



Univerza v Mariboru

Fakulteta za naravoslovje
in matematiko

UČNI NAČRT PREDMETA / COURSE SYLLABUS

Predmet:	Elektromagnetizem
Course title:	Electromagnetism

Študijski program in stopnja Study programme and level	Študijska smer Study field	Letnik Academic year	Semester Semester
Fizika, 1. stopnja		1	2
Physics, 1st cycle		1	2

Vrsta predmeta / Course type

Obvezni/Compulsory

Univerzitetna koda predmeta / University course code:

Predavanja Lectures	Seminar Seminar	Vaje Tutorial	Klinične vaje work	Druge oblike študija	Samost. delo Individ. work	ECTS
60		30			120	7

Nosilec predmeta / Lecturer:

Samo Kralj

Jeziki /

Languages:

Predavanja /

Lectures:

slovenski/Slovenian

Vaje / Tutorial:

slovenski/Slovenian

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

Priporočeno je predznanje maturitetnega programa matematike in fizike ter predznanje iz mehanike ter osnov analize. Vsaka izmed naštetih obveznosti v načinih ocenjevanja mora biti opravljena s pozitivno oceno.

Prerequisites:

Knowledge on the level of the secondary school program of Physics and Mathematics is recommended as well as knowledge on mechanics and fundamentals of analysis. Each of the listed obligations in the assessment methods must be completed with a positive grade.

Vsebina:

Content (Syllabus outline):

Električno polje in električni tok:

Električni naboj, prevodniki in izolatorji, Coulombov zakon, električno polje, električni dipol, Gaussov zakon, električni potencial in napetost, kondenzatorji, energija kondenzatorja. Električni tok in upor, Ohmov zakon, polprevodniki, superprevodniki, električni tokokrog, viri napetosti, amperimeter, voltmeter, Kirchhoffova pravila.

Magnetno polje:

gostota in jakost, Hallov pojav, sila na vodnik in navor na tokovno zanko v magnetnem polju; Amperov zakon; indukcija, Faradayev zakon, Lenzova pravila; tuljava, induktivnost, energija tuljave, transformator; Maxwellove enačbe: simetrija enačb, premikalni tok in magnetni monopol.

Electric field and current:

Electric charge, conductors and isolators, Coulomb law, electric field, electric dipole, Gauss law, electric potential and voltage, capacitors, electric field and energy. Electric current, Ohm law, semiconductors, superconductors, electric circuits, voltage sources, amperimeter, voltmeter, Kirchhoff's rules.

Magnetic field:

Hall effect, force and electric current, magnetic torque; Ampere's law; induction, Faray's law, Lenz's rule; solenoid, inductance, Faraday's law, magnetic field and energy, transformers; Maxwell equations: symmetry, displacement current, magnetic monopole.

Temeljni literatura in viri / Readings:

1. D. Halliday, R. Resnick, J. Walker, Fundamentals of Physics, 5. izdaja, (John Wiley & Sons, Inc., New York, 1997).
2. J. Strnad, Fizika, 1. del, (DMFA, Ljubljana, 2002).
3. J. Strnad, Fizika, 2. del, (DMFA, Ljubljana, 1995).
4. Z. Bradač, Naloge iz fizike, (Pedagoška fakulteta Maribor, 1991).
5. M. Gros, M. Hribar, A. Kodre, J. Strnad, Naloge iz fizike, (DMFA, Ljubljana, 1991).
6. B. Majaron, M. Mikuž, A. Ramšak, Kolokvijske naloge iz fizike 1, (DMFA, Ljubljana, 1998).

Cilji in kompetence:

Študenti usvojijo temeljna teoretična znanja s področja elektromagnetizma in jih znajo uporabiti pri reševanju ustreznih problemov z rabo matematičnih orodij.

Objectives and competences:

Students acquire basic theoretical knowledge in electromagnetism and are able to use the knowledge to solve problems with the use of mathematical tools.

Predvideni študijski rezultati:**Znanje in razumevanje:**

Po uspešno zaključeni učni enoti bodo študenti zmožni:

- uporabiti Maxwellove enačbe za analizo in vrednotenje elektromagnetnih pojavov v odvisnosti od spremenljivk in parametrov, od katerih so odvisne lastnosti sistema;

Intended learning outcomes:**Knowledge and understanding:**

- use Maxwell equations for analysis and evaluation of electromagnetic phenomena on varying boundary conditions;
- describe impact of electrical charges and current on structure of electric and magnetic fields;

- opisati vpliv električnih nabojev in električnih tokov na strukturo električnega in magnetnega polja; - napovedati kvalitativne lastnosti sistema v odvisnosti od simetrije sestavnih gradnikov sistema. Prenesljive/ključne spretnosti in drugi atributi: Razumevanje osnovnih procesov v naravi, ki vodijo do elektromagnetnih pojavov in celosten pristop k reševanju problemov.	- description of qualitative behaviour of system as a function of symmetry. Transferable/Key Skills and other attributes: Understanding of basic processes in the nature giving rise to electromagnetic phenomena and gained global approach to solving problems
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Metode poučevanja in učenja:

predavanja in eksperimentalna predavanja (teoretičen uvod v problematiko z razlago in razgovorom, numerično reševanje posameznih problemov, demonstracijski poskusi pri predavanjih) teoretične vaje (delo s tekstom, metoda pisnih in grafičnih del, uporaba simulacij)
elementi obrnjenega poučevanja

Poučevanje in učenje potekata z didaktično uporabo informacijsko-komunikacijske tehnologije

Learning and teaching methods:

lectures and experimental lectures (theoretical introduction by explanation and discussion, numerical solving of specific problems, demonstration experiments during lectures) theoretical exercises (work with text, work with graphic elements, use of simulations) elements of flipped learning

Teaching and learning are done through the didactic use of ICT.

Delež (v %) / Weight (in %) Assessment:		
Načini ocenjevanja:		
Pisni izpit	50	Written exam
Ustni izpit.	50	Oral exam.

Opombe:

Pisni izpit se lahko nadomesti z dvema pisnima kolokvijema.

Comments:

Written exam can be replaced by two written midterm examinations.

Reference nosilca / Lecturer's references:

- 1) ČREŠNAR, Devid, ROŽIČ, Brigita, KUTNJAK, Zdravko, KRALJ, Samo. Theoretical and experimental study of elastocaloric responses in liquid crystalline elastomers. *Journal of molecular liquids*. [Online ed.]. Nov. 2024, vol. 413, [article no.] 126058, str. 1-14, ilustr. ISSN 1873-3166. DOI: [10.1016/j.molliq.2024.126058](https://doi.org/10.1016/j.molliq.2024.126058). [COBISS.SI-ID [208151299](https://cobiss.si/id/208151299)],
- 2) SINGH, Varun, PAL, Kaushik, SINGH WATTS, Sarangat, ASTHANA, Nidhi, ALI KHAN, Azmat, FATIMA, Sabiha, JELEN, Andreja, KRALJ, Samo. Graphene oxide dispersed rose-petals based green chemistry synthesis of hybrid composite for novel spectroscopic applications. *Journal of*

molecular liquids. [Print ed.]. 2024, vol. 414, art. 126166, 16 str. ISSN 0167-7322.
DOI: [10.1016/j.molliq.2024.126166](https://doi.org/10.1016/j.molliq.2024.126166). [COBISS.SI-ID [211786243](#)]

- 3) SVETEC, Milan, HARKAI, Saša, PAL, Kaushik, KRALJ, Samo. Twist disclinations mediated transformations in confined nematic liquid crystals. *Journal of molecular liquids*. [Online ed.]. 15 Nov. 2024, part b, [article no.] 126138, 10 str., ilustr. ISSN 1873-3166. DOI: [10.1016/j.molliq.2024.126138](https://doi.org/10.1016/j.molliq.2024.126138). [COBISS.SI-ID [214061315](#)]
- 4) JELEN, Andreja, ZID, Maha, PAL, Kaushik, RENUKA, Remya Rajan, ČREŠNAR, Dejvid, KRALJ, Samo. Nano and micro-structural complexity of nematic liquid crystal configurations. *Journal of molecular liquids*. [Print ed.]. 2024, vol. 415, part a, [article no.] 126275, 9 str., ilustr. ISSN 0167-7322. DOI: [10.1016/j.molliq.2024.126275](https://doi.org/10.1016/j.molliq.2024.126275), DOI: [20.500.12556/DKUM-91264](https://doi.org/20.500.12556/DKUM-91264). [COBISS.SI-ID [217792259](#)]
- 5) HÖLBL, Arbresha, PAL, Kaushik, AHMAD, Irfan, ASIRI, Hatem Mohammed A, KRALJ, Samo. Colloid and nanoparticle-driven phase behavior in weakly perturbed nematic liquid crystals. *Journal of molecular structure*. [Print ed.]. Jul. 2024, vol. 1307, [article no.] 138002, 8 str. ISSN 0022-2860. DOI: [10.1016/j.molstruc.2024.138002](https://doi.org/10.1016/j.molstruc.2024.138002). [COBISS.SI-ID [194451715](#)]