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| **UČNI NAČRT PREDMETA / COURSE SYLLABUS** | | | | | | | | | | | | | | | | | |
| **Predmet:** | | | Optoelektronika | | | | | | | | | | | | | | |
| **Course title:** | | | Optoelectronics | | | | | | | | | | | | | | |
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| **Študijski program in stopnja**  **Study programme and level** | | | | | **Študijska smer**  **Study field** | | | | | | | | **Letnik**  **Academic year** | | **Semester**  **Semester** | | |
| doktorski študijski program tretje stopnje Elektrotehnika | | | | | Ni smeri | | | | | | | | 1 | |  | | |
| 3rd cycle: doctoral study programme Electrical Engineering | | | | |  | | | | | | | | 1 | |  | | |
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| **Vrsta predmeta / Course type** | | | | | | | | | | | | izbirni / elective | | | | | |
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| **Univerzitetna koda predmeta / University course code:** | | | | | | | | | | | | 64814 | | | | | |
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| **Predavanja**  **Lectures** | **Seminar**  **Seminar** | | | **Vaje**  **Tutorial** | | | **Klinične vaje**  **work** | | | | **Druge oblike študija** | | | **Samost. delo**  **Individ. work** | |  | **ECTS** |
| **30** | **15** | | |  | | |  | | | |  | | | **80** | |  | **5** |
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| **Nosilec predmeta / Lecturer:** | | | | | Prof. dr. Janez Krč | | | | | | | | | | | | |
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| **Jeziki /**  **Languages:** | | **Predavanja / Lectures:** | | | | slovenski / Slovene  (foreign students - consultations in English) | | | | | | | | | | | |
| **Vaje / Tutorial:** | | | |  | | | | | | | | | | | |
| **Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:** | | | | | | | | |  | **Prerequisits:** | | | | | | | |
| * vpis v 1. letnik doktorskega študija (3. stopnja) * priporočeno poznavanje polprevodniških elementov in osnov optoelektronike | | | | | | | | |  | * enrolment in the 1st academic year of post-graduate doctoral study * recommended knowledge on semiconductor devices and basics of optoelectronics | | | | | | | |
| **Vsebina:** | | | | | | | |  | | **Content (Syllabus outline):** | | | | | | | |
| UVOD: sodobni izzivi in trendi v optoelektroniki  OPTIKA: modeli svetlobe, interakcija svetlobe s snovjo, kompleksna dielektričnost in kompleksni lomni količnik, odboj na gladkih in hrapavih površinah, refrakcija, sipanje na nanostrukturah, fotometrija in radiometrija  OPTIČNI VIRI:  - Svetleče diode (LED): spontana emisija , materiali, , strukture, sodobne tehnologije, optične in električne karakteristike,  - Organske LED (OLED); materiali, strukture in trendi  - Laserji: stimulirana emisija, princip in zahteve za lasersko delovanje, zgradbe laserjev, optično ojačenje in izgube, spekter in oblika žarka, aplikacije  - Laserske diode (LD): strukture (PN, DH, DBR, DFB, VCSEL), delovanje, praktični primeri uporabe, močnostne LD  DETEKTORJI SVETLOBE in BARVE:  - polprevodniški fotodetektorji (pn, pin, hetero, PD s plazovito ionizacijo, fototranzistor), optični filtri, vertikalni tankoplastni detektorji barve na osnovi a-Si:H  - detektorska polja: CCD, CMOS, večja a-Si:H detektorska polja  ZASLONI: zgradba in delovanje sodobnih LCD, LED. plazemskih in OLED zaslonov, lastnosti in karakteristike TFT-jev, EL zasloni, 3D zasloni  OSTALE IZBRANE TEMATIKE: fotonski kristali, nanofotonika, plazmonika, tiskana optoelektronika, metamateriali, optične antene, optični senzorji, fourierjeva optika  Vsebina predmeta se dopolnjuje in nadgrajuje s specifičnimi poglobljenimi tematikami seminarskih nalog z različnih področij optoelektronike in fotonike. | | | | | | | |  | | INTRODUCTION: current challenges and trends in Optoelectronics  OPTICS: models of light, light and matter, complex permittivity and complex refractive index, reflection on flat and rough interfaces, refraction, scattering, photometry and radiometry  OPTICAL SOURCES:  - Light emitting diodes (LED): spontaneous emission, materials, structures, technologies, optical and electrical characteristics  - Organic LED (OLED): materials, structures and trends  - Lasers: stimulated emission, operational principle and requiements, main parts of a laser, optical amplification and losses, spectrum and shape of the output beam, applications of lasers  - Laser diodes (LD): structures, PN, DH, DBR, DFB VCSEL LD, applications, power LD  PHOTODETECTORS and COLOUR DETECTORS:  - semiconductor photodetectors (pn, pin, heterodiode, avalance, phototransistor), optical filters, vertical thin-film colour detectors based on a-Si:H  - detector arrays: CCD, CMOS and a-Si:H detector arrays  DISPLAYS: structure and operation of LCD, properties and characteristics of TFTs, LED, plasma and OLED displays, 3D displays  OTHER SELECTED TOPICS: photonic crystals, nanophotonics, plasmonics, printed optoelectronics, metamaterials, optical antennas, optical sensors, Foirier optics  The contents of the course is being updated and upgraded with seminar works on specific topics on optoelectronics and photonics | | | | | | | |

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| **Temeljni literatura in viri / Readings:** | | | | | |
| 1. Saleh B E A, Tech M C (2007) Fundamentals of photonics. Wiley, New Jersey  2. Gong Q, Hu X (2014) Photonic crystals, Principles and applications. Pan Stanford, Singapore  3. Smith F G, King T A, Wilkins D (2007) Optics and Photonics - An Introduction. Wiley, New Jersey  4. Smith W J (2008) Modern Optical Engineering: The Design of Optical Systems. Mcgraw Hill Book Co, UK  5. Chrostowski L, Hoshberg M (2015) Silicon Photonics Design. Cambridge University Press, Cambridge | | | | | |
| **Cilji in kompetence:** | |  | | **Objectives and competences:** | |
| * poznavanje pregleda sodobnih gradnikov, tehnologij in trendov v optoelektroniki * nadgradnja znanja o principih delovanja  optoelektronskih elementov * sposobnost nadaljnjega samostojnega raziskovalnega dela na področju | |  | | * an overview knowledge on contemporary devices, technologies and trends in optoelectronics * upgrade of knowledge on operational principles of optoelectronic devices * ability of further research work in the field | |
| **Predvideni študijski rezultati:** | | |  | **Intended learning outcomes:** | |
| * predznanja za nadaljnji razvoj in raziskave na področju optoelektronskih znanosti * razumevanje delovanja in uporabe sodobnih optoelektronskih gradnikov * specifično raziskovalno delo na ožjem segmentu optoelektronike (seminarska naloga) | | |  | * pre-knowledge for further research and development in optoelectronic sciences * understanding of operational principle and usage of optoelectronic devices * specific research work on narrower field of optoelectronics (seminar work) | |
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| **Metode poučevanja in učenja:** | | |  | **Learning and teaching methods:** | |
| predavanja, konzultacije, samostojno delo | | |  | lectures, consultations, individual work | |
| **Načini ocenjevanja:** | Delež (v %) /  Weight (in %) | | | | **Assessment:** |
| Končna oceno se določi na osnovi izdelane seminarske naloge in ustnega zagovora. | seminar 60%  ustni izpit 40 %  / Seminar 60 %  oral exam 40 % | | | | Final grade is based on evaluation of seminar work and oral exam. |
| **Reference nosilca / Lecturer's references:** | | | | | |
| 1. Krč J, Lipovšek B, Topič M (2014) Design for high out-coupling efficiency of white OLED using CROWM - a combined geometric/wave optics model, Solid-State and Organic Lighting, Tuscon, Arizona, United States, November 3-7, 2013. Solid-State and Organic Lighting 2. Schmid M, Klenk R, Lux-Steiner M, Ch, Topič M, Krč J (2011) Modeling plasmonic scattering combined with thin-film optics. Nanotechnology 22/10: 1-10 3. Conde J P, Joskowiak A, Lipovšek B, Pimentel A, Pereira A T, Santos M, Krč J, Topič M, Prazers D M F, Chu V (2010) Spectral selectivity constraints in fluorescence detection of biomolecules using amorphous silicon based detectors, Physica status solidi. C,7: 1156-1159 4. Kovačič M, Krč J, Lipovšek B, Topič M (2013) Diffraction gratings for optical filtering in fluorescence detection of biomolecules. 49th International Conference on Microelectronics, Devices and Materials & theWorkshop on Digital Electronic Systems, September 25 – 27, Kranjska Gora, 71-75 5. Krč J,Topič M (2013)Optical modeling and simulation of thin-film photovoltaic devices. CRC Press, New York | | | | | |