

## UČNI NAČRT PREDMETA / COURSE SYLLABUS

<b>Predmet:</b>	Fizika mehkih kompleksnih sistemov
<b>Course title:</b>	Soft Complex Matter Physics

Študijski program in stopnja Studyprogramme and level	Študijska smer Studyfield	Letnik Academic year	Semester Semester
FIZIKA		1. ali 2.	1. ali 2.
PHYSICS		1. or 2.	1. or 2.

**Vrsta predmeta / Course type**

Izbirni za modula Biofizika in Fizika

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

Predavanja Lectures	Seminar Seminar	Vaje Tutorial	Lab. vaje Laboratory work	Mentorstvo Mentorship	Samost. delo Individ. work	ECTS
10	5				165	6

**Nosilec predmeta / Lecturer:**

Ioannis Lelidis

**Jeziki /**

**Languages:**

**Predavanja /**

**Lectures:**

**Vaje / Tutorial:**

angleški/English

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

Predznanje iz klasične in moderne fizike in fizike trdne snovi.

**Prerequisites:**

Preknowledge of classical and modern physics and solid state physics.

**Vsebina:**

Predavanja bodo vsebovala bazična in napredna znanja s področja fizike kompleksne mehke snovi in aplikacije.

Poglavja bodo izbrana skladno z raziskovalnim delom študenta. Primeri poglavij so naslednji: statika in dinamika faznih prehodov, elastičnost in elastične nestabilnosti, fizikalne lastnosti in adsorpcija. Ilustrirane bodo ustrezne aplikacije v tekočih kristalih, koloidih, polimerih, elektrolitih in bioloških sistemih. Predstavljena bodo številne eksperimentalne meritve in analize merjenih rezultatov (impedančna spektroskopija, optične in

**Content (Syllabus outline):**

The lectures will cover basic and advanced topics in Soft Matter Physics, applications will be discussed.

Topics may be chosen in accordance with the candidate's research work. Examples of topics: static and dynamics of phase transitions, elasticity and elastic instabilities, physical properties, adsorption. Applications in the fields of liquid crystals, colloids, polymers, electrolytes and bio-systems. Analysis of experimental measurements (impedance spectroscopy, optical and electro-optical measurements, systems under high external fields).

elektro-optične meritve, uporaba močnih električnih polj).

### Temeljni literatura in viri / Readings:

1. P-G de Gennes, J. Prost, The Physics of Liquid Crystals (Clarendon Press Oxford 1993)
2. M. Kleman, O. D. Lavrentovich, Soft Matter Physics (Springer-Verlag, New York, 2003)
3. P. M. Chaikin, T. C. Lubensky, Principles of Condensed Matter Physics (Cambridge University Press, Cambridge, 1995)
4. J. Selinger, Introduction to the Theory of Soft Matter: From Ideal Gases to Liquid Crystals (Springer, Heidelberg, 2016)
5. R. A. L. Jones, Soft Condensed Matter (Oxford University Press, Oxford, 2001)
6. W. B. Russel et al, Colloidal Dispersions (Cambridge University Press 1989)
7. M. E. Orazem, B. Tribollet, Electrochemical impedance spectroscopy (John Wiley & Sons, Inc, 2008)

### Cilji in kompetence:

Namen predmeta je študente usposobiti za raziskovalno delo na izbranem področju fizike kondenzirane snovi.

### Objectives and competences:

The objective of this course is to teach students how to carry out research work on a selected field within condensed matter physics.

### Predvideni študijski rezultati:

Znanje in razumevanje:

Po zaključku tega predmeta bo študent zmožen:

- analizirati, vrednotiti in primerjati najnovejše raziskave na izbranem področju fizike mehke snovi;
- uporabiti napredno fizikalno znanje in matematične metode na danem področju za analizo in vrednotenje fizikalnih pojavov v odvisnosti od relevantnih fizikalnih parametrov in spremenljivk;
- prepoznati analogije med različnimi pojavi in jih uporabiti za obravnavo novih pojavov.

Prenosljive/ključne spretnosti in drugi atributi:

### Intended learning outcomes:

Knowledge and understanding:

On completion of this course the student will be able to:

- analyse, evaluate and compare the latest research on a chosen field of soft matter physics;
- use advanced physical knowledge and mathematical methods from a specific field for an analysis and evaluation of physical effects as a function of physical parameters and variables;
- recognise analogies among different effects and apply them to describe novel physical effects.

Transferable/Key Skills and other attributes:

<ul style="list-style-type: none"> <li>- <i>Spretnosti komuniciranja</i>: ustno in pisno izražanje pri predstavitvi izbrane teme.</li> <li>- <i>Uporaba informacijske tehnologije</i>: uporaba programskih orodij za modeliranje in obdelavo podatkov.</li> <li>- <i>Reševanje problemov</i>: prepoznavanje univerzalnosti, analogij in celosten pristop k reševanju problemov.</li> </ul>	<ul style="list-style-type: none"> <li>- <i>Communication skills</i>: manner of expression at written and oral presentation of a chosen topic.</li> <li>- <i>Use of information technology</i>: use of software tools for modelling and data manipulation.</li> <li>- <i>Problem solving</i>: ability to recognize universalities, analogies, and global approach to solving problems.</li> </ul>
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#### Metode poučevanja in učenja:

Predavanja, seminarji, konzultacije, razlaga, razgovor, delo s tekstom, metoda pisnih in grafičnih del, problemsko učenje, študija primera, raziskovalno učenje, uporaba programskih orodij.

#### Learning and teaching methods:

Lectures, seminars, tutorials, explanation, discussion, work with text, work with graphic elements, case study, problem based learning, inquiry based learning, use of software tools.

		Delež (v %) / Weight (in %)	Assessment:
<b>Načini ocenjevanja:</b>			Type (examination, oral, coursework, project):
Način (pisni izpit, ustno izpraševanje, naloge, projekt)			
seminar		<b>100%</b>	seminar

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

1. A. Skarlatos, A. Martínez-de-Guerenu, D. J. Badiola, **I. Lelidis**, Interpretation of the magnetic susceptibility behaviour of soft carbon steels based on the scaling theory of second order phase transitions for systems with supercritical disorder, **J. Magnetism Magnetic Mater** 555, 169265 (2022). <https://doi.org/10.1016/j.jmmm.2022.169265>
2. G. Barbero, F. Batalioto, A. M. Figueiredo Neto, **I. Lelidis**, Deviations from linearity in impedance spectroscopy measurements confirmed by Kramers-Kronig analysis, **Electrochimica Acta** 397, 139277 (2021). <https://doi.org/10.1016/j.electacta.2021.139277>
3. G. Barbero, L. R. Evangelista, **I. Lelidis**, Effective adsorption energy and generalization of the Frumkin-Fowler-Guggenheim isotherm, **J Mol. Liq.** 327, 114795 (2021). <https://doi.org/10.1016/j.molliq.2020.114795>
4. C. Kyrou, D. Tsiourvas, S. Kralj, **I. Lelidis**, Effect of superhydrophobic nanoplatelets on the phase behavior of liquid crystals, **J. Mol. Liq.** 298, 111984 (2020). <https://doi.org/10.1016/j.molliq.2019.111984>
5. **I. Lelidis**, E. Kume, A new flexoelectric mode in twist-bend nematic liquid crystals, **J. Mol. Liq.** 295, 111701 (2019). <https://doi.org/10.1016/j.molliq.2019.111707>