



Univerza v Mariboru

Fakulteta za naravoslovje
in matematiko

UČNI NAČRT PREDMETA / COURSE SYLLABUS

Predmet:	Izbrana poglavja iz fizike mehke snovi
Course title:	Selected topics on soft matter physics

Študijski program in stopnja Study programme and level	Študijska smer Study field	Letnik Academic year	Semester Semester
FIZIKA		1. ali .2	1., 2. ali 4.
PHYSICS		1. or 2.	1., 2. or 4.

Vrsta predmeta / Course type

Izbirni za vse module

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:

Nataša Vaupotič

Jeziki /

Languages:

Predavanja /

Lectures:

Vaje / Tutorial:

slovenski/Slovenian in/and angleški s slovenskim prevodom/English with translation in Slovenian

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:

Predstavljeni bodo aktualni primeri s področja fizike mehke snovi.

Predavanja bodo pokrivala področja raziskav osnovnih principov kot tudi področje aplikacij.

Izbrane vsebine se bodo prilagajale področju znanstvenoraziskovalnega dela doktorskega študenta. Primeri vsebin: kontinuumski in diskretni modeli (različne vrste tekočih

Content (Syllabus outline):

Recent advances in soft matter physics will be presented.

The lectures will cover research of basic principles and also of applications.

Topics will be chosen in accordance with the candidate's research work. Examples of topics: continuum and discrete models (for different phases of liquid crystals, colloids, polymers...),

kristalov, koloidi, polimeri...), naravna, inducirana in strukturna kiralnost, optične, toplotne, električne, magnetne in mehanske lastnosti mehke snovi, teoretična obravnava eksperimentalnih meritev (dielektrične meritve, optične meritve, elastična in resonančna rentgenska spektroskopija...).

natural, induced and structural chirality; optical, thermal, electric, magnetic and mechanical properties of soft matter materials, theoretical studies of experimental measurements (dielectric measurements, optical measurements, elastic and resonant x-ray spectroscopy...).

Temeljni literatura in viri / Readings:

- 1) M. Kleman, O.D. Lavrentovich, *Soft Matter Physics* (Springer-Verlag, New York, 2003).
- 2) P. M. Chaikin, T. C. Lubensky, *Principles of Condensed Matter Physics* (Cambridge University Press, Cambridge, 1995).
- 3) J. Selinger, *Introduction to the Theory of Soft Matter: From Ideal Gases to Liquid Crystals* (Springer, Heidelberg, 2016).
- 4) Znanstvenoraziskovalni članki s področja obravnavanih tem

Cilji in kompetence:

Študenti poglobijo znanje s področja fizike mehkih sistemov in spoznajo najnovejše raziskave na tem področju.

Objectives and competences:

Students acquire advanced knowledge on physics of soft systems. They get acquainted with recent advances in soft matter systems.

Predvideni študijski rezultati:

Znanje in razumevanje:
 Razumevanje procesov v mehkih sistemih.
 Prenosljive/ključne spretnosti in drugi atributi:
 Rešitev problemov z matematičnimi orodji, numeričnimi metodami, univerzalnosti v fiziki in celosten pristop k reševanju problemov.

Intended learning outcomes:

Knowledge and understanding:
 Understanding of processes in soft systems.
 Transferable/Key Skills and other attributes:
 Solving of problems with mathematical tools, numerical methods, universalities in physics and gained global approach on solving a problem.

Metode poučevanja in učenja:

Predavanja, seminarji, konzultacije, izdelava seminarske naloge.

Learning and teaching methods:

Lectures, seminars, tutorials, written seminar.

Načini ocenjevanja:	Delež (v %) / Weight (in %)	Assessment:
Način (pisni izpit, ustno izpraševanje, naloge, projekt)		Type (examination, oral, coursework, project):
4 Seminarji	100%	4 Seminars

Reference nosilca / Lecturer's references:

1. MATRASZEK, Joanna, TOPNANI, Neha, VAUPOTIČ, Nataša, TAKEZOE, Hideo, MIECZKOWSKI, Jozef, POCIECHA, Damian, GÓRECKA, Ewa. Monolayer filaments versus multilayer stacking of bent-core molecules. *Angewandte Chemie*, ISSN 1433-7851. [Print ed.], 2016, vol. 55, iss. 10, str. 3468-3472, doi: [10.1002/anie.201510123](https://doi.org/10.1002/anie.201510123). [COBISS.SI-ID [29302055](#)].
2. GÓRECKA, Ewa, VAUPOTIČ, Nataša, ZEP, Anna, POCIECHA, Damian. From sponges to nanotubes : a change of nanocrystal morphology for acute-angle bent-core molecules. *Angewandte Chemie*, ISSN 1521-3773. [Online ed.], 2016, vol. 55, no. 40, str. 12238-12242, doi: [10.1002/anie.201604915](https://doi.org/10.1002/anie.201604915). [COBISS.SI-ID [29763367](#)],
3. VAUPOTIČ, Nataša, CURK, Samo, OSIPOV, Mikhail, ČEPIČ, Mojca, TAKEZOE, Hideo, GÓRECKA, Ewa. Short-range smectic fluctuations and the flexoelectric model of modulated nematic liquid crystal. *Physical review. E, Statistical, nonlinear, and soft matter physics*, ISSN 1539-3755, 2016, vol. 93, no. 2, str. 022704-1-022704-5, doi: [10.1103/PhysRevE.93.022704](https://doi.org/10.1103/PhysRevE.93.022704). [COBISS.SI-ID [29301799](#)].
4. GÓRECKA, Ewa, VAUPOTIČ, Nataša, ZEP, Anna, POCIECHA, Damian, YOSHIOKA, Jun, YAMAMOTO, Jun, TAKEZOE, Hideo. A twist-bend nematic (N_{TB}) phase of chiral materials : Ewa Gorecka ... [et al.]. *Angewandte Chemie*, ISSN 1433-7851. [Print ed.], 2015, vol. 54, no. 35, str. 10155-10159, doi: [10.1002/anie.201502440](https://doi.org/10.1002/anie.201502440). [COBISS.SI-ID [28844839](#)].
5. UEHARA, Michiru, TAKEZOE, Hideo, VAUPOTIČ, Nataša, POCIECHA, Damian, GÓRECKA, Ewa, AOKI, Yuko, MORIKAWA, Junko. Thermal diffusivity anisotropy measured by a temperature wave method in the homologous series of (p-alkoxybenzylidene)-p'-octylaniline (nO.8). *The Journal of chemical physics*, ISSN 0021-9606, 2015, vol. 143, no. 7, str. 074903-1- 074903-7, doi: [10.1063/1.4928587](https://doi.org/10.1063/1.4928587). [COBISS.SI-ID [28845095](#)].
6. VOGRIN, Martin, VAUPOTIČ, Nataša, WOJCIK, M. M., MIECZKOWSKI, Jozef, MADRAK, Karolina, POCIECHA, Damian, GÓRECKA, Ewa. Thermotropic cubic and tetragonal phases made of rod-like molecules. *PCCP. Physical chemistry chemical physics*, ISSN 1463-9076, 2014, vol. 16, issue 30, str. 16067-16074, doi: [10.1039/C4CP01641F](https://doi.org/10.1039/C4CP01641F). [COBISS.SI-ID [27813671](#)].
7. LESKOVAR, Kristina, ČEPIČ, Mojca, VAUPOTIČ, Nataša. Effect of a bias electric field on the structure and dielectric response of the ferroelectric smectic-A liquid crystal in thin planar cells. *Physical review. E, Statistical, nonlinear, and soft matter physics*, ISSN 1539-3755, 2014, vol. 89, no. 1, str. 012501-1-012501-9, doi: [10.1103/PhysRevE.89.012501](https://doi.org/10.1103/PhysRevE.89.012501). [COBISS.SI-ID [27378983](#)].
8. VAUPOTIČ, Nataša, ČEPIČ, Mojca, OSIPOV, Mihail A., GÓRECKA, Ewa. Flexoelectricity in chiral nematic liquid crystals as a driving mechanism for the twist-bend and splay-bend modulated phases. *Physical review. E, Statistical, nonlinear, and soft matter physics*, ISSN 1539-3755, 2014, vol. 89, no. 3, 030501-1-030501-5, doi: [10.1103/PhysRevE.89.030501](https://doi.org/10.1103/PhysRevE.89.030501). [COBISS.SI-ID [27591975](#)].
9. AYA, Satoshi, VAUPOTIČ, Nataša, et al. Structure-sensitive bend elastic constants between piconewton and subnanonewton in diphenylacetylene-core-based liquid crystals. *Physical review. E, Statistical, nonlinear, and soft matter physics*, ISSN 1539-3755, 2014, vol. 90, no. 4, str. 042506-1-042506-6, doi: [10.1103/PhysRevE.90.042506](https://doi.org/10.1103/PhysRevE.90.042506). [COBISS.SI-ID [28087591](#)].
10. ZEP, Anna, SALAMONCZYK, Mirosław, VAUPOTIČ, Nataša, POCIECHA, Damian, GÓRECKA, Ewa. Physical gels made of liquid crystalline B_{4} phase. *Chemical communications*, ISSN 1359-7345, 2013, vol. 49, issue 30, str. 3119-3121, doi: [10.1039/C3CC41225C](https://doi.org/10.1039/C3CC41225C). [COBISS.SI-ID [26593831](#)].