Univerza v Mariboru

Fakulteta za naravoslovje in matematiko

UČNI NAČRT PREDMETA / COURSE SYLLABUS	
Predmet:	Uvod v fotoniko
Course title:	Introduction to Photonics

Študijski program in stopnja Study programme and level	Študijska smer Study field	Letnik Academic year	Semester Semester
Fizika Physics		3	6

Vrsta predmeta / Course type	izbirni
Univerzitetna koda predmeta / University course code:	

Predavanja Lectures	Seminar Seminar	Vaje Tutorial	Lab. vaje Laboratory work	Terenske vaje Field work	Samost. delo Individ. work	ECTS
45		15			120	6

Nosilec predmeta / Lecturer:	Nataša Vaupotič

Jeziki / Languages:		
	Predavanja / Lectures:	slovenski/Slovene in/and angleški/English
	Vaje / Tutorial:	slovenski/Slovene in/and angleški/English

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:	Prerequisits:
Predznanje iz klasične in moderne fizike ter matematične fizike.	Prekowledge of classical and modern physics and mathematical physics.

Vsebina:	Content (Syllabus outline):
Svetloba kot žarki, valovanje, fotoni; kvantizacija elektromagnetnega polja, votlinsko sevanje. Polarizacija: linearna, krožna in eliptična polarizacija, Jonesove matrike, lom in odboj na ravni površini, Brewsterjev kot, popoln odboj, evanescentno polje. Interferenca: Fabry – Perotov interferometer, odbojnost in prepustnost večplastnih nanosov, dielektrična zrcala. Koherenca: časovna in prostorska, avtokorelacijska funkcija. Oblika in širina spektralnih črt: naravna širina, homogena in	Light as rays or waves or photons; quantization of EM field, cavity radiation. Polarization: linear, circular, elliptic, Jones calculus, diffraction and refraction on a plane surface, Brewster angle, total reflection, evanescent field. Interference: Fabry – Perot interferometer, reflection and transmission of multilayer films, dielectric mirrors. Spatial and temporal coherence, autocorrelation function. Shape and width of spectral lines: natural width, homogeneous and nonhomogeneous broadening; correlation

nehomogena širitev; povezava med koherenco in širino spektralnih črt. Laserji: optični resonatorji, stimulirana emisija, optično črpanje, ojačanje, prag delovanja, Gaussovi snopi, preslikave Gaussovih snopov z lečami, vrste laserjev, primerjava laserjev in nekoherentnih svetil, tehnološka uporaba laserjev Optična vlakna: valovni vodnik, eno in večrodovno vlakno, izgube, disperzija, žarkovna analiza, valovna slika Optično anizotropne snovi: razširjanje svetlobe v optično enoosnih kristalih, modulacija svetlobe, ploščica $\lambda/4$, optična aktivnost, Faradayev in Kerrov pojav.	between the spectral width and coherence length. Lasers: optical resonators, stimulated emission, optical pumping, gain, threshold, Gaussian beams, transformation of Gaussian beams with lenses, types of lasers, comparison of lasers and incoherent light sources, lasers in technology. Optical fibers: guided waves, single mode and multimode fibers, losses, dispersion, ray analysis, wave picture. Optically anisotropic materials: light propagation in optically uniaxial crystals, modulation of light, quarter-wave plate, optical activity, Faraday and Kerr effect.

Temeljni literatura in viri / Readings:

1. F. G. Smith, T. A King, Optics and Photonics, An introduction (Wiley, Chichester, 2000).
2. D. Meschede, Optics, Light and Lasers (Wiley-VCH, Weinheim, 2004).
3. G. Brooker, Modern Classical Optics (Oxford University Press, New York, 2002)
4. D. Đonlagić, M. Završnik, D. Đonlagić, Fotonika: uvodna poglavja (Fakulteta za elektrotehniko, računalništvo in informatiko, Maribor, 1997).
5. katerakoli knjiga s področja moderne optike, laserjev, optoelektronike ali fotonike / any book from the field of modern optics, lasers, optoelectroncs and photonics

Cilji in kompetence:	**Objectives and competences:**
Študenti usvojijo osnovno znanje s področja moderne optike, delovanja in uporabe optičnih vlaken in laserjev. Študenti razumejo področja uporabe in znajo napovedati uporabno merilno tehniko, ki temelji na uporabi večplastnih nanosov, optičnih vlaken in laserjev	Students obtain the basic knowledge from modern optics, use and work of optical fibers and lasers. Students understand the use of and are able to predict a useful measurement technique that is based on the usage of multilayer films, optical fibers and lasers.

Predvideni študijski rezultati:	**Intended learning outcomes:**
Znanje in razumevanje: Kvalitativno in kvantitativno razumejo osnove moderne optike in fotonike.	Knowledge and understanding: Qualitative and quantitative understanding of modern optics and photonics.

Metode poučevanja in učenja:	**Learning and teaching methods:**
Predavanja Seminarske vaje Tutorsko delo	Lectures Theoretical excercises Tutorial work

Delež (v %) /

Načini ocenjevanja:	Weight (in %)	Assessment:
ustni kolokviji (seminarske vaje) ustni kolokviji (predavanja) pisni kolokviji Za pozitivno končno oceno morajo biti opravljene vse seminarske vaje in ocena iz vsakega posameznega načina ocenjevanja mora biti pozitivna.	 **40%** **30%** **30%**	oral tests (theoretical exercises) oral tests (lectures) Written tests For passing the course all the theoretical excersises must be solved and the grade in every type of assessment must be positive.

Reference nosilca / Lecturer's references:

1. MATRASZEK, Joanna, TOPNANI, Neha, VAUPOTIČ, Nataša, TAKEZOE, Hideo, MIECZKOWSKI, Jozef, POCIECHA, Damian, GÓRECKA, Ewa. Monolayer filaments versus multilayer stacking of bent-core molecules. *Angewandte Chemie*, ISSN 1433-7851. [Print ed.], 2016, vol. 55, iss. 10, str. 3468-3472, doi: 10.1002/anie.201510123. [COBISS.SI-ID 29302055].

2. GÓRECKA, Ewa, VAUPOTIČ, Nataša, ZEP, Anna, POCIECHA, Damian. From sponges to nanotubes : a change of nanocrystal morphology for acute-angle bent-core molecules. *Angewandte Chemie*, ISSN 1521-3773. [Online ed.], 2016, vol. 55, no. 40, str. 12238-12242, doi: 10.1002/anie.201604915. [COBISS.SI-ID 29763367].

3. VAUPOTIČ, Nataša, CURK, Samo, OSIPOV, Mikhail, ČEPIČ, Mojca, TAKEZOE, Hideo, GÓRECKA, Ewa. Short-range smectic fluctuations and the flexoelectric model of modulated nematic liquid crystal. *Physical review. E, Statistical, nonlinear, and soft matter physics*, ISSN 1539-3755, 2016, vol. 93, no. 2, str. 022704-1-022704-5, doi: 10.1103/PhysRevE.93.022704. [COBISS.SI-ID 29301799].

4. VAUPOTIČ, Nataša, ČEPIČ, Mojca, OSIPOV, Mihail A., GÓRECKA, Ewa. Flexoelectricity in chiral nematic liquid crystals as a driving mechanism for the twist-bend and splay-bend modulated phases. *Physical review. E, Statistical, nonlinear, and soft matter physics*, ISSN 1539-3755, 2014, vol. 89, no. 3, 030501-1-030501-5, doi: 10.1103/PhysRevE.89.030501. [COBISS.SI-ID 27591975].

5. SZCZYTKO, Jacek, VAUPOTIČ, Nataša, MADRAK, Karolina, SZNAJDER, Paweł, GÓRECKA, Ewa. Magnetic moment of a single metal nanoparticle determined from the Faraday effect. *Physical review. E, Statistical, nonlinear, and soft matter physics*, ISSN 1539-3755, 2013, vol. 87, no. 3, 033201-1-033201-6, doi: 10.1103/PhysRevE.87.033201. [COBISS.SI-ID 26612519].

6. SZCZYTKO, Jacek, VAUPOTIČ, Nataša, OSIPOV, Mihail A., MADRAK, Karolina, GÓRECKA, Ewa. Effect of dimerization on the field-induced birefringence in ferrofluids. *Physical review. E, Statistical, nonlinear, and soft matter physics*, ISSN 1539-3755, 2013, vol. 87, no. 6, str. 062322-1-062322-6, doi: 10.1103/PhysRevE.87.062322. [COBISS.SI-ID 26839079].