

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 2 nd 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
60	0	30	30	0	180	10

Nosilec predmeta / Lecturer:

Janez Dolinšek, 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:

Predznanje klasične in moderne fizike

Prerequisites:

Preknowledge of classical and modern physics

Vsebina:

1. Metode določevanja strukture snovi (x-žarki, mikroskopi: elektronski vrstični mikroskop - SEM, tunnelski 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. Merjenje magnetizma (magnetometer z vibriranjem vzorca, SQUID - "Superconducting Quantum Interference Device")
4. Siplne tehnike (sinhrotron, presevalni elektronski mikroskop - TEM, na trdni in mehki snovi)
5. Merjenja transportnih pojavov v snovi (električna in termična prevodnost, termoelektrična napetost, Hallov pojav)
6. Laboratorijske 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. Magnetic measurements (vibrating sample magnetometer, Superconducting Quantum Interference Device - SQUID)
4. Scattering techniques (synchrotron, transmission electron microscope - TEM, application to solid and soft matter)
5. Measurements of transport properties (electrical and thermal conductivity, thermoelectric power, Hall effect)
6. Laboratory 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 osvojijo osnovno znanje s področja metod eksperimentalne fizike in biofizike. Seznanjanje z načinom eksperimentalno raziskovalnega dela v laboratorijih, s profesionalno raziskovalno opremo, materiali ter obstoječimi analiznimi in spektroskopskimi metodami.

Objectives and competences:

Students acquire elemental knowledge on the methods of experimental physics and biophysics. Gaining the current experimental work in the real research laboratories, with professional equipment, materials and existing analytical/spectroscopical methods

Predvideni študijski rezultati:

Znanje in razumevanje modernih eksperimentalnih metod za raziskave žive in nežive snovi.

Intended learning outcomes:

Knowledge and understanding of modern experimental methods for the investigation of inorganic and biological matter.

Metode poučevanja in učenja:

Metodika obsega: teoretična razlaga fizikalnih principov merskih metod in postavitev eksperimentov
Projektni pristop k izbrani vaji

Learning and teaching methods:

They are based on: theoretical explanation of the underlying physical principles and design of the experimental setup
Project approach to chosen laboratory exercise

Načini ocenjevanja:

2 pisna kolokvija ali izpit
Ocenjevanje pristopa k eksperimentalnem delu in opravljeno eksperimentalno delo

Delež (v %) /
Weight (in %)

Assessment:

2 written tests or written exam
Assessment of the approach to the experimental work and done experimental work

Reference nosilca / Lecturer's references:

Janez Dolinšek:

JAGLIČIĆ, Zvonko, VRTNIK, Stanislav, FEUERBACHER, Michael, DOLINŠEK, Janez. Magnetic properties of $\text{FeAl}_{1/2}$ and $\text{Fe}_{1/2}\text{Al}_{1/2}$. *Phys. rev., B, Condens. matter mater. phys.*, 2011, vol. 83, no. 22, str. 224427-1-224427-13, doi: [10.1103/PhysRevB.83.224427](https://doi.org/10.1103/PhysRevB.83.224427). [COBISS.SI-ID [24856359](https://www.cobiss.si/id/24856359)]

BOBNAR, Matej, VRTNIK, Stanislav, JAGLIČIĆ, Zvonko, WENCKA, Magdalena, CUI, Can, TSAI, An Pang, DOLINŠEK, Janez. Electrical, magnetic, and thermal properties of the single-grain $\text{Ag}_{1/2}\text{In}_{1/2}\text{Yb}_{1/2}$ icosahedral quasicrystal : experiment and modeling. *Phys. rev., B, Condens. matter mater. phys.*, 2011, vol. 84, no. 13, str. 134205-1-134205-10, doi: [10.1103/PhysRevB.84.134205](https://doi.org/10.1103/PhysRevB.84.134205). [COBISS.SI-ID [25170215](https://www.cobiss.si/id/25170215)]

KASHIMOTO, S., KOCJAN, Andraž, JAGLIČIĆ, Zvonko, JAZBEC, Simon, IGA, H., ISHIMASA, T., DOLINŠEK, Janez. Magnetic properties of $[\sigma]$ - and hexagonal- $\text{Mn}_{1/2}\text{Si}_{1/2}\text{Cr}_{1/2}$ approximant phases of a dodecagonal quasicrystal. *Phys. rev., B, Condens. matter mater. phys.*, 2011, vol. 84, no. 22, str. 224201-1-224201-11, doi: [10.1103/PhysRevB.84.224201](https://doi.org/10.1103/PhysRevB.84.224201). [COBISS.SI-ID [25421095](https://www.cobiss.si/id/25421095)]

KLANJŠEK, Martin, GRADIŠEK, Anton, KOCJAN, Andraž, BOBNAR, Matej, JEGLIČ, Peter, WENCKA, Magdalena, JAGLIČIĆ, Zvonko, POPČEVIĆ, Petar, IVKOV, Jovica, SMONTARA, Ana, GILLE, Peter, ARMBRÜSTER, M., GRIN, Yuri, DOLINŠEK, Janez. PdGa intermetallic hydrogenation catalyst : an NMR

and physical property study. *J. phys., Condens. matter*, 2012, vol. 24, no. 8, str. 085703-1-085703-9, doi: [10.1088/0953-8984/24/8/085703](https://doi.org/10.1088/0953-8984/24/8/085703). [COBISS.SI-ID [25582375](#)]

BOBNAR, Matej, JEGLIČ, Peter, KLANJŠEK, Martin, JAGLIČIČ, Zvonko, WENCKA, Magdalena, POPČEVIČ, Petar, IVKOV, Jovica, STANIČ, Denis, SMONTARA, Ana, GILLE, Peter, DOLINŠEK, Janez. Intrinsic anisotropic magnetic, electrical, and thermal transport properties of d-Al-Co-Ni decagonal quasicrystals. *Phys. rev., B, Condens. matter mater. phys.*, 2012, vol. 85, no. 2, str. 024205-1-024205-11, doi: [10.1103/PhysRevB.85.024205](https://doi.org/10.1103/PhysRevB.85.024205). [COBISS.SI-ID [25544231](#)]

Janez Štrancar:

ARSOV, Zoran, URBANČIČ, Iztok, GARVAS, Maja, BIGLINO, Daniele, LJUBETIČ, Ajasja, KOKLIČ, Tilen, ŠTRANCAR, Janez. Fluorescence microspectroscopy as a tool to study mechanism of nanoparticles delivery into living cancer cells. *Biomedical optics express*, 2011, vol. 2, no. 8, str. 2083-2095, doi: [10.1364/BOE.2.002083](https://doi.org/10.1364/BOE.2.002083). [COBISS.SI-ID [24859687](#)]

KUŽDŽAŁ, Michał, WESOŁOWSKA, Olga, ŠTRANCAR, Janez, MICHALAK, Krystyna. Fluorescence and ESR spectroscopy studies on the interaction of isoflavone genistein with biological and model membranes. *Chem. phys. lipids*. [Print ed.], 2011, vol. 164, no. 4, str. 283-291, doi: [10.1016/j.chemphyslip.2011.03.001](https://doi.org/10.1016/j.chemphyslip.2011.03.001). [COBISS.SI-ID [24927271](#)]

MLAKAR, Jana, ŠTRANCAR, Janez. Overheating in residential passive house : solution strategies revealed and confirmed through data analysis and simulations. *Energy build.*. [Print ed.], 2011, vol. 43, no. 6, str. 1443-1451, doi: [10.1016/j.enbuild.2011.02.008](https://doi.org/10.1016/j.enbuild.2011.02.008). [COBISS.SI-ID [24680743](#)]

PAJK, Stane, GARVAS, Maja, ŠTRANCAR, Janez, PEČAR, Slavko. Nitroxide-fluorophore double probes: a potential tool for studying membrane heterogeneity by ESR and fluorescence. *Organic and Biomolecular Chemistry*. [Print ed.], 2011, vol. 9, issue 11, str. 4150-4159. <http://pubs.rsc.org/en/content/articlelanding/2011/ob/c0ob01173h>, doi: [10.1039/C0OB01173H](https://doi.org/10.1039/C0OB01173H). [COBISS.SI-ID [3007601](#)]

KOKLIČ, Tilen, ŠTRANCAR, Janez. Lysolipid containing liposomes for transendothelial drug delivery. *BMC research notes*, [in press] 2012, 9 str., doi: [10.1186/1756-0500-5-179](https://doi.org/10.1186/1756-0500-5-179). [COBISS.SI-ID [25811239](#)]