



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 Study programme and level	Študijska smer Study field	Letnik Academic year	Semester Semester
Enovit magistrski študijski program druge stopnje Predmetni učitelj	Izobraževalna fizika	2	3
Five-year master's degree program Subject Teacher	Educational physics		

Vrsta predmeta / Course type

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
5			35		50	3

Nosilec predmeta / Lecturer:

Jeziki / Predavanja / Lectures:
Languages: Vaje / Tutorial:

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:

Pogojev ni.
Priporočljivo predznanje iz elektromagnetizma in termodinamike.

Prerequisites:

None.
Recommended preknowledge of electromagnetism and thermodynamics.

Vsebina:

Predavanja
teoretični pregled zahtevnejših vsebin laboratorijskih vaj in uporabljenih merilnih tehnik.
Laboratorijske vaje
Študent opravi zahtevnejše vaje s področja termodinamike in elektromagnetizma.

Content (Syllabus outline):

Lectures:
theoretical overview of the demanding experiments and used measuring techniques.
Laboratory work
Student performs advanced experiments from thermodynamics and electromagnetism.



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<p>Vsebine, ki so zastopane v vajah iz termodinamike so: odvisnost vrelišča vode od tlaka, izparilna in talilna toplota.</p> <p>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.</p> <p>Uporaba fizikalnih vsebin iz laboratorijskih vaj pri poučevanju fizike.</p> <p>Projektno delo Študent pripravi projektno nalogo: načrtuje in izdelava meritve, pripravi navodila za izvajanje meritve, izvede meritve in napiše poročilo.</p> <p>Seminar Predstavitve projektnega dela.</p>	<p>The experiments on thermodynamics contain: Clausius Clapeyrone equation, heat of vaporization.</p> <p>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.</p> <p>Use of physical content from laboratory exercises in teaching physics.</p> <p>Project work Each student works on a project. The work involves planning the experiment, building the experiment, performing the measurements and writing report.</p> <p>Seminar Oral presentation of project work.</p>
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Temeljna literatura in viri / Readings:

- R. Repnik, M. Slavinec, E. Klemenčič, Fizikalni eksperimenti 2 – zbirka laboratorijskih vaj.
- 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:

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

Objectives and competences:

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 theoretical knowledge in electromagnetism and thermodynamics as well as professional literature and computer



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sposobni smiselno oblikovati končno rešitev problema.

simulation tolls student is able to reasonably formulate the final solution of the problem.

Predvideni študijski rezultati:

Znanje in razumevanje:

Po uspešno zaključeni enoti je študent zmožen:

- uporabiti teoretična znanja iz področja termodinamike in elektromagnetizma za izvedbo laboratorijskih vaj,
- aplicirati teoretična znanja o merilnih tehnikah,
- uporabiti ustrezne metode za obdelavo in analizo podatkov,
- ovrednotiti in interpretirati rezultate ter jih povezati s teorijo,
- precizno in adekvatno poročati o svojih eksperimentalnih ugotovitvah.

Prenesljive/ključne spretnosti in drugi atributi:

Študent:

- pridobi laboratorijske spretnosti potrebne za samostojno delo pri demonstracijah in eksperimentalnih vajah s področja elektromagnetizma in termodinamike,
- se priuči rokovanja z merilnimi napravami in laboratorijsko opremo,
- prepozna možne vire nevarnosti pri eksperimentalnem delu in pozna postopke za varno delo v laboratoriju,
- usvoji znanje potrebno za pripravo kvantitativnega in kvalitativnega eksperimenta s področja elektromagnetizma in termodinamike,
- se seznanj z iskanjem, sortiranje in ustrezno rabo virov,
- pridobi spretnosti uporabe programskih orodij za analizo podatkov eksperimentov s

Intended learning outcomes:

Knowledge and understanding:

On completion of this course student will be able to:

- use the knowledge from thermodynamics and electromagnetism to execute laboratory work,
- apply the knowledge of measuring techniques,
- use appropriate methods for processing and analyzing data,
- evaluate and interpret results and connect them with theory,
- accurate and adequate reporting on their experimental work.

Transferable/Key Skills and other attributes

Student:

- acquires experiences and laboratory skills that are essential for an autonomous execution of demonstrative physics experiments in the field of electromagnetism and thermodynamics,
- gains ability of handling with measuring devices and laboratory equipment,
- recognizes potential dangers in experimental work and knows procedures for safe laboratory work,
- gains knowledge needed to produce quantitative and qualitative experiments,
- gets acquainted with searching and sorting information sources and efficient use of sources,
- acquires skills to use software tools for analyzing data from experiments in the field of electromagnetism and thermodynamics



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področja elektromagnetizma in termodinamike,

- je zmožen presoje smiselnosti uporabe približkov,
- je sposoben sodelovalnega učenja,
- spozna didaktične pristope pri obravnavi naravnih pojavov ter pridobi sposobnost prenesti znanje laiku.

- is capable to judge the effective use of approximations,

- is capable of collaborative learning,
- gets acquainted with didactic approaches to study to real-life phenomena and the ability to transfer this knowledge to a non-specialist.

Metode poučevanja in učenja:

- 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)
- projektno delo (individualizacija poučevanja)
- seminar (razlaga, razgovor)
- elementi obrnjenega poučevanja

Learning and teaching methods:

- 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)
- project work (individualization in teaching)
- seminar work (explanation, discussion)
- elements of flipped learning

Načini ocenjevanja:

Način (ustno izpraševanje, naloge, projekt):

Ustno in pisno preverjanje pripravljenosti na vajo

Opravljenе vse laboratorijske vaje, izdelan dnevnik vaj in ustni zagovor vaj

Projekt (izdelek in predstavitev)
Ustni in praktični izpit

Vsaka izmed naštetih obveznosti mora biti opravljena s pozitivno oceno.

Delež (v %) /

Weight (in %) /

Assessment:

Type (oral, coursework, project):

Oral and written assessment of readiness for the forthcoming experiment

All experiments done, done laboratory report, and the oral avocation of experiments

Project (work and presentation)

Oral exam

Each of the mentioned commitments must be assessed with a passing grade.

Positive grade of laboratory report and advocacy, positive grade of readiness

20

60

10

10



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Pozitivno ocenjeno poročilo laboratorijskih vaj z zagovorom, pozitivno ocenjeno preverjanje pripravljenosti na vaji in uspešno izdelan in predstavljen projektso pogoji za pristop k ustnemu izpitu.		assessment and a successfully created and presented project are a prerequisite for access to oral examination. All experiments done, done laboratory report, and the oral avocation of experiments
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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](https://doi.org/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](https://doi.org/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](https://doi.org/10.1016/j.chaos.2019.01.019). [COBISS.SI-ID [24425992](https://www.cobiss.si/id/24425992)]