



Univerza v Mariboru

Fakulteta za naravoslovje
in matematiko

UČNI NAČRT PREDMETA / COURSE SYLLABUS

Predmet:	Fizika materialov
Course title:	Physics of materials

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/elective

Univerzitetna koda predmeta / University course code:

Predavanja Lectures	Seminar Seminar	Seminarske vaje Tutorial	Terenske vaje Field work	Druge oblike študija	Samost. delo Individ. work	ECTS
10	5	20	5		110	5

Nosilec predmeta / Lecturer:

Mitja Slavinec

Jeziki /

Languages:

Predavanja /

Lectures:

slovenski/Slovenian

Vaje / Tutorial:

slovenski/Slovenian

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

Pogojev ni.
Priporočljivo predznanje Mehanike, Elektromagnetizma, Matematične fizike, Moderne fizike in Trdne snovi.

Prerequisites:

None.
Recommended preknowledge in Mechanics, Electromagnetism, Mathematical physics, Modern Physics and Solid State Physics.

Vsebina:

- Kristali in simetrije
- Interakcije v trdni snovi
- Blochovi elektroni, prevodnost, specifična toplota
- Mrežna nihanja, specifična toplota (eno dimenzionalni (1D), 3D, 1D sistemi in nečistoče)

Content (Syllabus outline):

- Crystals and symmetries
- Interactions in solid state systems
- Bloch electrons, conductivity, specific heat
- Lattice oscillations, specific heat (one dimensional (1D), 3D, 1D system and impurities)
- Quantization of oscillations, phonons

<ul style="list-style-type: none"> • Kvantizacija mrežnih nihanj, fononi • Termično raztezanje • Elektronska in ionska polarizabilnost • Fazni in strukturni prehodi, spinski valovi, mehke in Goldstonove fluktuacije, teorija superprevodnosti, kritični pojavi, skaliranje <ul style="list-style-type: none"> • Mehanske lastnosti strukturnih materialov • Fazna separacija in večkomponentni materiali • Umetne mase • Tekstilni materiali • Jeklo in železove zlitine • Preizkusi mehanskih lastnosti jekel • Barvne kovine • Akustično aktivni materiali
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<ul style="list-style-type: none"> • Thermal expansion • Electron and ion polarizability • Phase and structural transitions, spin waves, soft and Goldstone modes, theory of superconductivity, critical phenomena, scaling • Mechanical properties of structural materials • Phase separation and multi-component materials • Plastics • Textile materials • Steel and iron alloys • Tests of mechanical properties of steels • Color metals • Acoustically active materials
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Temeljni literatura in viri / Readings:

<ol style="list-style-type: none"> 1. N.W. Ashcroft, N.D. Mermin, Solid state physics, Rinehart and Winston, New York, 1976 in kasnejše izdaje. 2. C. Kittel, Introduction to Solid State Physics, John Wiley&Sons, New York, 1986 in kasnejše izdaje. 3. S. Blundell, Magnetism in Condensed Matter, Oxford University Press, New York, 2001. 4. Aktualna gradiva bodo sproti objavljena tudi na spletnih straneh Oddelka za fiziko http://www.fizika.uni-mb.si/. <p>The relevant sources and teaching material will be published on the website of the Department of Physics http://www.fizika.uni-mb.si/</p>

Cilji in kompetence:

<p>Študent osvoji napredno znanje na področju fizike trdne snovi in fizike materialov: kristali, keramika, umetne mase, jeklo in železove zlitine, tekstilni materiali.</p>

Objectives and competences:

<p>Student acquires advanced knowledge on physics of solid state physics and physics of materials: crystals, ceramics, plastics, steel and iron alloys, textile materials.</p>
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Predvideni študijski rezultati:

<p>Znanje in razumevanje: Po uspešno zaključeni učni enot študent:</p> <ul style="list-style-type: none"> • razume ključne koncepte in procese v fiziki trdnih snovi, • povezuje teoretično znanje iz fizike za študijo lastnosti materialov, • povezuje teoretično znanje fizike različnih materialov (kristali, keramika, umetne mase, jeklo in železove zlitine, tekstilni materiali) in oblikuje celostno sliko,

Intended learning outcomes:

<p>Knowledge and Understanding: On completion of this course student:</p> <ul style="list-style-type: none"> • understands key concepts and processes in the physics of solids, • connects theoretical knowledge in physics to study the properties of materials, • connects the theoretical knowledge of the physics of various materials (crystals, ceramics, plastics, steel and iron alloys,

- se seznanjajo z merilnimi tehnikami in metodami na področju fizike materialov,
- spozna in uporablja matematične modele za obravnavo fizikalnih problemov v fiziki materialov,
- vrednoti in interpretira rezultate.

Prenesljive/ključne spretnosti in drugi atributi:
 Študent je zmožen uporabiti matematične modele za reševanje realnih fizikalnih problemov, uporabljati sodobno računalniško programsko opremo kot pomoč pri kvantitativni obravnavi zahtevnih fizikalnih problemov in uporabiti znanje za obravnavo dejanskih tehnoloških problemov v fiziki materialov.

textile materials) to form overall understanding,

- gets acquainted with measurement techniques and methods in the field of physics of materials,
- learns about the use of mathematical models for studying physical problems in the field of physics of materials,
- evaluates and interprets results.

Transferable/Key Skills and other attributes:
 Student is able to use mathematical methods to solve real problems in physics, use modern computer software tools for quantitative study of advanced physical problems, use the knowledge to tackle actual technological problems in physics of materials.

Metode poučevanja in učenja:

Predavanja in eksperimentalna predavanja (razlaga, razgovor, demonstracija)
 Seminarske vaje (delo s tekstom, metoda pisnih in grafičnih del, metoda praktičnih del, uporaba simulacij in simulacijskih okolij)
 Terensko delo (ekskurzije, študija primera)
 Seminar (razlaga in razgovor)
 Poučevanje in učenje potekata z didaktično uporabo informacijsko-komunikacijske tehnologije.

Learning and teaching methods:

Lectures and experimental lectures (explanation, discussion, demonstration)
 Seminar exercises (work with text, work with graphic elements, practical work, use of simulations and simulation environments)
 Field work (excursion, case study)
 Seminar (explanation and discussion)
 Teaching and learning are done through the didactic use of ICT.

Delež (v %) /

Načini ocenjevanja:

Weight (in %)

Assessment:

<p>Seminarska naloga (izdelek in predstavitev) ustni izpit</p> <p>Vsaka izmed naštetih obveznosti mora biti opravljena s pozitivno oceno.</p> <p>Pozitivna ocena iz seminarske naloge je pogoj za pristop k izpitu.</p>	<p>50</p> <p>50</p>	<p>Seminar (work and presentation) oral exam</p> <p>Each of the mentioned commitments must be assessed with a passing grade.</p> <p>Positive grade of seminar are a prerequisite for access to the exam.</p>
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Reference nosilca / Lecturer's references:

ROSTAMI, Zahra, RAJAGOPAL, Karthikeyan, KHALAF, Abdul Jalil M., JAFARI, Sajad, PERC, Matjaž, SLAVINEC, Mitja. Wavefront-obstacle interactions and the initiation of reentry in excitable media. *Physica.A, Statistical mechanics and its applications*. 2018, vol. 509, str. 1162-1173.

KLEMENČIČ, Eva, SLAVINEC, Mitja. Liquid crystals as phase change materials for thermal stabilization. *Advances in condensed matter physics*. 2018, vol. 2018, art. id 1878232, str. 1-8.

SLAVINEC, Mitja, REPNIK, Robert, KLEMENČIČ, Eva. The impact of moisture on thermal conductivity of fabrics = Meritve vpliva vlage na toplotno prevodnost tkanin. *Anali PAZU*. nov. 2016, letn. 6, št. 1/2, str. 8-12

WEI, Zhouchao, ZHU, Bin, YANG, Jing, PERC, Matjaž, SLAVINEC, Mitja. Bifurcation analysis of two disc dynamos with viscous friction and multiple time delays. *Applied mathematics and computation*. [Print ed.]. 2019, vol. 347, str. 265-281. ISSN 0096-3003. DOI: 10.1016/j.amc.2018.10.090.