



Univerza v Mariboru



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Fakulteta za naravoslovje in
matematiko

UČNI NAČRT PREDMETA / COURSE SYLLABUS

Predmet:	Moderna optika
Course title:	Modern Optics

Študijski program in stopnja Study programme and level	Študijska smer Study field	Letnik Academic year	Semester Semester
Fizika 2. st.		1	2
Physics 2 nd 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
35		10			105	5

Nosilec predmeta / Lecturer: Nataša Vaupotič

Jeziki / Languages:	Predavanja / Lectures:	slovenski / slovene
	Vaje / Tutorial:	slovenski / slovene

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

predznanje iz predmetov nihanje in valovanje, elektromagnetizem, matematična fizika 1 in 2, moderna fizika.

Prerequisites:

preknowledge of the Oscillations and Waves, Electromagnetism, Mathematical Physics 1 and 2 and Modern Physics.

Vsebina:

Valovna in delčna narava svetlobe; časovna in prostorska koherenca; polarizacija svetlobe. Lom in odboj na ravni površini. Fraunhoferjev in Fresnelov uklon. Potovanje svetlobe v snovi: Maxwellove enačbe v snovi, valovna enačba, kompleksni lomni količnik, potovanje svetlobe v izotropnih dielektrikih, potovanje svetlobe po prevodnikih, optično anizotropni materiali, potovanje svetlobe v kristalih in tekočih kristalih, dvojni lom, elektrooptični in magnetooptični pojav, modulatorji,

Content (Syllabus outline):

Wave and particle nature of light; spatial and temporal coherence; polarization. Diffraction and refraction on a plane surface. Fraunhofer and Fresnel diffraction. Light propagation in matter: Maxwell equations in matter, wave equation, complex index of refraction, light propagation in isotropic dielectrics, light propagation in conducting media, anisotropic optical materials, light propagation in crystals and liquid crystals, double refraction, electro-optic and magneto-optic effects,

optični retarderji, konoskopija.
Nelinearna optika: simetrija v kristalih, nelinearna susceptibilnost, generiranje druge harmonične frekvence, štirivalovno mešanje.

modulators, optical retarders, conoscopy.
Nonlinear optics: symmetries in crystals, second- order nonlinear susceptibility, frequency doubling, four wave mixing.

Temeljna literatura in viri / Readings:

1. G. R. Fowles, Introduction to Modern Optics, 2nd. Ed. (Dover, New York, 1989).
2. R. D. Guenther, Modern Optics (Wiley, New York, 1990).
3. G. Brooker, Modern Classical Optics (Oxford Master Series in Atomic, Optical and Laser Physics) (Oxford University Press, Oxford, 2003).
4. katerakoli knjiga s področja moderne optike, laserjev, optoelektronike ali fotonike

Cilji in kompetence:

Študenti usvojijo osnovno znanje s področja linearne in nelinearne optike in razumejo osnove optičnih preiskav materialov.

Objectives and competences:

Students obtain the basic knowledge from linear and nonlinear optics and understand the basics of the optical study of materials.

Predvideni študijski rezultati:

Znanje in razumevanje:
Elementarno razumevanje principov moderne optike.

Prenesljive/ključne spretnosti in drugi atributi:
Predmet daje predznanje, ki je potrebno za razumevanje dejanskih tehniških problemov v, npr., optoelektroniki, preiskavah v medicini, v preiskavah materialov, ...

Intended learning outcomes:

Knowledge and Understanding:
Fundamental understanding of the principles of modern optics.

Transferable/Key Skills and other attributes:
The modern optics course is a prerequisite to understand several actual engineering problems in e.g. optoelectronics, in medical imaging, in material research, ...

Metode poučevanja in učenja:

Predavanja z demonstracijskimi eksperimenti
Seminarske vaje
vodeno samostojno delo

Learning and teaching methods:

Lectures with demonstration experiments
Theoretical exercises
supervised individual work

Načini ocenjevanja:

Aktivna udeležba na seminarskih vajah, izračun teoretičnih nalog in njihov zagovor;
ustni izpit

Delež (v %) /
Weight (in %)

70%

30%

Assessment:

Active work at theoretical exercises;
Solving of theoretical exercises and their defense;

Oral exam

Reference nosilca / Lecturer's references:

1. GUO, Lingfeng, VAUPOTIČ, Nataša, ČEPIČ, Mojca, GORNIK, Kristina. Ferroelectric behavior of orthogonal smectic phase made of bent-core molecules. Phys. rev., E Stat. nonlinear soft matter phys. (Print), 2011, vol. 84, no. 3, str. 031706-1-031706-8, doi: 10.1103/PhysRevE.84.031706. [COBISS.SI-ID 25228327],
2. VAUPOTIČ, Nataša, POCIECHA, Damian, ČEPIČ, Mojca, GOMOLA, Kinga, MIECZKOWSKI, Jozef, GÓRECKA, Ewa. Evidence for general tilt columnar liquid crystalline phase. Soft matter, 2009, vol. 5, no. 11, str. 2281-2285. [COBISS.SI-ID 22867239]
3. VAUPOTIČ, Nataša, ČOPIČ, Martin, GÓRECKA, Ewa, POCIECHA, Damian. Modulated structures in bent-core

- liquid crystals: two faces of one phase. Phys. rev. lett., 2007, vol. 98, no. 24, str. 247802-1-247802-4. [COBISS.SI-ID 20912167],
4. POČIECHA, Damian, GÓRECKA, Ewa, VAUPOTIČ, Nataša, ČEPIČ, Mojca, MIECZKOWSKI, Jozef. Spontaneous breaking of minimal surface condition : labyrinths in free standing smectic films. Phys. rev. lett., 2005, 95, str. 207801-1-207801-4, ilustr. [COBISS.SI-ID 14311688]
 5. MADRAK, Karolina, VAUPOTIČ, Nataša, SCZYTKO, Jacek, OSEWSKI, Paweł, TURSKI, Henryk, GÓRECKA, Ewa. Voigt and Faraday effect in nanocomposite materials made of cobalt and gold nanoparticles embedded in the liquid crystal host. V: 23rd International Liquid Crystal Conference, 11-16 July, Krakow, Poland. Abstract book. [S. l.: s. n.], 2010, [1] str. [COBISS.SI-ID 18242056]
 6. MADRAK, Karolina, THAKUR, Pankaj, GÓRECKA, Ewa, SZCZYTKO, Jacek, VAUPOTIČ, Nataša. Magnetic and optic properties of cobalt and semiconductor nanoparticles. V: International School of Liquid Crystals, 18 Course [and] 2nd School of the Italian Liquid Crystal Society, 3-10 July 2011, Erice, Italy. Liquid crystal nanostructures and self-assembly: from organic electronics to nanomaterials. [S. l.: s. n.], 2011, 1 str. [COBISS.SI-ID 24893991]
 7. PAVLIN, Jerneja, ŠKARABOT, Miha, VAUPOTIČ, Nataša, ČEPIČ, Mojca. Experiment for illustrating the anisotropy in refractive index of liquid crystals in school. V: 24th International Liquid Crystal Conference, Mainz, August 19th - 24th 2012. Scientific program. Mainz: German Chemical Society, 2012, 1 str. [COBISS.SI-ID 9352009]