



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	2
Physics		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:

Pogojev ni.

Priporočljivo je predznanje srednješolske matematike in fizike.

Prerequisites:

None.

Secondary school level knowledge in mathematics and physics is desirable.

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, mperimeter, voltmeter, Kirchoffova 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, Kirchoff'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, trasformers; 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

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 %) /

Načini ocenjevanja:

Weight (in %)

Assessment:

Pisni izpit (lahko se nadomesti z dvema pisnima kolokvijema). Ustni izpit. Za uspešno zaključeno učno enoto mora vsak del posebej biti pozitiven.	50 50	Written exam (can be replaced by two written tests). Oral exam. For a successfully finished course, both oral and written exams have to be positive.
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Reference nosilca / Lecturer's references:

- 1) AMBROŽIČ, Milan, KRALJ, Samo. Field percolation-switching in soft ternary anisotropic system. Physica. A, Statistical mechanics and its applications, 2019, vol. 520, str. 11-25, doi: 10.1016/j.physa.2018.12.044 [COBISS.SI-ID 24324104].
- 2) KLEMENČIČ, Eva, TRČEK, Maja, KUTNJAK, Zdravko, KRALJ, Samo. Giant electrocaloric response in smectic liquid crystals with direct smectic-isotropic transition. Scientific reports, 2019, vol. 9, art. no. 1721, str. 1721-1-1721-10, doi: 10.1038/s41598-019-38604-9 [COBISS.SI-ID 32102951].

- 3) KURIOZ, Pavlo, KRALJ, Marko, MURRAY, Bryce S., ROSENBLATT, Charles, KRALJ, Samo. Nematic topological defects positionally controlled by geometry and external fields. *Beilstein journal of nanotechnology*, 2018, vol. 9, str. 109-118, <https://www.beilstein-journals.org/bjnano/content/pdf/2190-4286-9-13.pdf>, doi: 10.3762/bjnano.9.13 [COBISS.SI-ID 23661832].
- 4) KRAŠNA, Marjan, KLEMENČIČ, Eva, KUTNJAK, Zdravko, KRALJ, Samo. Phase-changing materials for thermal stabilization and thermal transport. *Energy*, 2018, vol. 162, str. 554-563 [COBISS.SI-ID 24002824].
- 5) DUBTSOV, Alexander, PASECHNIK, Sergey V., SHMELIOVA, Dina V., SAIDGAZIEV, Ayvr Sh., GONGADZE, Ekaterina, IGLIČ, Aleš, KRALJ, Samo. Liquid crystalline droplets in aqueous environments: electrostatic effects. *Soft matter*, 2018, vol. 14, iss. 47, str. 9619-9630, doi: 10.1039/C8SM01529E [COBISS.SI-ID 24177416].
- 6) MESAREC, Luka, KURIOZ, Pavlo, IGLIČ, Aleš, GÓŹDŹ, Wojciech, KRALJ, Samo. Curvature-controlled topological defects. *Crystals*, 2017, vol. 7, no. 6, str. 1-11, <http://www.mdpi.com/2073-4352/7/6/153>, doi: 10.3390/cryst7060153 [COBISS.SI-ID 11753556].