Univerza v Mariboru

Fakulteta za naravoslovje in matematiko

| UČNI NAČRT PREDMETA / COURSE SYLLABUS | |
|---|---|
| **Predmet:** | **Fizikalni eksperimenti 2** |
| **Course title:** | **Physics experiments 2** |

| Študijski program in stopnja<br>Study programme and level | Študijska smer<br>Study field | Letnik<br>Academic year | Semester<br>Semester |
|---|---|---|---|
| **Fizika, prva Bolonjska stopnja** | | **2** | **3** |
| **Physics, Bachelor degree** | | | |

**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 |
|---|---|---|---|---|---|---|
| **5** | | | **50** | | **65** | **4** |

**Nosilec predmeta / Lecturer:** Robert Repnik

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

| **Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:** | **Prerequisits:** |
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| Pogojev ni.<br>Priporočljivo predznanje iz elektromagnetizma, termodinamike, osnove analize in vektorske analize. | None.<br>Recommended preknowledge of electromagnetism,thermodynamics, basics of analysis and vector analysis. |

| **Vsebina:** | **Content (Syllabus outline):** |
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| **Predavanja**<br>teoretični pregled zahtevnejših vsebin laboratorijskih vaj in uporabljenih merilnih tehnik.<br><br>**Laboratorijske vaje**<br>Študent opravi zahtevnejše vaje s področja termodinamike in elektromagnetizma.<br><br>Vsebine, ki so zastopane v vajah iz termodinamike so: odvisnost vrelišča vode od | **Lectures:**<br>theoretical overview of the demanding experiments and used measuring techniques.<br><br>**Laboratory work**<br>Student performs advanced experiments from thermodynamics and electromagnetism.<br><br>The experiments on thermodynamics contain: Clausius Clapeyrone equation, heat of vaporization. |

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| tlaka, izparilna in talilna toplota.<br>Vaje z elektromagnetizma vsebujejo: električna vezja, notranji upor, koeficient upora, merilniki električnega toka in napetosti, indukcija in generatorji, elektromotorji, elektroni v električnem in magnetnem polju, Coulombov zakon, Hallov pojav. | The experiments on electromagnetism contain: electrical circuits, internal resistance, current- and voltage-meters, induction and generators, electromotor, electrons in electric and magnetic field, Coulomb law, Hall effect. |

**Temeljni literatura in viri / Readings:**

- Navodila za izvedbo vaj/ Guidelines for the experiments
- Sirkevič, Koškin: Priročnik elementarne fizike. Ljubljana: TZS, 1988.
- D. Halliday, R. Resnick, K. S. Krane, Physics, 5. izdaja, vol 1 in 2 (John Wiley & Sons, Inc., New York, (2002).
- J. Strnad, Fizika, 1. in 2. del, (DMFA, Ljubljana, 2002) Na spletnih straneh Oddelka za fiziko objavljena elektronska gradiva./ teaching material published on
- websites of Department of Physics

| **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 elektromagnetizma in termodinamike ter se usposobi za samostojno varno izvedbo laboratorijskih vaj iz področja elektromagnetizma in termodinamike. Na osnovi eksperimentalno pridobljenih podatkov, v kombinaciji z ustreznim teoretičnim znanjem iz elektromagnetizma in termodinamike 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 electromagnetism and thermodynamics and is able to use the knowledge for individual safe laboratory work in the field of electromagnetism and thermodynamics. On the basis of experimentally obtained data combined with their theoretial knowledge in electromagnetism and thermodynamics 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>Po uspešno zaključeni učni enoti je študent zmožen:<br>- uporabiti teoretična znanja iz področja termodinamike in elektromagnetizma za izvedbo laboratorijskih vaj, | **Knowledge and understanding:**<br><br>On completion of this course student will be able to:<br>- use the knowledge from thermodynamics and electromagnetism to execute laboratory work, |

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| - aplicirati teoretična znanja o merilnih tehnikah,<br>- uporabiti ustrezne metode za obdelavo in analizo podatkov,<br>- ovrednotiti in interpretirati rezultate ter jih povezati s teorijo,<br>- precizno in adekvatno poročati o svojih eksperimentalnih ugotovitvah.<br><br>**Prenesljive/ključne spretnosti in drugi atributi:**<br>Študent:<br>- pridobi laboratorijske spretnosti potrebne za samostojno delo pri demonstracijah in eksperimentalnih vajah s področja elektromagnetizma in termodinamike,<br>- se priuči rokovanja z merilnimi napravami in laboratorijsko opremo,<br>- prepozna možne vire nevarnosti pri eksperimentalnem delu in pozna postopke za varno delo v laboratoriju,<br>- usvoji znanje potrebno za pripravo kvantitativnega in kvalitativnega eksperimenta s področja elektromagnetizma in termodinamike,<br>- se seznani z iskanjem, sortiranje in ustrezno rabo virov,<br>- pridobi spretnosti uporabe programskih orodij za analizo podatkov eksperimentov s področja elektromagnetizma in termodinamike,<br>- je zmožen presoje smiselnosti uporabe približkov,<br>- je sposoben sodelovalnega učenja. | - apply the knowledge of measuring techniques,<br>- use appropriate methods for processing and analyzing data,<br>- evaluate and interpret results and connect them with theory,<br>- accurate and adequate reporting on their experimental work.<br><br>**Transferable/Key Skills and other attributes**<br>Student:<br>- acquires experiences and laboratory skills that are essential for an autonomous execution of demonstrative physics experiments in the field of electromagnetism and thermodynamics,<br>- gains ability of handling with measuring devices and laboratory equipment,<br>- recognizes potential dangers in experimental work and knows procedures for safe laboratory work,<br>- gains knowledge needed to produce quantitative and qualitative experiments,<br>- gets acqainted with searching and sorting information sources and efficient use of sources,<br>- acquires skills to use software tools for analyzing data from experiments in the field of electromagnetism and thermodynamics<br>- is capable to judge the effective use of approximations,<br>- is capable of collaborative learning. |

| **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, conversation, demonstration)<br>- lab work (method of working with text, written and graphic works, method of practical works, use of simulations and software tools for data processing, collaborative learning, discussion of results)<br>- elements of reverse teaching |

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| **Načini ocenjevanja:** | Delež (v %) / Weight (in %) | **Assessment:** |
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| Opravljene vse laboratorijske vaje, izdelan dnevnik vaj in ustni zagovor vaj | **30** | All experiments done, done laboratory report, and the oral avocation of experiments |
| Ustno in pisno preverjanje pripravljenosti na vajo | **20** | Oral and written assessment of readiness for the forthcoming experiment |
| Pisni kolokvij | **20** | Written test |
| Ustni | **30** | Oral exam |
| Vsaka izmed naštetih obveznosti mora biti opravljena s pozitivno oceno. | | Each of the mentioned commitments must be assessed with a passing grade. |
| Pozitivno ocenjeno poročilo laboratorijskih vaj z zagovorom, pozitivno ocenjeno preverjanje pripravljenosti na vaji in pozitivna ocena pri pisnem kolokviju so pogoji za pristop k ustnemu izpitu. | | Positive grade of laboratory report and advocacy, positive grade of readiness assessment and positive grade of test are a prerequisite for access to oral examination. |

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

1. HAUKO, Robert, ANDREEVSKI, Damjan, PAUL, Domen, ŠTERK, Marko, REPNIK, Robert. Teaching of the harmonic oscillator damped by a constant force: The use of analogy and experiments. *American journal of physics : a publication of American association of physics teachers*, ISSN 0002-9505. [Print ed.], Sep. 2018, vol. 86, no. 9, str. 657-662, ilustr. https://aapt.scitation.org/doi/pdf/10.1119/1.5044654, doi: 10.1119/1.5044654.

2. MEŠIĆ, Vanes, NEUMANN, Knut, AVIANI, Ivica, HASOVIĆ, Elvedin, BOONE, William J., ERCEG, Nataša, GRUBELNIK, Vladimir, SUŠAC, Ana, SALIBAŠIĆ GLAMOČIĆ, Džana, KARUZA, Marin, VIDAK, Andrej, ALIHODŽIĆ, Adis, REPNIK, Robert. Measuring students' conceptual understanding of wave optics : a rasch modeling approach. *Physical review, Physics education research*, ISSN 2469-9896, 2019, vol. 15, iss. 1, str. 010115-1-010115-20, doi: 10.1103/PhysRevPhysEducRes.15.010115.

3. NEPOMUCENO, Erivelton Geraldo, LIMA, Arthur M., ARIAS-GARCÍA, Janier, PERC, Matjaž, REPNIK, Robert. Minimal digital chaotic system. *Chaos, solitons and fractals*. [Print ed.], 2019, vol. 120, str. 62-66, doi: 10.1016/j.chaos.2019.01.019. [COBISS.SI-ID 24425992]