UČNI NAČRT PREDMETA / COURSE SYLLABUS	
Predmet:	Eksperimentalne metode v fiziki in biofiziki
Course title:	Experimental methods in physics and biophysics

Študijski program in stopnja Study programme and level	Študijska smer Study field	Letnik Academic year	Semester Semester
Fizika 2. st.		2	3
Physics 2nd degree		2	3

Vrsta predmeta / Course type	izbirni/ optional
Univerzitetna koda predmeta / University course code:	

Predavanja Lectures	Seminar Seminar	Sem. vaje Tutorial	Lab. vaje Laboratory work	Teren. vaje Field work	Samost. delo Individ. work	ECTS
15			75		210	10

Nosilec predmeta / Lecturer:	Janez Štrancar

Jeziki / Languages:	**Predavanja / Lectures:**	Slovenski/Slovenian in/and angleški/English
	Vaje / Tutorial:	Slovenski/Slovenian in/and angleški/English

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:	**Prerequisits:**
Ni	None

Vsebina:	**Content (Syllabus outline):**
1. Metode določevanja structure snovi (x-žarki, mikroskopi: elektronski vrstični mikroskop - SEM, tunelski vrstični mikroskop - STM, mikroskop na atomsko silo - AFM, fazno-kontrastni mikroskop, Augerjeva spektroskopija) 2. Spektroskopske tehnike (jedrska magnetna resonance - NMR, elektronska paramagnetna resonance - EPR, slikanje z magnetno resonanco – MRI, NMR mikroskopija, UV-VIS spektrofotometrija, IR spektroskopija, fluorescenčna spektroskopija, fotonska korelacijska spektroskopija) 3. Sipalne tehnike (sinhrotron, presevalni elektronski mikroskop – TEM, na trdni in mehki snovi) 4. Laboratorijske projektne vaje – pregled literature, priprava in izvedba biofizikalnega eksperimenta v raziskovalnih laboratorijih ter obdelava rezultatov z metodami, ki so v uporabi v laboratoriju	1. Structure determination (x-ray diffraction, scanning electron microscope – SEM, scanning tunnelling microscope – STM, atomic force microscope – AFM, phase-contrast microscope, Auger spectroscopy) 2. Spectroscopic techniques (nuclear magnetic resonance – NMR, electron paramagnetic resonance – EPR, magnetic resonance imaging – MRI, NMR microscopy, UV-VIS spectrophotometry, IR spectroscopy, fluorescence spectroscopy, photon correlation spectroscopy) 3. Scattering techniques (synchrotron, transmission electron microscope – TEM, application to solid and soft matter) 4. Laboratory project work – literature overview, preparation and running the (bio)physical experiment as well as data analysis according to the current state-of-the-art methodologies

Temeljni literatura in viri / Readings:

1. H. Kuzmany, Solid-State Spectroscopy, Springer, Berlin(1998)
2. J. C. Gallop, SQUIDS, the Josephson Effects and Superconducting Electronics, Adam Hilger, Bristol (1990)
3. J. Dolinšek, Metode eksperimentalne fizike (skripta), Univerza v Mariboru (2000)
4. Duane, M., Molecular Biophysics: Structures in Motion, Oxford University Press, 1999.
5. Tuszynski, J.A. and Kurzynski, M., Introduction to Molecular Biophysics, CRC Press, Boca Raton, Florida, 2000.
6. specialna literatura za posamezne eksperimentalne metode
7. smernice za vaje

Cilji in kompetence:

Študenti so sposobni izbrati ustrezno skupino eksperimentalnih tehnik za učinkovito reševanje njihovega raziskovalno razvojnega problema.

Objectives and competences:

Students can select the appropriate group of experimental techniques to address their research / development problems most efficiently

Predvideni študijski rezultati:

Znanje in razumevanje:

Definirati zahteve raziskovalnega problema
Definirati časovne in krajevne skale problema
Izbrati eksperimentalne tehnike glede na zahteve in skale
Izbrati eksperimentalne tehnike glede na tehnične možnosti (občutljivost, ločljivost, hitrost detekcije)
Obdelati in razumeti rezultate meritev in na tej podlagi optimizirati eksperiment.

Prenesljive/ključne spretnosti in drugi atributi:

Obdelati rezultate meritev
Izbrati ustrezne merilne metode in senzorske sisteme
Presoditi smiselnost uporabe metod v izbranih časovnih in krajevnih okvirih
Uporabiti splošna fizikalna znanja pri izbiranju eksperimentalnih tehnik in analizi rezultatov
Rokovati s kompleksnimi napravami
Spoznati najbolj napredne tehnološke eksperimentalne pristope

Intended learning outcomes:

Knowledge and understanding:

Identifying the requirements of the research problem
Identifying time and spatial scales of the problem
Selecting experimental technique(s) with respect to the scale requirements
Selecting experimental technique(s) with respect to the technical possibilities (sensitivity, resolution, speed of detection)
Analyzing and understanding the results of the measurements and employ them to optimize the experimental setup(s)

Transferable/Key Skills and other attributes:

Processing of the measurement data
Choosing the right measurement method and sensor systems
Deciding if the selected methods fit reasonable well to the defined time and spatial frame(s)
Using general physical knowledge to select experimental techniques and analyze results
Handling with complex machines
Mastering the most advanced technological experimental approaches

Metode poučevanja in učenja:

Predavanja
Eksperimentalna predavanja
Laboratorijske vaje
Problemsko učenje
Uporaba programskih okolij za krmiljenje in obdelavo podatkov

Learning and teaching methods:

Lectures
Experimental lectures
Laboratory work
Problem based learning
Using software for control and data analysis

Načini ocenjevanja:	Delež (v %) / Weight (in %)	Assessment:
ustni izpit	50	oral exam
Ocenjevanje pristopa k eksperimentalnem delu in opravljeno eksperimentalno delo	50	Assessment of the approach to the experimental work and done experimental work

Reference nosilca / Lecturer's references:

- URBANČIČ, Iztok, GARVAS, Maja, KOKOT, Boštjan, MAJARON, Hana, UMEK, Polona, ŠKARABOT, Miha, ARSOV, Zoran, KOKLIČ, Tilen, ČEH, Miran, MUŠEVIČ, Igor, ŠTRANCAR, Janez, et al. Nanoparticles can wrap epithelial cell membranes ... *Nano letters*, 2018, vol. 18, no. 8, str. 5294-5305, doi: 10.1021/acs.nanolett.8b02291.
- SEDMAK, Ivan, URBANČIČ, Iztok, PODLIPEC, Rok, ŠTRANCAR, Janez, MORTIER, Michel, GOLOBIČ, Iztok. Submicron thermal imaging ... *Energy*, 2016, vol. 109, 436-445, doi: 10.1016/j.energy.2016.04.121.
- PODLIPEC, Rok, ŠTRANCAR, Janez. Cell-scaffold adhesion dynamics ... *ACS applied materials & interfaces*, 2015, vol. 7, no. 12, 6782-6791
- URBANČIČ, Iztok, LJUBETIČ, Ajasja, ŠTRANCAR, Janez. Resolving internal motional correlations ... *The journal of physical chemistry letters*, 2014, vol. 5, no. 20, 3593-3600.
- MLAKAR, Jana, ŠTRANCAR, Janez. Temperature and humidity profiles ... *Building and environment*, 2013, vol. 60, 185-193
- ARSOV, Zoran, URBANČIČ, Iztok, GARVAS, Maja, BIGLINO, Daniele, LJUBETIČ, Ajasja, KOKLIČ, Tilen, ŠTRANCAR, Janez. Fluorescence microspectroscopy ... *Biomedical optics express*, 2011, vol. 2, no. 8, 2083-2095
- KAVALENKA, Aleh A., URBANČIČ, Iztok, KURE, Sandra, ŠTRANCAR, Janez, et al. Conformational analysis ... *Biophysical journal*, 2010, vol. 98, no. 6, 1055-1064
- OMERZU, Aleš, ANŽELAK, Bernarda, TUREL, Iztok, ŠTRANCAR, Janez, POTOČNIK, Anton, ARČON, Denis, ARČON, Iztok, MIHAILOVIĆ, Dragan, MATSUI, Hiroshi. Strong correlations in ... *Physical review letters*, 2010, vol. 104, no. 15, 156804-1-156804-4
- BELLE, Valerie, ŠTRANCAR, Janez, et al. Mapping α-helical induced folding ... *Proteins*, 2008, issue 4, vol. 73, 973-988