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.		1,2	1,2,3,4
Physics 2nd degree		1,2	1,2,3,4

Vrsta predmeta / Course type	izbirni/ elective
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:**
Vsaka obveznost študenta v načinih ocenjevanja mora biti opravljena s pozitivno oceno. Opravljeno laboratorijsko delo je pogoj za pristop k ustnemu izpitu.	Each student requirement within the assessment methods must be completed with a passing grade. Completed laboratory work is a prerequisite for taking the oral exam.

Vsebina:	**Content (Syllabus outline):**
1. Metode določevanja strukture 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	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

eksperimenta v raziskovalnih laboratorijih ter obdelava rezultatov z metodami, ki so v uporabi v laboratoriju	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 (2009); prosto dostopno v e-obliki na https://link.springer.com/book/10.1007/978-3-642-01479-6
2. Daune, M., Molecular Biophysics: Structures in Motion, Oxford University Press, 1999.
3. Tuszynski, J.A. and Kurzynski, M., Introduction to Molecular Biophysics, CRC Press, Boca Raton, Florida, 2000.

Dodatna literatura / Additional Readings:

1. J. C. Gallop, SQUIDS, the Josephson Effects and Superconducting Electronics, Adam Hilger, Bristol (1990).
2. specialna literatura za posamezne eksperimentalne metode
3. smernice za vaje

Cilji in kompetence:	**Objectives and competences:**
Študenti so sposobni izbrati ustrezno skupino eksperimentalnih tehnik za učinkovito reševanje njihovega raziskovalno razvojnega problema.	Students can select the appropriate group of experimental techniques to address their research / development problems most efficiently

Predvideni študijski rezultati:	**Intended learning outcomes:**
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.	**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)
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	**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)

Uporabiti splošna fizikalna znanja pri izbiranju eksperimentalnih tehnik in analizi rezultatov Rokovati s kompleksnimi napravami Spoznati najbolj napredne tehnološke eksperimentalne pristope	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:	**Learning and teaching methods:**
Predavanja Eksperimentalna predavanja Laboratorijske vaje Problemsko učenje Uporaba programskih okolij za krmiljenje in obdelavo podatkov	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
laboratorijsko delo	50	laboratory work

Reference nosilca / Lecturer's references:

1. LEROUX, Mélanie, KOKOT, Boštjan, KOKOT, Hana, KOKLIČ, Tilen, ŠTRANCAR, Janez, et al. Aerosol–cell exposure system applied to semi-adherent cells for aerosolization of lung surfactant and nanoparticles followed by high quality RNA extraction. Nanomaterials. [Online ed.]. 2022, vol. 12, no. 8, str. 1362-1-1362-23. ISSN 2079-4991. DOI: 10.3390/nano12081362. [COBISS.SI-ID 105193987]
2. PODLIPEC, Rok, MUR, Jaka, PETELIN, Jaka, ŠTRANCAR, Janez, PETKOVŠEK, Rok. Method for controlled tissue theranostics using a single tunable laser source. Biomedical optics express. 2021, vol. 12, no. 9, str. 5881-5893. ISSN 2156-7085. https://repozitorij.uni-lj.si/IzpisGradiva.php?id=129636, DOI: 10.1364/BOE.428467. [COBISS.SI-ID 75069699]
3. ODLIPEC, Rok, PUNZÓN QUIJORNA, Esther, PIRKER, Luka, KELEMEN, Mitja, VAVPETIČ, Primož, KAVALAR, Rajko, HLAWACEK, Gregor, ŠTRANCAR, Janez, PELICON, Primož, FOKTER, Samo K. Revealing inflammatory indications induced by titanium alloy wear debris in periprosthetic tissue by label-free correlative high-resolution ion, electron and optical microspectroscopy. Materials. 2021, vol. 14, issue 11, str. [1-16], ilustr. ISSN 1996-1944. https://www.mdpi.com/1996-1944/14/11/3048, DOI: 10.3390/ma14113048. [COBISS.SI-ID 66427395]