

UČNI NAČRT PREDMETA / COURSE SYLLABUS

Predmet:	Uvod v nanoznanosti in nanotehnologije
Course title:	Introduction to Nanosciences and Nanotechnologies

Študijski program in stopnja Study programme and level	Študijska smer Study field	Letnik Academic year	Semester Semester
Nanoznanosti in nanotehnologije, 2. stopnja	/	1	1
Nanosciences and Nanotechnologies, 2 nd cycle	/	1	1

Vrsta predmeta / Course type Obvezni / Mandatory

Univerzitetna koda predmeta / University course code: NANO2-889

Predavanja Lectures	Seminar Seminar	Vaje Tutorial	Klinične vaje work	Druge oblike študija	Samost. delo Individ. work	ECTS
30	30			30	210	10

**Navedena porazdelitev ur velja, če je vpisanih vsaj 15 študentov. Drugače se obseg izvedbe kontaktnih ur sorazmerno zmanjša in prenese v samostojno delo. / This distribution of hours is valid if at least 15 students are enrolled. Otherwise the contact hours are linearly reduced and transferred to individual work.*

Nosilec predmeta / Lecturer:

Doc. dr. Andreja Benčan Golob
 Prof. dr. Maja Remškar
 Doc. dr. Miha Čekada
 Prof. dr. Vid Bobnar
 Prof. dr. Tomaž Apih
 Doc. dr. Hana Uršič Nemevšek

Jeziki / Languages: **Predavanja / Lectures:** slovenski, angleški
Slovenian, English

Vaje / Tutorial:

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:

Zaključen študij prve stopnje s področja naravoslovja ali tehnike ali zaključen študij prve stopnje na drugih področjih z znanjem osnov s področja predmeta.

Prerequisites:

Completed first cycle studies in natural sciences or engineering or completed first cycle studies in other fields with knowledge of fundamentals in the field of this course.

Vsebina:

Študenti bodo poslušali izbrana predavanja s področja nanoznanosti in nanotehnologije ter o novjših analitskih tehnikah s tega področja, ki se uporabljajo na IJS in v sodelujočih raziskovalnih skupinah.

Poleg uvoda o lastnostih nanomaterialov in nanotehnologij bo poudarek predavanj na:

- metodah za pripravo in karakterizacijo materialov z nano dimenzijami (kot na primer fizikalne metode priprave tankih plasti),

Content (Syllabus outline):

Students will interact with researchers from the field of nanosciences and nanotechnologies. They will also learn novel analytic techniques from this field, which are used at JSI and participating research groups.

In addition to the introduction of nanomaterials and nanotechnologies, the focus will be on:

- methods for the preparation and characterization of materials with nano dimensions (for example the physical methods

- strukturnih metodah (kot na primer metode elektronske mikroskopije, jedrska magnetna resonanca),
- električnih in elektro-mehanskih lastnosti od lokalnega do makroskopskega nivoja (mikroskopija na atomsko silo z različnimi moduli, dielektrična spektroskopija).

- for the preparation of thin layers)
- structural methods (such as methods of electronic microscopy, nuclear magnetic resonance)
- electric and electro-mechanical properties from local to macroscopic level (atomic force microscopy with different modules, dielectric spectroscopy).

Temeljni literatura in viri / Readings:

Handbook of Nanotechnology, Editor: Bhushan Bharat , Springer 2010

S. Kalinin, A. Gruverman, Scanning probe microscopy, Electrical and electromechanical phenomena at the nanoscale, Springer, 2007

Modern Magnetic Resonance, Editor: G. A. Webb, 2nd edition, Springer 2018

Izbrani članki predvsem v revijah Nature Materials, Advanced Functional Materials, Acta materialia, Journal of applied physics, Journal of materials chemistry in pregledni članki. / Targeted selection of papers from Nature Materials, Advanced Functional Materials, Acta materialia, Journal of applied physics, Journal of materials chemistry and review papers.

Cilji in kompetence:

Cilj predmeta je seznaniti študente z aktualnimi problemi in najnovejšimi dosežki na področju nanoznanosti in nanotehnologij.

Kompetence:

- obvladovanje izbranih raziskovalnih metod,
- sposobnost samostojnega raziskovalnega dela,
- sposobnost uporabe znanj pri reševanju konkretnih problemov.

Objectives and competences:

The goal of this course is to give an overview of the major directions of research and the latest achievements in the field of nanosciences and nanotechnologies.

Competencies:

- mastering selected research methods
- ability to carry out independent research work
- ability to use the knowledge in practice

Predvideni študijski rezultati:

Študent bo na osnovi pridobljenega znanja:

- znal izbrati in napovedal omejitve posameznih metod,
- interpretiral dobljene rezultate analiz na izbranih primerih,
- izdelal seminar o izbrani metodi v angleškem jeziku.

Intended learning outcomes:

The student will:

- select a suitable method and forecast the experimental limitations
- interpret the results of analysis
- prepare the seminar about the selected method in English

Metode poučevanja in učenja:

Interaktivna predavanja
Laboratorijsko delo
Individualno voden študij

Learning and teaching methods:

Interactive lectures
Laboratory work
Individual guided studies

Delež (v %) /

Weight (in %)

Načini ocenjevanja:

Assessment:

Seminarska naloga, ki vsebuje zagovor reševanja izbranega primera.

100 %

Seminar which includes the case-study with defence.

Reference nosilca / Lecturer's references:

1. ROJAC, Tadej, BENČAN, Andreja, DRAŽIĆ, Goran, SAKAMOTO, Naonori, URŠIČ, Hana, JANČAR, Boštjan, TAVČAR, Gašper, MAKAROVIČ, Maja, WALKER, Julian, MALIČ, Barbara, DAMJANOVIĆ, Dragan. Domain-wall conduction in ferroelectric BiFeO₃ controlled by accumulation of charged defects. Nature materials, ISSN 1476-1122, 2017, vol. 16, no. 3, str. 322-327, doi: 10.1038/nmat4799. [COBISS.SI-ID 29936679]
2. MATAVŽ, Aleksander, MALIČ, Barbara, BOBNAR, Vid. Inkjet printing of metal-oxide-based electronic devices. Journal of applied physics, ISSN 0021-8979, 2017, vol. 122, no. 21, str. 214102-1-214102-6, doi: 10.1063/1.5000432. [COBISS.SI-ID 30978087]
3. POTTA THARA, Yasir-Beeran, BOBNAR, Vid, GORGIEVA, Selestina, GROHENS, Yves, THOMAS, Sabu, FINŠGAR, Matjaž, KOKOL, Vanja. Mechanically strong, flexible and thermally stable graphene oxide/nanocellulosic films with enhanced dielectric properties. RSC advances, ISSN 2046-2069, 2016, vol. 6, iss. 54, str. 49138-49149, doi: 10.1039/C6RA06744A. [COBISS.SI-ID 19525910]
4. IMANI, Roghayeh, DILLERT, Ralph, BAHNEMANN, Detlef W., PAZOKI, Meysam, APIH, Tomaž, KONONENKO, Veno, REPAR, Neža, KRALJ-IGLIČ, Veronika, BOSCHLOO, Gerrit, DROBNE, Damjana, EDVINSSON, Tomas, IGLIČ, Aleš. Multifunctional gadolinium-doped mesoporous TiO₂ nanobeads ephotoluminescence, enhanced spin relaxation, and reactive oxygen species photogeneration, beneficial for cancer diagnosis and treatment. Small, ISSN 1613-6810, 2017, vol. 13, iss. 20, str. 1-11, doi: 10.1002/smll.201700349. [COBISS.SI-ID 30414375]
5. ROJAC, Tadej, URŠIČ, Hana, BENČAN, Andreja, MALIČ, Barbara, DAMJANOVIĆ, Dragan. Mobile domain walls as a bridge between nanoscale conductivity and macroscopic electromechanical response. Advanced functional materials, ISSN 1616-301X, 2015, vol. 25, no. 14, str. 2099-2108, doi: 10.1002/adfm.201402963. [COBISS.SI-ID 28359975]