Univerza v Mariboru

Fakulteta za naravoslovje
in matematiko

Koroška cesta 160
2000 Maribor, Slovenija

UČNI NAČRT PREDMETA / COURSE SYLLABUS	
Predmet:	**Elektromagnetno polje**
Course title:	**Electromagnetic field**

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

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

Predavanja Lectures	Seminar Seminar	Sem. vaje Tutorial	Lab. vaje Laboratory work	Teren. vaje Field work	Samost. delo Individ. work	ECTS
15		30				5

Nosilec predmeta / Lecturer:	Uroš Tkalec

Jeziki / Languages:	**Predavanja / Lectures:**	Slovenski / Slovene
	Vaje / Tutorial:	Slovenski / Slovene

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:	**Prerequisits:**
Osnovno znanje klasične fizike in vektorske analize.	Basic knowledge of classical physics and vector analysis.

Vsebina:	**Content (Syllabus outline):**
• Električna sila in statični električni naboji; • Coulombov in Gaussov zakon, potencial in gradient potenciala, ekvipotencialne ploskve in silnice, Poissonova in Laplaceova enačba; • Energija električnega polja in električno polje v snovi, polarizacija v dielektrikih; • Magnetostatika: magnetna sila in polje, magnetni dipol, gibanje električnega naboja v magnetnem polju, vektorski potencial; • Primerjava diferencialnih enačb za magnetno in električno polje; • Indukcijski zakon in magnetno polje v snovi;	• Electric force and stationary charges; • Coulomb and Gauss law, potential and gradient of potential, surfaces with constant potential and field's lines, Poisson and Laplace equations, electric current; • Energy of the electric field and electric field in matter, polarization in the dielectrics; • Magnetostatics: magnetic force and field, magnetic dipol, vector potential; • Comparison of the equations for the electric and magnetic field; • Induction law, magnetic field in the matter;

• Magnetizacija v snovi (mikro in makro slika); • Maxwellove enačbe in multipoli; • Tenzorski opis elektromagnetnega polja; • Elektromagnetno valovanje: odboj, lom in polarizacija svetlobe, sevanje dipola, antene in valovni vodniki.	• Magnetization (micro and macro picture); • Maxwell's equations and multipoles; • Tensorial description of electromagnetism; • Electromagnetic waves:reflection, refraction and polarization of light, dipole radiation, antenas and optical waveguides.

Temeljni literatura in viri / Readings:

- M. Ambrožič, U. Tkalec, S. Kralj, Elektromagnetno polje: učbenik za študente fizike na FNM UM (Univerzitetna založba UM, Maribor, 2019).
- R. Podgornik, A. Vilfan, Elektromagnetno polje (DMFA, Ljubljana, 2012).
- D. Arčon, Rešene naloge iz elektromagnetnega polja (DMFA, Ljubljana, 2010).
- J. D. Jackson, Classical electrodynamics (Wiley International, 1998).
- E. M. Purcell, D. J. Morin, Electricity and Magnetism (Cambridge University Press, 2013).
- D. Fleisch, A student's guide to Maxwell's equations (Cambridge University Press, 2008).
- L. D. Landau, E. M. Lifshitz, The classical theory of fields (Butterworth-Heinemann, 1998).

Cilji in kompetence:	**Objectives and competences:**
Študenti usvojijo poglobljena teoretična in praktična znanja iz elektromagnetnega polja in jih znajo uporabiti na drugih področjih fizike.	Students get expanded theoretical and practical knowledge from the electromagnetic field and learn how to imply this knowledge in other fields of physics.

Predvideni študijski rezultati:	**Intended learning outcomes:**
Znanje in razumevanje: Študentje bodo sposobni analizirati številne koncepte in zakone elektromagnetnega polja, ki jih bodo znali uporabiti pri modeliranju in reševanju praktičnih problemov. **Prenesljive/ključne spretnosti in drugi atributi:** Strokovno pravilno izražanje pri pisnem in ustnem izpitu. Sposobnost izpeljave in razlage osnovnih enačb elektromagnetizma. Kvalitativne analize in reševanje problemov iz prakse in literature.	**Knowledge and understanding:** Students will be able to analyse many concepts and laws of electromagnetic field and will know how to apply them to model and solve practical problems. **Transferable/Key skills and other attributes:** Properly qualified manner of expression at written examination. The ability to derive and explain fundamental equations of electromagnetism. To have enough skills and experience to analyse and solve practical problems and exercises from literature.

Metode poučevanja in učenja:	**Learning and teaching methods:**
• predavanja in diskusije • seminarske vaje in domače naloge.	• lectures and discussions, • seminar work and homeworks.

Načini ocenjevanja:	Delež (v %) / Weight (in %)	**Assessment:**
• pisni izpit, • ustni izpit.	**50** **50**	• written exam, • oral exam.

Reference nosilca / Lecturer's references:

EMERŠIČ, Tadej, ZHANG, Rui, KOS, Žiga, ČOPAR, Simon, OSTERMAN, Natan, PABLO, Juan J. de, TKALEC, Uroš. Sculpting stable structures in pure liquids. *Science advances*, ISSN 2375-2548, Feb. 2019, vol. 5, art. no. eaav4283, 8 str., ilustr., doi: 10.1126/sciadv.aav4283. [COBISS.SI-ID 3291748]

KIM, Dae Seok, ČOPAR, Simon, TKALEC, Uroš, YOON, Dong Ki. Mosaics of topological defects in micro-patterned liquid crystal textures. *Science advances*, ISSN 2375-2548, Nov. 2018, vol. 4, art. no. eaau8064, 8 str., ilustr., doi: 10.1126/sciadv.aau8064. [COBISS.SI-ID 3267684]

ČOPAR, Simon, TKALEC, Uroš, MUŠEVIČ, Igor, ŽUMER, Slobodan. Knot theory realizations in nematic colloids. *Proceedings of the National Academy of Sciences of the United States of America*, ISSN 0027-8424, 2015, vol. 112, no. 6, str. 1675-1680, ilustr. http://www.pnas.org/content/112/6/1675.full.pdf+html. [COBISS.SI-ID 2787940]

SENGUPTA, Anupam, TKALEC, Uroš, RAVNIK, Miha, YEOMANS, Julia M., BAHR, Christian, HERMINGHAUS, Stephan. Liquid crystal microfluidics for tunable flow shaping. *Physical review letters*, ISSN 0031-9007. [Print ed.], 2013, vol. 110, iss. 4, str. 048303-1-048303-5. http://prl.aps.org/abstract/PRL/v110/i4/e048303. [COBISS.SI-ID 2528868]

TKALEC, Uroš, MUŠEVIČ, Igor. Topology of nematic liquid crystal colloids confined to two dimensions. *Soft matter*, ISSN 1744-683X, 2013, vol. 9, issue 34, str. 8140-8150, doi: 10.1039/C3SM50713K. [COBISS.SI-ID 26755367]