UČNI NAČRT PREDMETA / COURSE SYLLABUS	
Predmet:	Znanost o materialih in nanotehnologija
Course title:	Materials Science and Nanotechnology

Študijski program in stopnja **Study programme and level**	**Študijska smer** **Study field**	**Letnik** **Academic year**	**Semester** **Semester**
FIZIKA		1. ali .2	**1. ali 2.**
PHYSICS		1. or 2.	**1. or 2.**

Vrsta predmeta / Course type

Izbirni za modula Biofizika in Fizika

Univerzitetna koda predmeta / University course code:

Predavanja **Lectures**	**Seminar** **Seminar**	**Vaje** **Tutorial**	**Lab. vaje** **Laboratory work**	**Mentorstvo** **Mentorship**	**Samost. delo** **Individ. work**	**ECTS**
10	**5**				**165**	**6**

Nosilec predmeta / Lecturer: Kaushik Pal

Jeziki / **Languages:**	**Predavanja /** **Lectures:**	angleški/English
	Vaje / Tutorial:	

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

Predznanje iz klasične in moderne fizike.

Prerequisits:

Preknowledge of classical and modern physics.

Vsebina:

Obravnavani bodo aktualni primeri s področja spektroskopije. Poudarek je na znanjih, ki jih potrebuje kandidat doktorskega študija. Jedrne vsebine predmeta so naslednje:
- Osnove in sinteza nanomaterialov.
- Karakterizacija nanomaterialov & instrumentacijskih tehnik.
- Osnove znanosti o materialih in nanoinženiring.
- Kristalne lastnosti & dielektriki, feroelektriki in sončne celice.

Content (Syllabus outline):

Current cases in the field of spectroscopy will be discussed. The emphasis is on the knowledge needed by the doctoral candidate. The core contents of the course are as follows:
- Basics and synthesis of Nanomaterials.
- Characterization of Nanomaterials & Instrumentation Techniques.
- Basics of Materials Science and Nanoengineering.
- Crystalline Properties & Dielectrics, Ferroelectrics and Solar cells.

Temeljni literatura in viri / Readings:

1. Cao, G. (2004). Nanostructures and nanomaterials: Synthesis, properties and applications. Singapore: World Scientific Publishing Company. ISBN - 1-86094-415-9; 1-86094-480-9; 9786611347444; 1-86094-596-1; 1-281-34744-2; 1-59124-997-X Celotno besedilo dostopno v EBSCOhost Ebook Academic Collection - World Wide.
2. Abe, A. (2005). Inorganic polymeric nanocomposites and membranes [e-knjiga]. Berlin; Heidelberg: Springer. ISBN 978-3-540-31572-8. [COBISS.SI-ID 31603973] https://plus.cobiss.net/cobiss/si/sl/bib/pefmb/31603973
3. Pomogailo, A. D., & Kestelman, V. N. (2005). Metallopolymer nanocomposites [e-knjiga]. Berlin; Heidelberg: Springer. ISBN 978-3-540-26523-8. [COBISS.SI-ID 31195653] https://plus.cobiss.net/cobiss/si/sl/bib/pefmb/31195653
4. Atkins, P. W. (2000). Physical chemistry (6th ed., reprinted). Oxford: Oxford University Press. ISBN 0-19-850102-1. [COBISS.SI-ID 10432008] https://plus.cobiss.net/cobiss/si/sl/bib/pefmb/10432008
5. Pal, N., Banerjee, S., Roy, P., Pal, K. (2021). Cellulose nanocrystals–silver nanoparticles–reduced graphene oxide based hybrid PVA nanocomposites and its antimicrobial properties. International Journal of Biological Macromolecules, 191, 445–456. https://doi.org/10.1016/j.ijbiomac.2021.08.237

Dodatna literatura / Additional readings:

1. Poole, C. P., & Owens, F. J. (2003). Introduction to nanotechnology. Hoboken: Wiley. [COBISS.SI-ID 3902036]
2. Fahrner, W. R. (2005). Nanotechnology and nanoelectronics: Materials, devices, measurement techniques. Berlin; New York: Springer. [COBISS.SI-ID 18866471
3. Cao, G. (2004). Nanostructures & nanomaterials: Synthesis, properties & applications. London: Imperial College Press. [COBISS.SI-ID 18571815]
4. Reed, M. A., & Lee, T. (2003). Molecular nanoelectronics. Stevenson Ranch: American Scientific Publishers. [COBISS.SI-ID 17608487]
5. Callister, W. D., & Rethwisch, D. G. (2020). Materials science and engineering: An introduction (10th ed., global ed.). Hoboken: Wiley. [COBISS.SI-ID 43270403]
6. Chung, Y.-w. (2007). Introduction to materials science and engineering. Boca Raton: CRC Press; Taylor & Francis Group. [COBISS.SI-ID 12435250]
7. George, J. (1992). Preparation of thin films. New York: Marcel Dekker. [COBISS.SI-ID 4091]

Cilji in kompetence:	**Objectives and competences:**
Namen predmeta je študente usposobiti za raziskovalno delo na izbranem področju znanosti o materialih in nanotehnologiji.	The purpose of the course is to train students for research work in a selected field of materials science and nanotechnology.

Predvideni študijski rezultati:	**Intended learning outcomes:**
Znanje in razumevanje: Po zaključku tega predmeta bo študent zmožen:	Knowledge and understanding: On completion of this course the student will be able to:

- razumeti osnovne principe znanosti o materialih in nanotehnologiji, - analizirati, vrednotiti in primerjati najnovejše raziskave na izbranem področju znanosti o materialih in nanotehnologiji; - uporabiti napredno fizikalno znanje in matematične metode na danem področju za analizo in vrednotenje fizikalnih pojavov v odvisnosti od relevantnih fizikalnih parametrov in spremenljivk; - prepoznati analogije med različnimi pojavi in jih uporabiti za obravnavo novih pojavov ter jih uporabiti. -	- understand the basic principles of materials science and nanotechnology, - analyze, evaluate and compare the latest research in the selected field of materials science and nanotechnology; - use advanced physical knowledge and mathematical methods from a specific field for an analysis and evaluation of physical effects as a function of physical parameters and variables; - recognise analogies among different effects and apply them to describe novel physical effects and apply them.
Prenesljive/ključne spretnosti in drugi atributi: - *Spretnosti komuniciranja:* ustno in pisno izražanje pri predstavitvi izbrane teme. - *Uporaba informacijske tehnologije:* uporaba programskih orodij za modeliranje in obdelavo podatkov. - *Reševanje problemov:* prepoznavanje univerzalnosti, analogij in celosten pristop k reševanju problemov.	Transferable/Key Skills and other attributes: - *Communication skills:* manner of expression at written and oral presentation of a chosen topic. - *Use of information technology:* use of software tools for modelling and data manipulation. - *Problem solving:* recognizing universality, analogies and an global approach to solving problems.

Metode poučevanja in učenja:	**Learning and teaching methods:**
Predavanja, seminarji, konzultacije, razlaga, razgovor, delo s tekstom, metoda pisnih in grafičnih del, problemsko učenje, študija primera, raziskovalno učenje, uporaba programskih orodij.	Lectures, seminars, tutorials, explanation, discussion, work with text, work with graphic elements, case study, problem based learning, inquiry based learning, use of software tools.

Načini ocenjevanja:	Delež (v %) / Weight (in %)	**Assessment:**
~~Način (pisni izpit, ustno izpraševanje, naloge, projekt)~~ ~~seminar~~ Seminarska naloga	**100%**	~~Type (examination, oral, coursework, project):~~ ~~Seminar~~ Seminar paper

Reference nosilca / Lecturer's references:

1. N. Pal, S. Banerjee, P. Roy, **K. Pal**, Cellulose nanocrystals-silver nanoparticles-reduced graphene oxide based hybrid PVA nanocomposites and its antimicrobial properties, **International Journal of Biological Macromolecules** 191, 445-456, (2021). https://doi.org/10.1016/j.ijbiomac.2021.08.237

2. M. Kaur, **K. Pal**, Synthesis, characterization and electrochemical evaluation of hydrogen storage capacity of graphitic carbon nitride and its nanocomposites in an alkaline environment, **Journal of Materials Science: Materials in Electronics** 32, 12475-12489 (2021). https://doi.org/10.1007/s10854-021-05882-x

3. M. Kaur, **K. Pal**, Potential electrochemical hydrogen storage in nickel and cobalt nanoparticles-induced zirconia-graphene nanocomposite, **Journal of Materials Science: Materials in Electronics** 31, 10903-10911 (2020). https://doi.org/10.1007/s10854-020-03641-y

4. P. Singh, **K. Pal**, Activated carbon-Polyaniline composite active material slurry electrode for high capacitance, improved rheological performance electrochemical flow capacitor, **Electrochimica Acta** 354, 136719, (2020). https://doi.org/10.1016/j.electacta.2020.136719

5. K. Rathi, **K. Pal**, Fabrication of $MoSe_2$–Graphene Hybrid Nanoflakes for Toxic Gas Sensor with Tunable Sensitivity, **Advanced Materials Interfaces** 7(12), 2000140 (2020). https://doi.org/10.1002/admi.202000140