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, 3. stopnja		**1. ali .2**	**1. ali 2.**
PHYSICS, 3rd cycle		**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:	**Nataša Vaupotič**

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

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:	**Prerequisits:**
Priporočeno je predznanje iz klasične in moderne fizike in fizike trdne snovi. Študent izdela 4 projekte, pri čemer vsak prinese ¼ k skupni oceni in vsak mora biti ocenjen pozitivno.	Preknowledge of classical and modern physics and solid state physics is recommended. The student is required to complete four projects, each contributing one quarter to the final grade. A passing grade is required for each individual assignment.

Vsebina:	**Content (Syllabus outline):**
Obravnavani 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	Recent advances in soft matter physics will be studied. 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:

študenta. Primeri vsebin: kontinuumski in diskretni modeli (različne vrste tekočih 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…).	continuum and discrete models (for different phases of liquid crystals, colloids, polymers…), 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) Chaikin, P. M., & Lubensky, T. C. (1995). *Principles of condensed matter physics*. Cambridge University Press. **Celotno besedilo dostopno v EBSCOhost Ebook Academic Collection - World Wide**

2) Selinger, J. (2016). *Introduction to the theory of soft matter: From ideal gases to liquid crystals*. Springer. https://plus.cobiss.net/cobiss/si/sl/bib/22107656

3) Fox, M. (2010). *Optical properties of solids*. Oxford University Press. **Celotno besedilo dostopno v EBSCOhost Ebook Academic Collection - World Wide** https://plus.cobiss.net/cobiss/si/sl/bib/3710000000088680

Dodatna:

4) Kleman, M., & Lavrentovich, O. D. (2003). *Soft matter physics*. Springer-Verlag.

5) Jones, R. A. L. (2001). *Soft condensed matter*. Oxford University Press.

6) Als-Nielsen, J., & McMorrow, D. (2001). *Elements of modern X-ray physics*. Wiley. https://plus.cobiss.net/cobiss/si/sl/bib/3460000000003363

7) VAUPOTIČ, Nataša, SALAMONCZYK, Miroslaw, MATRASZEK, Joanna, VOGRIN, Martin, POCIECHA, Damian, GÓRECKA, Ewa. New structural model of a chiral cubic liquid crystalline phase. PCCP. Physical chemistry chemical physics : a journal of European chemical societies. 2020, vol. 22, no. 22, str. 12814--12820. ISSN 1463-9076. DOI: 10.1039/d0cp01579b. [COBISS.SI-ID 20104195]

8) Znanstvenoraziskovalni članki s področja obravnavanih tem/ Scientific research papers from chosen topics.

Cilji in kompetence:	**Objectives and competences:**
Namen predmeta je študente usposobiti za raziskovalno delo na izbranem področju fizike mehke snovi.	The objective of this course is to teach students how to carry out research work on a selected field within soft matter physics.

Predvideni študijski rezultati:	**Intended learning outcomes:**

Znanje in razumevanje:	Knowledge and understanding:
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.	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.
Prenesljive/ključne spretnosti in drugi atributi: - *Spretnosti komuniciranja:* ustno in pisno izražanje pri predstavitvi izbrane teme. - *Uporaba informacijske tehnologije:* uporaba programskih orodij za modeliranje in obdelavo podatkov. - *Reševanje problemov:* prepoznavanje univerzalnosti, analogij in celosten pristop k reševanju problemov.	Transferable/Key Skills and other attributes: - *Communication skills:* manner of expression at written and oral presentation of a chosen topic. - *Use of information technology:* use of software tools for modelling and data manipulation. - *Problem solving:* ability to recognize universalities, analogies, and global approach to solving problems.

Metode poučevanja in učenja:	**Learning and teaching methods:**
Predavanja, seminarji, konzultacije, razlaga, razgovor, delo s tekstom, metoda pisnih in grafičnih del, problemsko učenje, študija primera, raziskovalno učenje, uporaba programskih orodij.	Lectures, seminars, tutorials, explanation, discussion, work with text, work with graphic elements, case study, problem based learning, inquiry based learning, use of software tools.

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

Reference nosilca / Lecturer's references:

1. SALAMONCZYK, Miroslaw, VAUPOTIČ*, Nataša, POCIECHA, Damian, WALKER, Rebecca, STOREY, John M. D., IMRIE, Corrie T., WANG, Cheng, ZHU, Chenhui, GÓRECKA, Ewa. Multi-level chirality in liquid crystals

formed by achiral molecules. *Nature communications*, ISSN 2041-1723, 2019, vol. 8, str. 1922-1-1922-8, doi: 10.1038/s41467-019-09862-y. [COBISS.SI-ID 32322855.

2. VAUPOTIČ, Nataša, ALI, Muhammad, MAJEWSKI, P., GÓRECKA, Ewa, POCIECHA, Damian. Polarization gratings spontaneously formed from a helical twist-bend nematic phase. *ChemPhysChem : a European journal of chemical physics and physical chemistry*, ISSN 1439-4235. [Print ed.], [in press] 2018, 15 str., doi: 10.1002/cphc.201800360. [COBISS.SI-ID 31667751].

3. SALAMONCZYK, Miroslaw, VAUPOTIČ*, Nataša, POCIECHA, Damian, WANG, Cheng, ZHU, Chenhui, GÓRECKA, Ewa. Structure of nanoscale-pitch helical phases : blue phase and twist-bend nematic phase resolved by resonant soft X-ray scattering. *Soft matter*, ISSN 1744-683X, 2017, vol. 13, no. 38, str. 6694-6699, doi: 10.1039/c7sm00967d. [COBISS.SI-ID 30804519].

4**.** 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. [COBISS.SI-ID 29763367].

5. 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. [COBISS.SI-ID 29301799].

6. 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. [COBISS.SI-ID 29302055].

7. 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. [COBISS.SI-ID 29763367],

8. 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. [COBISS.SI-ID 29301799].

9. GÓRECKA, Ewa, VAUPOTIČ*, Nataša, ZEP, Anna, POCIECHA, Damian, YOSHIOKA, Jun, YAMAMOTO, Jun, TAKEZOE, Hideo. A twist-bend nematic (N[sub](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. [COBISS.SI-ID 28844839].