UČNI NAČRT PREDMETA / COURSE SYLLABUS	
Predmet:	Optika tekočih kristalov: modeliranje in aplikcije
Course title:	Optics of liquid crystals: modelling and applications

Študijski program in stopnja Study programme and level	Študijska smer Study field	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:	Viktor Reshetnyak

Jeziki / Languages:	**Predavanja / Lectures:**	angleški/English
	Vaje / Tutorial:	

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:	**Prerequisits:**
Predznanje iz klasične in moderne fizike in fizike trdne snovi.	Preknowledge of classical and modern physics and solid state physics.

Vsebina:	**Content (Syllabus outline):**
Predstavljeni bo aktualni napredek s področja modeliranja in aplikacij fizike kompleksnih mešanic tekočih kristalov (TK) in nanodelcev. Slednji so bodisi kovinski, feroelektrični ali feromagnetni. Predstavljeni bodo osnovni fizikalni mehanizmi, ki diktirajo obnašanje takšnih snovi in potencialne aplikacije. Poudarek je na znanjih, ki jih potrebuje kandidat doktorskega študija. Jedrne vsebine predmeta so naslednje. Tekoče-kristalno osnovani metamateriali in prilagodljivi TK (npr. optične leče) in njihova uporaba npr. v virtualni resničnosti. Efektivni	Recent advances in physics of liquid crystals, their modelling and applications will be studied. The study includes LC doped with particles of different nature (core-shell metallic, ferroelectric, ferromagnetic). 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: liquid crystal based metamaterials; tunable liquid and liquid crystal lenses and their use in for instance in virtual and augmented reality;

elektromagnetni parametri heterogenih materialov (npr. TK dopirani z nanodelci z lupinami). Površinski in Tamm-ovi plazmoni in njihov vpliv na obnašanje TK.	effective electromagnetic parameters of heterogeneous media, for instance, liquid crystals filled with core-shell particles; surface and Tamm plasmons and their control with liquid crystals;

Temeljni literatura in viri / Readings:

1. P. G. de Gennes, J. Prost, The Physics of Liquid Crystals, Oxford University Press, Oxford, 1993
2. Iain W. Stewart, The Static and Dynamic Continuum Theory of Liquid Crystals: A Mathematical Introduction, CRC Press, 2004
3. Vladimir Belyakov, Diffraction Optics of Complex-Structured Periodic Media, Springer Series in Optical Sciences, 2019 https://link.springer.com/book/10.1007/978-3-319-43482-7
4. Lev M. Blinov, Structure and Properties of Liquid Crystals, Springer, 2011 https://link.springer.com/book/10.1007/978-90-481-8829-1
5. Deng-Ke Yang Shin-Tson Wu, Fundamentals of Liquid Crystal Devices, Wiley, 2015 https://www.wiley.com/en-us/Fundamentals+of+Liquid+Crystal+Devices%2C+2nd+Edition-p-9781118751985
6. Hongwen Ren and Shin-Tson Wu, Introduction to Adaptive Lenses, WILEY, 2012

Cilji in kompetence:	**Objectives and competences:**
Namen predmeta je študente usposobiti za raziskovalno delo na izbranem področju fizike kondenzirane snovi.	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:	**Intended learning outcomes:**
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. Prenesljive/ključne spretnosti in drugi atributi:	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:

- *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.	- *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) seminar	**100%**	Type (examination, oral, coursework, project): seminar

Reference nosilca / Lecturer's references:

1. **V. Yu. Reshetnyak**, I. P. Pinkevych, M. E. McConney, D. R. Evans, Director grating and two-beam energy exchange in a hybrid photorefractive cholesteric cell with a helicoidal polymer network, **Journal of Applied Physics** 127, 125502 (2020). https://doi.org/10.1063/1.5142079

2. **Victor Yu. Reshetnyak**, Victor I. Zadorozhnii, Igor P. Pinkevych, Timothy J. Bunning, Dean R. Evans, Modelling the Surface Plasmon Spectra of an ITO Nanoribbon Grating Adjacent to a Liquid Crystal Layer, **Materials** 13(7), 1523 (2020). https://doi.org/10.3390/ma13071523

3. **V. Y. Reshetnyak**, I. P. Pinkevych, M. E. McConney, J. E. Slagle, D. R. Evans, Impact of the Liquid Crystal Director Twisting on Two-Beam Energy Exchange in a Hybrid Photorefractive Inorganic-Liquid Crystal Cell, **Crystals** 10(12), 1104 (2020). https://doi.org/10.3390/cryst10121104

4. **V. Y. Reshetnyak**, I. P. Pinkevych, T. J. Bunning, D. R. Evans, Influence of Rugate Filters on the Spectral Manifestation of Tamm Plasmon Polaritons, **Materials** 14, 1282 (2021). https://doi.org/10.3390/ma14051282

5. **V. Yu. Reshetnyak**, I. P. Pinkevych, D. R. Evans, Flexoelectro-optic effect and two-beam energy exchange in a hybrid photorefractive cholesteric cell with a short-pitch horizontal helix, **Physical Review E** 97(6), 062701 (2018) https://doi.org/10.1103/PhysRevE.97.062701