| | |
|---|---|
| **Predmet:** | Eksperimentalne metode v fiziki in biofiziki |
| **Course title:** | Experimental methods in physics and biophysics |

| Študijski program in stopnja<br>Study programme and level | Študijska smer<br>Study field | Letnik<br>Academic year | Semester<br>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<br>Lectures | Seminar<br>Seminar | Sem. vaje<br>Tutorial | Lab. vaje<br>Laboratory<br>work | Teren. vaje<br>Field work | Samost. delo<br>Individ. work | ECTS |
|---|---|---|---|---|---|---|
| 15 | | | 75 | | 210 | 10 |

**Nosilec predmeta / Lecturer:** | Janez Štrancar

| **Jeziki /**<br>**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:**

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 eksperimenta v raziskovalnih laboratorijih ter obdelava rezultatov z metodami, ki so v uporabi v laboratoriju

**Content (Syllabus outline):**

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 (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:** | **Knowledge and understanding:** |
| Definirati zahteve raziskovalnega problema | Identifying the requirements of the research problem |
| Definirati časovne in krajevne skale problema | Identifying time and spatial scales of the problem |
| Izbrati eksperimentalne tehnike glede na zahteve in skale | Selecting experimental technique(s) with respect to the scale requirements |
| Izbrati eksperimentalne tehnike glede na tehnične možnosti (občutljivost, ločljivost, hitrost detekcije) | Selecting experimental technique(s) with respect to the technical possibilities (sensitivity, resolution, speed of detection) |
| Obdelati in razumeti rezultate meritev in na tej podlagi optimizirati eksperiment. | Analyzing and understanding the results of the measurements and employ them to optimize the experimental setup(s) |
| **Prenesljive/ključne spretnosti in drugi atributi:** | **Transferable/Key Skills and other attributes:** |
| Obdelati rezultate meritev | Processing of the measurement data |
| Izbrati ustrezne merilne metode in senzorske sisteme | Choosing the right measurement method and sensor systems |
| Presoditi smiselnost uporabe metod v izbranih časovnih in krajevnih okvirih | 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 | Using general physical knowledge to select experimental techniques and analyze results |
| Rokovati s kompleksnimi napravami | Handling with complex machines |
| Spoznati najbolj napredne tehnološke eksperimentalne pristope | Mastering the most advanced technological experimental approaches |

| **Metode poučevanja in učenja:** | **Learning and teaching methods:** |
|---|---|
| Predavanja | Lectures |
| Eksperimentalna predavanja | Experimental lectures |
| Laboratorijske vaje | Laboratory work |
| Problemsko učenje | Problem based learning |

| Uporaba programskih okolij za krmiljenje in obdelavo podatkov | 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]