics study of ion-selectivity in mixtures of hydrophobic polyelectrolytes with sodium halides in water. PCCP. Physical chemistry chemical physics, 2012, 14 (6), 2024-2031  
- **LUKŠIČ, Miha**, BUCHNER, Richard, HRIBAR, Barbara, VLACHY, Vojko. Dielectric relaxation spectroscopy of aliphatic ionene bromides and fluorides in water: the role of the polyion's charge density and the nature of the counterions. Macromolecules, 2009, 42 (12), 4337-4342  
- RODIČ, Peter, BRATUŠA, Marsel, **LUKŠIČ, Miha**, VLACHY, Vojko, HRIBAR, Barbara. Influence of the hydrophobic groups and the nature of counterions on ion-binding in aliphatic ionene solutions. Colloids and surfaces. A, Physicochemical and Engineering Aspects, 2013, 424 (1), 18-25.