UČNI NAČRT PREDMETA / COURSE SYLLABUS	
Predmet:	Električne, optične in magnetne lastnosti nanomaterialov
Course title:	Electrical, Optical, and Magnetic Properties of Nanomaterials

Študijski program in stopnja Study programme and level	Študijska smer Study field	Letnik Academic year	Semester Semester
Nanoznanosti in nanotehnologije, 3. stopnja		1	1
Nanosciences and Nanotechnologies, 3rd cycle		1	1

Vrsta predmeta / Course type	Izbirni / Elective
Univerzitetna koda predmeta / University course code:	NANO3-795

Predavanja Lectures	Seminar Seminar	Vaje Tutorial	Klinične vaje work	Druge oblike študija	Samost. delo Individ. work	ECTS
15	**15**			**15**	**105**	**5**

**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 transfered to individual work.*

Nosilec predmeta / Lecturer:	Doc. dr. Alenka Mertelj

Jeziki / Languages:	**Predavanja / Lectures:**	angleščina / English
	Vaje / Tutorial:	angleščina / English slovenščina, nemščina ali italijanščina po potrebi / Slovenian, German or Italian if needed

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:	**Prerequisits:**
Zaključen študij druge stopnje s področja naravoslovja ali tehnologije ali zaključen študij druge stopnje na drugih področjih z znanjem osnov s področja predmeta.	Completed second cycle studies in natural sciences or technologies or completed second cycle studies in other fields with knowledge of fundamentals in the field of this course.

Vsebina:	**Content (Syllabus outline):**
Električne lastnosti: elektronske komponente (kontakti, spoji, diode, tranzistorji, elementi, ki izkoriščajo kvantne učinke). Magnetne lastnosti: osnovni koncept magnetizma, magnetni pojavi v materialih, uporaba.	Electrical properties: electronic components (contacts, connections, diodes, transistors, elements using quantum effects). Magnetic properties: the basic concept of magnetism, magnetic phenomena in materials, application.

Moderne metode optične spektroskopije, optične komponente in integrirana optična vezja v fotoniki. Optične lastnosti: elektromagnetna teorija, osnove in pomen optičnih lastnosti, interakcija svetlobe s snovjo, spektralne meritve in njihov pomen, optične komponente.	Modern methods of optical spectroscopy, optical components, and integrated optical circuits in photonics. Optical properties: electromagnetic theory, the basics and relevance of optical properties, interaction of light with matter, spectral measurements and their relevance, optical components.

Temeljni literatura in viri / Readings:

Student seminars will be based mostly on recent scientific publications. Introductory lectures are based on the following books:
N. W. Ashcroft & N. D. Mermin, *Solid State Physics,* Thomson Press, 2003, ISBN 978-8131500521
M. Fox, *Optical properties of Solids*, Oxford University Press; 2nd edition, 2010, ISBN 978-0199573370
S. Blundell, *Magnetism in Condensed Matter,* Oxford University Press, 2001, ISBN 978-0198505914
S. Datta, *Quantum Transport: Atom to Transistor,* Cambridge University Press; Revised edition, 2013, ISBN 978-1107632134
C. F. Klingshirn, *Semiconductor Optics,* Springer, 4th edition, 2012, ISBN 978-3642283611

Cilji in kompetence:	**Objectives and competences:**
Študentje bodo dobili pregled o elektronski teoriji, teoriji pasov, električnih in optičnih lastnostih materialov in o izkoriščanju le teh, magnetnih lastnostih in uporabi oksidnih in kovinskih magnetnih materialov. Tako bodo seznanjeni s širokim spektrom lastnosti materialov, razumeli bodo od česa so te lastnosti odvisne ter kako jih izkoriščamo in prilagajamo za določeno uporabo. Seznanjeni bodo z uporabo optičnih spektroskopskih metod za karakterizacijo materialov in uporabo v fotoniki.	Students will acquire an overview of the electron theory, band theory, electrical and optical properties of materials and their use, magnetic properties and the use of oxide and metallic magnetic materials. They will become acquainted with a wide range of material properties, they will understand what these properties depend on and how we use and tailor them for particular applications. They will be acquainted with the use of optical spectroscopic methods for the characterization of materials and application in photonics.

Predvideni študijski rezultati:	**Intended learning outcomes:**
Znanje in razumevanje: • razumevanje električnih, optičnih in magnetnih lastnosti nanomaterialov. <u>Splošne sposobnosti:</u> • obvladanje raziskovalnih metod, postopkov in procesov, • razvoj kritične in samokritične presoje, • razvoj komunikacijskih sposobnosti in spretnosti, posebej komunikacije v mednarodnem okolju, • sodelovanje, delo v skupini (v mednarodnem okolju). Predmetne sposobnosti: • Predmet pripravlja študente za uporabo znanja s	Knowledge and understanding: • the students will understand electrical, optical, and magnetic properties of nanomaterials. General learning outcomes: • the students will master research methods, procedures, and processes, • the students will develop critical thinking, • the students will develop communication skills to present research achievements in the international environment, • cooperation, work in teams (in international environment). Course-specific learning outcomes:

področja električnih, optičnih in magnetnih lastnosti nanomaterialov.	• this course prepares students to apply knowledge of electrical, optical, and magnetic properties of nanomaterials.

Metode poučevanja in učenja:	**Learning and teaching methods:**
• predavanja • seminarji • konzultacije	• lectures • seminar work • consultations

Načini ocenjevanja:	Delež (v %) / Weight (in %)	**Assessment:**
• seminar	40 %	• seminar
• aktivna udeležba pri predavanjih in seminarjih	40 %	• active participation during lectures and seminars
• ustni izpit	20 %	• oral exam

Reference nosilca / Lecturer's references:

• VEGA MAYORAL, Victor, BORZDA, Tetiana, VELLA, Daniele, PRIJATELJ, Matej, POGNA, Eva Arianna Aurelia, BACKES, Claudia, COLEMAN, Jonathan N., CERULLO, Giulio, MIHAILOVIĆ, Dragan, GADERMAIER, Christoph. Charge trapping and coalescence dynamics in few layer MoS2MoS2. *2D materials*, ISSN 2053-1583, 2018, vol. 5, no. 1, str. 015011-1-015011-8

• BORZDA, Tetiana, GADERMAIER, Christoph, VUJIČIĆ, Nataša, TOPOLOVŠEK, Peter, BOROVŠAK, Miloš, MERTELJ, Tomaž, MIHAILOVIĆ, Dragan, et al. Charge photogeneration in few-layer MoS2MoS2. *Advanced functional materials*, ISSN 1616-301X, 2015, vol. 25, no. 22, str. 3351-3358

• TOPOLOVŠEK, Peter, GADERMAIER, Christoph, VENGUST, Damjan, STROJNIK, Martin, STRLE, Jure, MIHAILOVIĆ, Dragan. Unlocking the functional properties in one-dimensional MoSI cluster polymers by doping and photoinduced charge transfer. *Nano letters*, ISSN 1530-6984, 2015, vol. 15, issue 2, str. 813-818

• MAJKIĆ, Aleksej, GADERMAIER, Christoph, ĆELIĆ, Nevena, TOPOLOVŠEK, Peter, BRATINA, Gvido, MIHAILOVIĆ, Dragan. Mo6S9−xIxMo6S9−xIx nanowires as additives for enhanced organic solar cell performance. *Solar energy materials and solar cells*, ISSN 0927-0248. [Print ed.], 2014, vol. 127, str. 63-66

• GADERMAIER, Christoph, KABANOV, Viktor V., ALEXANDROV, Alexandre Sasha, STOJCHEVSKA, Ljupka, MERTELJ, Tomaž, MIHAILOVIĆ, Dragan, et al. Strain-induced enhancement of the electron energy relaxation in strongly correlated superconductors. *Physical review. X*, ISSN 2160-3308, 2014, vol. 4, no. 1, str. 011056-1-011056-6