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<br>Study programme and level | Študijska smer<br>Study field | Letnik<br>Academic year | Semester<br>Semester |
|---|---|---|---|
| Fizika, 1. stopnja | | 3 | 5 |
| Physics, 1st cycle | | | |

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| **Vrsta predmeta / Course type** | Obvezni / Compulsory |
| **Univerzitetna koda predmeta / University course code:** | |

| Predavanja<br>Lectures | Seminar<br>Seminar | Vaje<br>Tutorial | Lab. vaje<br>Laboratory work | Terenske vaje<br>Field work | Samost. delo<br>Individ. work | ECTS |
|---|---|---|---|---|---|---|
| 15 | | | 45 | | 60 | 4 |

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| **Nosilec predmeta / Lecturer:** | Uroš Tkalec |

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

| **Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:** | **Prerequisites:** |
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| Priporočljivo je predznanje iz Moderne fizike in osnove analize in vektorske analize. | Recommended is preknowledge of modern physics and fundamentals of analysis and vector analysis. |

| **Vsebina:** | **Content (Syllabus outline):** |
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| **Predavanja**<br>Vsebine iz Moderne fizike, ki se neposredno vežejo na uspešno izvedbo eksperimentov. Osnovna znanja iz varstva pred ionizirajočimi sevanji.<br><br>**Laboratorijske vaje**<br><br>1. Poskusi z rentgensko svetlobo<br>2. Poskusi z mikrovalovi<br>3. Fotoefek in merjenje Planckove konstante | **Lectures**<br>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.<br><br>**Laboratory work**<br><br>1. Experiments with X-rays<br>2. Experiments with microwaves |

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| 4. Gaussova porazdelitev pri radioaktivnem razpadu<br>5. Merjenje idealnega izkoristka toplotnega stroja<br>6. Difuzija tekočin<br>7. Odklon beta žarkov v magnetnem polju<br>8. Gama spektroskopija<br>9. Michelsonov interferometer<br>10. Franck-Hertzov poskus in de Brogliejeva enačba | 3. Photo-effect and measurement of the Planck constant<br>4. Gaussian distribution in radioactive decay<br>5. Measurement of the ideal gain of a heat engine<br>6. Diffusion of liquids<br>7. Diffraction of beta rays in a magnetic field<br>8. Gamma ray spectroscopy<br>9. Michelson interferometer<br>10. Franck-Hertz experiment and de Broglie equation |

**Temeljni literatura in viri / Readings:**


- P. A. Tipler, , R. A. Llewellyn, Modern Physics (, Freeman 2000).
- D. Halliday, R. Resnick, J. Walker, Fundamentals of Physics, 9. izdaja, (John Wiley & Sons, New York, 2008).
- 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, 2024).
- M. Slavinec, Z. Bradač, M. Brumen, M. Cvahte, S. Kralj, M. Marhl, N. Vaupotič, Praktikum III: Navodila za vaje (PeF UM, Maribor, 1999).


| **Cilji in kompetence:** | **Objectives and competences:** |
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| 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 theoretical 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:** |
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| **Znanje in razumevanje:**<br><br>Študentje bodo sposobni analizirati osnovne procese v naravi, ki temeljijo na zakonih kvantne mehanike in relativistične fizike. | **Knowledge and understanding:**<br><br>Students will be able to analyse basic processes in nature that originate in laws of quantum mechanics and relativistic physics. They will be |

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| Usvojena znanja bodo znali demonstrirati v primerno opremljenem laboratoriju.<br><br>**Prenesljive/ključne spretnosti in drugi atributi:**<br><br>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. | able to demonstrate their skills in an appropriately equipped laboratory.<br><br>**Transferable/Key skills and other attributes:**<br><br>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:** |
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| -predavanja (razlaga, razgovor, demonstracija)<br>-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)<br>- elementi obrnjenega poučevanja | -lectures (explanation, discussion, demonstration)<br>-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)<br>- elements of flipped learning |

| **Načini ocenjevanja:** | Delež (v %) / Weight (in %) | **Assessment:** |
|---|---|---|
| laboratorijsko delo | 100 | laboratory work |

**Reference nosilca / Lecturer's references:**

XU, Yang, YAO, Yuxing, DENG, Weichen, FANG, Jen-Chun, DUPONT, Robert L., ZHANG, Meng, ČOPAR, Simon, TKALEC, Uroš, WANG, Xiaoguang. Magnetocontrollable droplet mobility on liquid crystal-infused porous surfaces. *Nano research*. Apr. 2023, vol. 16, iss. 4, str. 5098-5107. ISSN 1998-0124. DOI: 10.1007/s12274-022-5318-y. [COBISS.SI-ID 136269571]

YANG, Xu, RATHER, Adil M., YAO, Yuxing, FANG, Jen-Chun, MAMTANI, Rajdeep S., BENNETT, Robert K. A., ATTA, Richard G., ADERA, Solomon, TKALEC, Uroš, WANG, Xiaoguang. Liquid crystal-based open surface microfluidics manipulate liquid mobility and chemical composition on demand. *Science advances*. Oct. 2021, vol. 7, no. 40, 11 str. ISSN 2375-2548. DOI: 10.1126/sciadv.abi7607. [COBISS.SI-ID 79203075]

PARK, Geonhyeong, ČOPAR, Simon, SUH, Ahram, YANG, Minyong, TKALEC, Uroš, YOON, Dong Ki. Periodic arrays of chiral domains generated from the self-assembly of micropatterned achiral lyotropic chromonic liquid crystal. *ACS central science*. 2020, vol. 6, iss. 11, str. 1964-1970, ilustr. ISSN 2374-7951. DOI: 10.1021/acscentsci.0c00995. [COBISS.SI-ID 28153859]