Univerza v Mariboru

Fakulteta za naravoslovje in matematiko

UČNI NAČRT PREDMETA / COURSE SYLLABUS	
Predmet:	**Interakcije nanomaterialov in bioloških sistemov**
Course title:	**Interactions between nanomaterials and biological systems**

Študijski program in stopnja Study programme and level	Študijska smer Study field	Letnik Academic year	Semester Semester
FIZIKA		**1**. ali 2.	**1., 2. ali 3.**
PHYSICS		1. or 2.	**1., 2. or 3.**

Vrsta predmeta / Course type

Izbirni za modula Biofizika 1, 2, 3 in Fizika 1, 2, 3

Univerzitetna koda predmeta / University course code:

Predavanja Lectures	Seminar Seminar	Vaje Tutorial	Lab. vaje Laboratory work	Mentorstvo Mentorship	Samost. delo Individ. work	ECTS
10					**290**	**10**

Nosilec predmeta / Lecturer: **Janez Štrancar**

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

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

Ni posebnih zahtev.

Prerequisits:

No special prerequisites.

Vsebina:

Content (Syllabus outline):

- Zlivanje lipidnih vesiklov in biomembran - Vpliv biokorone na interakcijo med nanodelci in membranami - Ovijanje nanodelcev z lipidi - Prenos lipofilnih substanc s trdnimi lipidnimi nanodelci - Antibakterijska zašcita opreme z nanomateriali - Interakcija guanizinskih kompleksov s celicami - Molekularni označevalci nanodelcev - Detekcija toksinov s pomočjo biosenzorjev na membranah - Preprečevanje razvoja biofilmov na tehnološko pomembnih površinah - Interakcija toksinov s celičnimi membranami - Prilagodljivost virusnih plaščnih proteinov na različna lipidna okolja - Interakcija in dinamika v dendrimernih sistemih za transport učinkovin	- Liposome-Cell Membrane fusion - Effect of biocorona on interaction between nanoparticles and membranes - Lipid wrapping of nanoparticles - Lipophilic substances transport with solid lipid nanoparticles - Antibacterial protection with nanomaterials - Guanisin complex - cell interaction - Nanoparticle Molecular Labels - Toxin detection via membrane biosensors - Preventing biofilm growth on technologically important surfaces - Toxin-cell membrane interaction - Adaptation of viral coat proteins in various lipid environments - Interactions and dynamics in dendrimer systems for drug delivery

Temeljni literatura in viri / Readings:

1. J. Israelaschvili: Intermolecular Interactions & Surface Forces. Academic Press, London, 1992.
2. C. M. Niemeyer and C. A. Mirkin: Nanobiotechnology: Concepts, Applications and Perspectives, Wiley-VCH, 2004
3. Izbrani članki: S. Martens, H. T. McMahon: Mechanisms of membrane fusion: disparate players and common principles. Nature Reviews Molecular Cell Biology 9, 543-556, 2008; S. A. Wissinga, O. Kayserb and R. H. Müller: Solid lipid nanoparticles for parenteral drug delivery. Advanced Drug Delivery Reviews 56, 1257-1272, 2004; I. Yacoby, I. Benhar. Antibacterial nanomedicine. Nanomedicine 3, 329-341, 2008; H.Ti Tien. Bilayer lipid membranebased electrochemical biosensors. Journal of Clinical Laboratory Analysis 2, 256 – 264, 2005

Cilji in kompetence:	**Objectives and competences:**
Študenti poglobijo znanje s področja molekularnih znanosti ter nanomaterialov s posebnim poudarkom na interakcijah nanomaterialov z biološkimi sistemi, kar predstavlja enega najbolj vročih problemov nanobiotehnologije. Razumejo pomembnost	Students acquire advanced knowledge on fields of molecular sciences and nanomaterials with special focus on the interactions between nanomaterials and biological systems, that represents one of the hot topics current nanobiotechnology. Students understand an

povezanosti področij naravoslovja in tehnike ter način razmišljanja pri reševanju struktur in funkcij kompleksnih bioloških sistemov. Poznajo najnovejše raziskave in delo raziskovalnih skupin na tem področju v regiji.	importance of the connections between the natural sciences and technology as well as the way of thinking while resolving structure and function of complex biological systems. Students get familiar with up-to-date research work and research teams working in that field in the region.

Predvideni študijski rezultati:	**Intended learning outcomes:**
Znanje in razumevanje: Poglabljanje znanja o interakcijah med nanomateriali in biološkimi sistemi, kar je osnova za varno aplikativno raziskovalno in razvojno delo ter produkte na tem področju. Prenesljive/ključne spretnosti in drugi atributi: - sposobnost reševanja tehnoloških in biokompatibilnostnih problemov na področju novih materialov in tehnologij s fizikalnimi pristopi na bioloških sistemih - sposobnost oblikovanja in implementacije izvirnih znanstvenih rešitev v danih biofizikalnih, nanotehnoloških in interdisciplinarnih problemih.	Knowledge and understanding: Gaining additional knowledge about interactions between nanomaterials and biosystems, which is basis for safe applied research & development work and products in this field. Transferable/Key Skills and other attributes: - ability of solving of technological and biocompatibility problems in the field of novel materials and technologies with physical approaches on biosystems. - ability of defining and implementing unique scientific solution within defined biophysical, nanotechnological and interdisciplinary problems.

Metode poučevanja in učenja:	**Learning and teaching methods:**
Predavanja, seminar in izdelava seminarske naloge iz področja interakcij nanomaterialov in bioloških sistemov.	Lectures, seminar and work out of seminar from the field of interacting nanomaterials and biological systems.

Načini ocenjevanja:	Delež (v %) / Weight (in %)	**Assessment:**
Način (pisni izpit, ustno izpraševanje, naloge, projekt)		Type (examination, oral, coursework, project):
Seminarska naloga	**50%**	Course work
Ustni izpit	**50%**	Oral exam

Reference nosilca / Lecturer's references:

1) PODLIPEC, Rok, GORGIEVA, Selestina, JURAŠIN, Darija, URBANČIČ, Iztok, KOKOL, Vanja, ŠTRANCAR, Janez. Molecular mobility of scaffolds` biopolymers influences cell growth. *ACS applied materials & interfaces*, ISSN 1944-8244. [Print ed.], August 29, 2014, str. 1-50, doi: 10.1021/am5037719. [COBISS.SI-ID 18043926]
2) URBANČIČ, Iztok, LJUBETIČ, Ajasja, ŠTRANCAR, Janez. Resolving internal motional

correlations to complete the conformational entropy meter. *The journal of physical chemistry letters*, ISSN 1948-7185, 2014, vol. 5, no. 20, str. 3593-3600, doi: 10.1021/jz5020828. [COBISS.SI-ID 28004647]
3) LJUBETIČ, Ajasja, URBANČIČ, Iztok, ŠTRANCAR, Janez. Recovering position-dependent diffusion from biased molecular dynamics simulations. *The journal of physical chemistry letters*, ISSN 1948-7185, 2014, vol. 140, no. 8, str. 084109-1-084109 -11, doi: 10.1063/1.4866448. [COBISS.SI-ID 28006951]
4) URBANČIČ, Iztok, LJUBETIČ, Ajasja, ARSOV, Zoran, ŠTRANCAR, Janez. Coexistence of probe conformations in lipid phases : a polarized fluorescence microspectroscopy study. *Biophysical journal*, ISSN 0006-3495, 2013, vol. 105, no. 4, str. 919-927, doi: 10.1016/j.bpj.2013.07.005. [COBISS.SI-ID 26970919]
5) URBANČIČ, Iztok, ARSOV, Zoran, LJUBETIČ, Ajasja, BIGLINO, Daniele, ŠTRANCAR, Janez. Bleaching-corrected fluorescence microspectroscopy with nanometer peak position resolution. *Optics express*, ISSN 1094-4087, 2013, vol. 21, no. 21, str. 25291-25306, doi: 10.1364/OE.21.025291. [COBISS.SI-ID 27156007]