



Univerza v Mariboru

Fakulteta za naravoslovje  
in matematiko

### UČNI NAČRT PREDMETA / COURSE SYLLABUS

<b>Predmet:</b>	<b>Fizika polimerov</b>
<b>Course title:</b>	<b>Physics of polymers</b>

Študijski program in stopnja Study programme and level	Študijska smer Study field	Letnik Academic year	Semester Semester
FIZIKA		1. ali 2.	1., 2. ali 3.
PHYSICS		1. or 2.	1., 2. or 3.

**Vrsta predmeta / Course type**

Izbirni za modula Biofizika 3 in Fizika 1, 2, 3

**Univerzitetna koda predmeta / University course code:**

Predavanja Lectures	Seminar Seminar	Vaje Tutorial	Lab. vaje Laboratory work	Terenske vaje Field work	Samost. delo Individ. work	ECTS
10	5				435	15

**Nosilec predmeta / Lecturer:**

Lea Spindler

**Jeziki /**

**Languages:**

**Predavanja /**

**Lectures:**

**Vaje / Tutorial:**

slovenski/Slovenian

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

Priporočljivo je predznanje s področij fizike mehke snovi, fizike materialov in statistične termodinamike

**Prerequisites:**

Preknowledge from the following fields of physics is recommended: soft matter physics, physics of materials and statistical thermodynamics

**Vsebina:**Osnove polimerov

- osnovne definicije, konfiguracije polimernih verig, modeli za masno porazdelitev

Statistična termodinamika polimernih raztopin

- splošne termodinamske zveze, entropija mešanja, razredčene polimerne raztopine

Fazno ravnovesje v polimernih sistemih

- fazno ravnovesje v polimernih tekočinah in kristalih

Polimeri s kompleksno strukturo

- polimerne mešanice, sestavljeni linearni in zvezdasti sistemi, interakcijski parameter

Lastnosti raztopin in metode za karakterizacijo

- masna porazdelitev, viskoznost, osmotski pritisk, difuzija, mikrofazna separacija  
- sipanje vidne in rentgenske svetlobe, sipanje nevtronov, cirkularni dikroizem, elektronska mikroskopija, jedrska magnetna resonanca, elektronska in IR spektroskopija,

Polimeri na površinah in metoda za karakterizacija

- termodinamika prostih površin, površinska napetost, urejanje v tankih plasteh  
- elektronska mikroskopija, mikroskopija na atomsko silo

Pomembnost in uporaba polimerov**Content (Syllabus outline):**Polymer basics

- primary definitions, configuration of polymer chains, models of molecular weight distributions

Statistical thermodynamics of polymer solutions

- general thermodynamic relations, entropy of mixing, dilute polymer solutions

Phase equilibria in polymer systems

- phase equilibria in liquid and crystalline polymer systems

Polymers with complex structure

- polymer blends, block copolymers with linear and starlike geometries, interaction parameters

Solution properties and characterisation

- mass distributions, viscosity, osmotic pressure, diffusion  
- light scattering, x-ray and neutron scattering, circular dichroism, electron microscopy, nuclear magnetic resonance, electronic and infrared spectroscopy

Polymer on surfaces and characterisation

- thermodynamics of free surfaces, surface tension, ordering in thin films  
- electron microscopy, atomic force microscopy (AFM)

Modern applications and use of polymers**Temeljni literatura in viri / Readings:**

- 1) S.F. Sun: Physical Chemistry of Macromolecules (John Wiley & Sons, New York, 1994)
- 2) R.J. Young, P.A. Lovell: Introduction to Polymers, 3rd edition (CRC Press, Boca Raton, 2011)
- 3) L.H. Sperling, Introduction to physical polymer science, 4th edition (Wiley-Interscience, 2006).
- 4) M. Doi, S.F. Edwards: The Theory of Polymer Dynamics (Oxford University Press, New York, 2001)

5) J. Israelachvili, Intermolecular and Surface Forces, 3rd edition (Academic Press, San Diego, 2011)

**Cilji in kompetence:**

Študenti poglobijo znanje s področja polimernih sistemov in dobijo pregledno znanje o eksperimentalnih metodah, teoretičnih modelih in moderni uporabi polimerov.

**Objectives and competences:**

Students acquire a deeper knowledge on polymer systems and gain an overview of experimental methods, theoretical models and applications of polymers.

**Predvideni študijski rezultati:**

Znanje in razumevanje:  
  
Razumevanje fizikalnih pojavov iz področja polimernih sistemov  
Prenesljive/ključne spretnosti in drugi atributi:  
  
Različni eksperimentalni pristopi, računske metode za opis polimerov in celoten pristop k reševanju problemov.

**Intended learning outcomes:**

Knowledge and understanding:  
  
Knowledge and understanding of physical laws in polymer systems  
Transferable/Key Skills and other attributes:  
  
Different experimental techniques, numerical methods for describing polymers, and an integral approach to problem solving

**Metode poučevanja in učenja:**

Metodika obsega teoretičen uvod v obravnavano snov in reševanje posameznih problemov.

**Learning and teaching methods:**

They are based on theoretical introduction and on solving of specific problems.

	Delež (v %) / Weight (in %)	Assessment:
<b>Načini ocenjevanja:</b>		
Način (pisni izpit, ustno izpraševanje, naloge, projekt)		Type (examination, oral, coursework, project):
ustni izpit	50%	oral exam
seminar	50%	seminar

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

1. SPINDLER, Lea, RIGLER, Martin, DREVENŠEK OLENIK, Irena, HESSARI, Nason Ma'ani, WEBBA DA SILVA, Mateus. Effect of base sequence on G-wire formation in solution. V: ERITJA, Ramon (ur.), et al. *G-Quadruplex Nucleic Acids*, (Journal of Nucleic Acids, ISSN 2090-021X, 2010). [S. l.]: SAGE-Hindawi Access to Research, 2010, vol. 2010, str. 431651-1-431651-8, doi: [10.4061/2010/431651](https://doi.org/10.4061/2010/431651). [COBISS.SI-ID [23737127](https://www.cobiss.si/id/23737127)]
2. MARIANI, Paolo, SPINOZZI, Francesco, FEDERICONI, Francesco, ORTORE, M. G., AMENITSCH, Heinz, SPINDLER, Lea, DREVENŠEK OLENIK, Irena. Guanosine quadruplexes in solution : a small-angle X-ray scattering analysis of temperature effects on self-assembling of deoxyguanosine monophosphate. V: ERITJA, Ramon (ur.), et al. *G-Quadruplex Nucleic Acids*, (Journal of Nucleic Acids, ISSN 2090-021X, 2010). [S. l.]: SAGE-Hindawi Access to Research, 2010, vol. 2010, str. 472478-1-472478-10, doi: [10.4061/2010/472478](https://doi.org/10.4061/2010/472478). [COBISS.SI-ID [23736871](https://www.cobiss.si/id/23736871)]

- 3.** MARIANI, Paolo, SPINOZZI, Francesco, FEDERICONI, Francesco, AMENITISCH, Heinz, SPINDLER, Lea, DREVENŠEK OLENIK, Irena. Small angle x-ray scattering analysis of deoxyguanosine 5'-monophosphate self-assembling in solution : nucleation and growth of G-quadruplexes. *The journal of physical chemistry. B, Condensed matter, materials, surfaces, interfaces & biophysical*, ISSN 1520-6106, 2009, issue 22, vol. 113, str. 7934-7944, doi: [10.1021/jp809734p](https://doi.org/10.1021/jp809734p). [COBISS.SI-ID 2167652]
- 4.** KUNSTELJ, Klemen, SPINDLER, Lea, FEDERICONI, Francesco, BONN, Mischa, DREVENŠEK OLENIK, Irena, ČOPIČ, Martin. Sum-frequency generation spectroscopy of self-assembled structures of Guanosine 5'-monophosphate on mica. *Chemical Physics Letters*, ISSN 0009-2614. [Print ed.], 2008, vol. 467, no. 1/3, str. 159-163. [COBISS.SI-ID 22215975]
- 5.** WONG, Alan, RAMSEY, Ida, SPINDLER, Lea, WU, Gang. Disodium guanosine 5'-monophosphate self-associates into nanoscale cylinders at pH 8: a combined diffusion NMR spectroscopy and dynamic light scattering study. *Journal of the American Chemical Society*, ISSN 0002-7863, 2005, vol. 127, no. 19, str. 6990-6998. <http://dx.doi.org/10.1021/ja042794d>. [COBISS.SI-ID 9783574]