Univerza v Mariboru

Fakulteta za naravoslovje in matematiko

UČNI NAČRT PREDMETA / COURSE SYLLABUS	
Predmet:	**Napredne eksperimentalne metode v biofiziki**
Course title:	**Advanced experimental methods in biophysics**

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	Teren. vaje Field work	Samost. delo Individ. work	ECTS
3			**7**		**290**	**10**

Nosilec predmeta / Lecturer: **Janez Štrancar**

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

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:	**Prerequisits:**
Ni posebnih zahtev.	No special prerequisites.

Vsebina: **Content (Syllabus outline):**

1. Koncepti naprednih biofizikalnih eksperimentalnih metod (predavanja), primerjava konceptov in izvedb družin spektroskopij, mikroskopij, mikrospektroskopij, sipanj, mehanskih analiz in mikromanipulacij 2. Reševanje biofizikalnih problemov z naprednimi eksperimentalnimi metodami (vaje): - Karakterizacija makroskopskih lastnosti s kalorimetrijo - Slikanje celic z elektronsko mikroskopijo - Aplikacija UV-VIS spektroskopije v bioloških raziskavah - IR in ramanska spektroskopija biopolimerov - Karakterizacja celičnih membran s fluorescenčno in mikrospektroskopijo in spektroskopijo elektronsko paramagnetno resonanco - Karakterizacija pretoka z in vivo s slikanjem z magnetno resonanco - Merjenje kisika in vivo z elektronsko paramagnetno resonanco - Raziskovanje lipidnih faz s SAXS in WAXS - Detekcija vezave vode na površini biomembran z ATR-FTIR	1. Concepts of advanced biophysical experimental methods (lectures), comparison of concepts and implementations of spectroscopy, microscopy, microspectroscopy , scattering , mechanical analysis and micromanipulation 2. Biophysical problem solving with advanced experimental methods (lab. work): - Characterization of macroscopic properties with calorimetry - Electron microscopy of cells - Practical applications of UV-VIS spectroscopy in biological research - Infrared and Raman spectroscopy of biopolymers - Characterization of cell membranes by fluorescent microspectroscopy and electron paramagnetic resonance - Flow characterization with in vivo magnetic resonance imaging - In vivo oxymetry with EPR spectroscopy - Lipid phases exploration by SAXS and WAXS - Bind-water detection on biomembrane surfaces with ATR-FTIR

Temeljni literatura in viri / Readings:

1) Hans-Ulrich Gremlich and Bing Yan: Infrared and Raman Spectroscopy of Biological Materials (Practical Spectroscopy)
2) William R., Hendee, E. Russell Ritenour, Medical Imaging Physics , John Wiley & Sons, New York 2002.
3) Berliner, Lawrence J. (ur./ed.), Hemminga, Marcus A (ur./ed.). ESR spectroscopy in membrane biophysics, (Biological magnetic resonance, vol. 27). New York: Springer, 2007.
4) Ottova-Leitmannova, Angelica (ur./ed.). Advances in planar lipid bilayers and liposomes. Vol. 6. Amsterdam [etc.]: Academic Press, Elsevier Science, 2008
5) Tom Waigh: Applied Biophysics: A Molecular Approach for Physical Scientists, Willey-Interscience, 2007

Cilji in kompetence:	**Objectives and competences:**
Študenti poglobijo znanje s področja eksperimentalnih metod pri raziskovanju realnih biofizikalnih problemov s sodobno	Students acquire advanced knowledge on experimental methods in exploring real biophysical problems with up-to-date

eksperimentalno infrastrukturo z vsemi podpornimi sistemi od priprave eksperimentalnih sistemov (vzorcev) do zahtevnih analiz eksperimentalnih podatkov na računalniških gručah. Razumejo kompleksnost interdisciplinarnih spretnosti ter način razmišljanja pri detekciji struktur in funkcij kompleksnih bioloških sistemov s čim manjšim vplivom na strukturiranost realnih bioloških sistemov. Poznajo najnovejše raziskave, delo in opremo raziskovalnih skupin na tem področju v regiji.	experimental infrastructure including with all the supporting facilities from sample preparation laboratories to extensive experimental data analysis on computer clusters. Students understand complexity of interdisciplinary skills and the way of thinking while detecting structure and function of complex biological systems with smallest impact on the structure of real biological systems. Students learn up-to-date research work, equipment and research teams working in that field in the region.
Predvideni študijski rezultati:	**Intended learning outcomes:**
Znanje in razumevanje: Poglabljanje in nadgradnja interdisciplinarnih znanj s področij eksperimentalnih metod v biofiziki, spektroskopijah, metodah slikanja in sipanja, metodah molekularne biologije in fizikalne biokemije. Prenesljive/ključne spretnosti in drugi atributi: - sposobnost reševanja konkretnih raziskovalnih problemov ter razvoj eksperimentalnih veščin in spretnosti na področju biofizike ter sorodnih disciplin z uporabo moderne raziskovalne opreme R&R laboratorijev v regiji, - sposobnost oblikovanja in implementacije izvirnih znanstvenih rešitev v danih biofizikalnih in interdisciplinarnih problemih, - sposobnost predstavitve pridobljenih znanstvenih izsledkov s področja biofizike v obliki publikacij v mednarodni znanstveni periodiki, - poglobljeno razumevanje teoretskih in metodoloških fizikalnih konceptov pri eksperimentalnemu in razvojnemu delu v biofiziki.	Knowledge and understanding: Gaining additional knowledge and upgrading interdisciplinary approach in the fields of experimental methods in biophysics, spectroscopies, imaging and scattering methods as well as methods in molecular biology and physical biochemistry. Transferable/Key Skills and other attributes: - ability of solving research problems and development of experimental skills in the field of biophysics and relating fields with utilizing modern research infrastructure R&D laboratories in the region, - ability of defining and implementing unique scientific solution within defined biophysical and interdisciplinary problems - ability of presenting R&D results in the filed of biophysics in a form of publication in international scientific journal - deeper understanding of theoretical and methodological physical concepts in experimental and development work in biophysics
Metode poučevanja in učenja:	**Learning and teaching methods:**

Uvoden sklop predavanj, ki podajo koncepte eksperimentalnih metod v biofiziki. Eksperimentalno delo v profesionalnih razvojno-raziskovalnih laboratorijih ter individualna priprava na raziskovalno delo.	Introductory lectures into the concepts of experimental methods in biophysics. Experimental work in professional research&development laboratories as well as individual work as an introduction to research work.

Načini ocenjevanja:	Delež (v %) / Weight (in %)	**Assessment:**
Način (pisni izpit, ustno izpraševanje, naloge, projekt) Projektna naloga, ki vključuje pripravo, izvedbo in analizo petih izbranih eksperimentalnih problemov	**100%**	Type (examination, oral, coursework, project): Project including preparation, evaluation and analysis of 5 chosen experimental problems

Reference nosilca / Lecturer's references:

1. MLAKAR, Nina, PAVLICA, Zlatko, PETELIN, Milan, ŠTRANCAR, Janez, ZRIMŠEK, Petra, PAVLIČ, Alenka. Animal and human dentin microstructure and elemental compositon. *Central european journal of medicine*, ISSN 1644-3640. [Online ed.], 2014, vol. 9, iss. 3, str. 468-476, doi: 10.2478/s11536-013-0295x. [COBISS.SI-ID 3850106]

2. GORGIEVA, Selestina, ŠTRANCAR, Janez, KOKOL, Vanja. Evaluation of surface/interface-related physicochemical and microstructural properties of gelatin 3D scaffolds, and their influence on fibroblast growth and morphology. *Journal of biomedical materials research. Part A*, ISSN 1549-3296, Article first published online: 6 JAN 2014, str. 1-12, doi: 10.1002/jbm.a.35076. [COBISS.SI-ID 17454870]

3. JAUŠOVEC, Darja, BOŽIČ, Mojca, KOVAČ, Janez, ŠTRANCAR, Janez, KOKOL, Vanja. Synergies of phenolic-acids' surface-modified titanate nanotubes (TiNT) for enhanced photo-catalytic activities. *Journal of colloid and interface science*, ISSN 0021-9797, Available online 13 October 2014, str. 1-41. http://www.sciencedirect.com/science/article/pii/S0021979714007401#, doi: 10.1016/j.jcis.2014.09.081. [COBISS.SI-ID 18155542]

4. 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]

5. MLAKAR, Jana, ŠTRANCAR, Janez. Temperature and humidity profiles in passive-house building blocks. *Building and environment*, ISSN 0360-1323. [Print ed.], 2013, vol. 60, str. 185-193, doi: 10.1016/j.buildenv.2012.11.018. [COBISS.SI-ID 26407719]