Univerza v Mariboru

Fakulteta za naravoslovje in matematiko

UČNI NAČRT PREDMETA / COURSE SYLLABUS	
Predmet:	**Fizikalni eksperimenti 4**
Course title:	**Physics experiments 4**

Študijski program in stopnja Study programme and level	Študijska smer Study field	Letnik Academic year	Semester Semester
Fizika		3	5
Physics			

Vrsta predmeta / Course type	Obvezni / Compulsory
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
15			45		60	4

Nosilec predmeta / Lecturer:	Uroš Tkalec

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

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:	**Prerequisits:**
Pogojev ni. Priporočljivo predznanje iz Moderne fizike in osnove analize in vektorske analize.	Pogojev ni. Recommended knowledge of Modern physics and basics of analysis and vector analysis..

Vsebina:	**Content (Syllabus outline):**
Predavanja Vsebine iz Moderne fizike, ki se neposredno vežejo na uspešno izvedbo eksperimentov. Osnovna znanja iz varstva pred ionizirajočimi sevanji. **Laboratorijske vaje** Poskusi z rentgensko svetlobo, Poskusi z mikrovalovi, Franck-Hertzov poskus, Fotoefekt, Merjenje Planckove konstante, Gaussova porazdelitev, Merjenje idealnega izkoristka toplotnega stroja, Difuzija tekočin,	**Lectures** Selected topics from Modern physics, which are directly linked to the experiments, and are thus of immediate importance for the successful execution of laboratory work. Basic knowledge on ionizing radiation. **Laboratory work** Experiments with Roentgen rays, Experiments with microwaves, Franck-Hertz experiment, Photo-effect, Measurement of the Planck constant, Gaussian distribution, Measurement of the ideal gain of a heat engine, Diffusion of liquids, Gamma

Gama spektroskopija, Michelsonov interferometer, Odklon beta žarkov v magnetnem polju, Absorpcija beta in gama žarkov.	ray spectroscopy, Michelson interferometer, Diffraction of beta rays in an electro-magnetic field, Absorption of beta and gamma rays.

Temeljni literatura in viri / Readings:

- R. A. Serway, C. J. Moses, C. A. Moyer, Modern Physics (Thomson Learning, 2005).
- D. Halliday, R. Resnick, J. Walker, Fundamentals of Physics, 9. izdaja, (John Wiley & Sons, New York, 2010).
- J. Strnad, Fizika, 3. del (DMFA, Ljubljana, 2018).
- J. Strnad, Fizika, 4. del (DMFA, Ljubljana, 2018).
- A. Zorko, M. Nemevšek, N. Košnik, M. Lubej, Zbirka rešenih nalog iz Moderne fizike (DMFA, Ljubljana, 2018).
- U. Tkalec, Navodila za delo z viri ionizirajočih sevanj (FNM UM, Maribor, 2018).

Cilji in kompetence:	**Objectives and competences:**
Cilj tega predmeta je, da študent usvoji temeljna znanja o merilnih tehnikah in metodah na področju moderne fizike in se usposobi za samostojno varno izvedbo laboratorijskih vaj iz področja moderne fizike. Na osnovi eksperimentalno pridobljenih podatkov, v kombinaciji z ustreznim teoretičnim znanjem iz moderne fizike in drugimi informacijskimi viri ter računalniškimi simulacijskimi okolji so sposobni smiselno oblikovati končno rešitev problema.	The objective of this course is for student to acquire basic knowledge in measuring techniques and methods used in modern physics and is able to use the knowledge for individual safe laboratory work in the field of modern physics. On the basis of experimentally obtained data combined with their theoretial knowledge in modern physics as well as professional literature and computer simulation tolls student is able to reasonably formulate the final solution of the problem.

Predvideni študijski rezultati:	**Intended learning outcomes:**
Znanje in razumevanje: Študentje bodo sposobni analizirati osnovne procese v naravi, ki temeljijo na zakonih kvantne mehanike in relativistične fizike. Usvojena znanja bodo znali demonstrirati v primerno opremljenem laboratoriju. **Prenesljive/ključne spretnosti in drugi atributi:** Suveren ustni zagovor laboratorijski vaj in strokovno pravilno izražanje pri pisnem izpitu. Sposobnost razlage obravnavanih tematik laiku in predlaganje fizikalnih rešitev za probleme, ki izhajajo iz raziskovalno orientiranega okolja.	**Knowledge and understanding:** Students will be able to analyse basic processes in nature that originate in laws of quantum mechanics and relativistic physics. They will be able to demonstrate their skills in an appropriately equipped laboratory. **Transferable/Key skills and other attributes:** Supreme oral lab work defence and properly qualified manner of expression at written examination. The ability to transfer gained knowledge to a non-specialist, and to provide accurate descriptions and physically motivated

	solutions to particular problems in a research oriented environment.

Metode poučevanja in učenja:	**Learning and teaching methods:**
-predavanja (razlaga, razgovor, demonstracija) -laboratorijske vaje (metoda dela s tekstom, pisnih in grafičnih del, metoda praktičnih del, uporaba simulacij in programskih orodij za obdelavo podatkov, sodelovalno učenje, diskusija rezultatov) - elementi obrnjenega poučevanja	-lectures (explanation, discussion, demonstration) -laboratory exercises (work with text, work with graphic elements, practical work, use of simulations and software tools for data processing, collaborative learning, discussion of results) - elements of flipped learning

Načini ocenjevanja:	Delež (v %) / Weight (in %)	**Assessment:**
• sprotno preverjanje pripravljenosti na vaje, opravljene laboratorijske vaje in lično izdelan dnevnik vaj, • pisni izpit, • ustni zagovor. Vsaka od naštetih obveznosti mora biti opravljena s pozitivno oceno.	30 30 40	• a constant checking of readiness for experiments, done laboratory work and neatly organized lab diary, • written exam, • oral exam. Each of the mentioned commitments has to be assessed with a passing grade.

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]