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UČNI NAČRT PREDMETA / COURSE SYLLABUS	
Predmet:	Mehka snov in mehki nanokompoziti
Course title:	Soft Matter and Soft Nanocomposites

Študijski program in stopnja Study programme and level	Študijska smer Study field	Letnik Academic year	Semester Semester
Nanoznanosti in nanotehnologije , 3. stopnja	/	1	1
Nanosciences and Nanotechnologies, 3rd cycle	/	1	1

Vrsta predmeta / Course type Izbirni / Elective

Univerzitetna koda predmeta / University course code: NANO3-885

Predavanja Lectures	Seminar Seminar	Vaje Tutorial	Klinične vaje work	Druge oblike študija	Samost. delo Individ. work	ECTS
15	**15**			**15**	**105**	**5**

**Navedena porazdelitev ur velja, če je vpisanih vsaj 15 študentov. Drugače se obseg izvedbe kontaktnih ur sorazmerno zmanjša in prenese v samostojno delo. / This distribution of hours is valid if at least 15 students are enrolled. Otherwise the contact hours are linearly reduced and transfered to individual work.*

Nosilec predmeta / Lecturer: Prof. dr. Samo Kralj

Jeziki / Languages:	**Predavanja / Lectures:**	slovenščina, angleščina / Slovenian, English
	Vaje / Tutorial:	slovenščina, angleščina / Slovenian, English

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:	**Prerequisits:**
Opravljeni izpiti iz mehanike, elektromagnetizma, moderne fizike.	Passed exams in Mechanics, Electromagnetism, and Modern Physics.

Vsebina:	**Content (Syllabus outline):**
1) Urejena mehka snov: osnovne značilnosti in primeri. 2) Mešanice urejene mehke snovi in nanodelcev: prispevki posameznih komponent, mutliferoični odzivi. 3) Modeliranje: termodinamske osnove, Onsagerjev model, Landau-ov mezoskopski pristop (translacijska in orientacijska urejenost), Doi-Edwardsov model. 4) Nanodelčno vodeni strukturni prehodi v mehki snovi: osnovni mehanizmi, interakcija nanodelcev z biološkimi membranami in aplikacije.	1) Ordered soft matter: basic properties and examples. 2) Mixtures of ordered soft matter and nanoparticles: specific contributions of constituting components, multi-ferroic responses. 3) Modelling: basic thermodynamics, Onsager model, Landau mesoscopic approach (in translational and orientational degree of ordering), Doi-Edwards model. 4) Nanoparticles (NPs) driven structural transitions in soft matrices: basic mechanisms,

5) Urejanje nanodelcev z mehko snovjo: kontrolirano vodeni nanodelci, orientacijsko in pozicijsko urejanje, sklopitev med nanodelci in topološkimi defekti, geometrijsko nadzorovani vzorci nanodelcev, kompleksna samoorganizacija nanodelcev, koloidni kristali in potencialne aplikacije.	interactions between NPs and biological membranes, possible applications. 5) Soft matter enabled ordering of NPs: controlled positional targeting of NPs, orientational and positional ordering of NPs, trapping of NPs to topological defects, geometrically driven templates of NPs trapping centers, complex self-assembling of NPs, colloidal crystals and potential applications.

Temeljni literatura in viri / Readings:

1. P.G. de Gennes, J. Prost, The Physics of Liquid Crystals, Clarendon press, Oxford, 1998.
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, England, 1995.

Cilji in kompetence:	**Objectives and competences:**
Študentje se seznanijo s kompleksnimi pojavi in novimi materiali, ki jih omogočajo kombinacije raznovrstnih nanodelcev in mehkih materialov. Spoznajo ključne mehanizme, ki omogočajo razvoj nanokompozitov, osnovanih na mehki snovi.	Students get acquainted with complex phenomena and new materials enabled via interactions between diverse nanoparticles and soft materials. They understand basic mechanisms giving rise to diverse soft material - based nanocomposites.

Predvideni študijski rezultati:	**Intended learning outcomes:**
Študenti spoznajo ključne značilnosti mehkih snovi in ustrezne osnovne teoretičnega modeliranja. Spoznajo vrsto mehanizmov, ki lahko omogočijo učinkovite sistemske makroskopske strukturne transformacije ali nove materialne lastnosti preko interakcij med nanodelci in mehko snovjo. in sposobnost uporabe v svojem raziskovalnem delu. Predmet pripravlja študente za uporabo znanja s področja mehke snovi in mehkih nanokompozitov.	Students gain understanding of key properties of soft materials and corresponding theoretical modelling. They get familiar with several mechanisms which have potential to efficiently drive macroscopic changes in effective materials via interactions between specific nanoparticles and soft matrices. This course prepares students to apply knowledge of soft matter and soft nanocomposites.

Metode poučevanja in učenja:	**Learning and teaching methods:**
• Predavanja • Seminarji • Konzultacije	• Lectures • Seminar work • Consultations

Načini ocenjevanja:	Delež (v %) / Weight (in %)	**Assessment:**
ustni izpit	50 %	oral examination
naloge ali projekt	50 %	coursework or project

Reference nosilca / Lecturer's references:

- KURIOZ, Pavlo, KRALJ, Marko, MURRAY, Bryce S., ROSENBLATT, Charles, KRALJ, Samo. Nematic topological defects positionally controlled by geometry and external fields. Beilstein journal of nanotechnology, 2018, vol. 9, str. 109-118, https://www.beilstein-

journals.org/bjnano/content/pdf/2190-4286-9-13.pdf, doi: 10.3762/bjnano.9.13.
- HARKAI, Saša, AMBROŽIČ, Milan, KRALJ, Samo. Impact of diffusion limited aggregates of impurities on nematic ordering. Physica. A, Statistical mechanics and its applications, 2017, vol. 467, str. 249-256, doi: 10.1016/j.physa.2016.10.001.
- KRALJ, Samo, MURRAY, Bryce S., ROSENBLATT, Charles. Decomposition of strongly charged topological defects. Physical review. E, 2017, vol. 95, iss. 4, str. 042702-1-042702-9, doi: 10.1103/PhysRevE.95.042702.
- STARZONEK, Szymon, RZOSKA, Sylwester, DROZD-RZOSKA, Aleksandra, CZUPRYŃSKI, Krzysztof, KRALJ, Samo. Impact of ferroelectric and superparaelectric nanoparticles on phase transitions and dynamics in nematic liquid crystals. Physical review. E, 2017, vol. 96, iss. 2, str. 022705-1-022705-7, doi: 10.1103/PhysRevE.96.022705.
- MESAREC, Luka, GÓŹDŹ, Wojciech, IGLIČ, Aleš, KRALJ, Samo. Effective topological charge cancelation mechanism. Scientific reports, ISSN 2045-2322, 2016, vol. 6, art. no. 27117, str. 1-9, http://www.nature.com/articles/srep27117, doi: 10.1038/srep27117.