



Univerza v Mariboru

Fakulteta za naravoslovje  
in matematiko

### UČNI NAČRT PREDMETA / COURSE SYLLABUS

**Predmet:** Fizikalni eksperimenti 3  
**Course title:** Physics experiments 3

Študijski program in stopnja Study programme and level	Študijska smer Study field	Letnik Academic year	Semester Semester
Fizika, prva Bolonjska stopnja Physics, Bachelor degree	/	2	4

**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
1	4		50		125	6

**Nosilec predmeta / Lecturer:**

Robert Repnik

**Jeziki / Predavanja / Lectures:** slovenski/Slovenian

**Languages: Vaje / Tutorial:** slovenski/Slovenian

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

Pogojev ni.

Priporočljivo predznanje iz nihanja, valovanja in optike ter osnove analize in vektorske analize.

**Prerequisites:**

None.

Recommended preknowledge of oscillations, waves and optics and basics of analysis and vector analysis.

**Vsebina:****Predavanja**

teoretični pregled zahtevnejših vsebin  
laboratorijskih vaj in uporabljenih merilnih tehnik.

**Laboratorijske vaje**

Študent opravi eksperimente s področja nihanja in valovanja ter valovne in geometrijske optike. Laboratorijske vaje so iz naslednjih vsebin: dušeno in nedušeno nihanje, vsiljeno nihanje in resonanca, električni nihajni krog, potujoče in stoječe valovanje, leče in zrcala, lečja, uklon in interferenca, spektroskopija, sevanje črnega telesa.

**Projektno delo**

Študent pripravi projektno nalogo: načrtuje in izdelava meritev, pripravi navodila za izvajanje meritve, izvede meritve in napiše poročilo.e.

**Seminar**

Predstavitev projektne dela.

**Content (Syllabus outline):****Lectures**

theoretical overview of the demanding experiments and used measuring techniques.

**Laboratory work**

Student performs experiments from oscillations and waves and from wave and geometrical optics. Experiments are from the following topics: undamped and damped oscillations, forced oscillations and resonance, electrical oscillation circuit, travelling and standing waves, lenses and mirrors, systems of lenses, diffraction and interference, spectroscopy, blackbody radiation.

**Project work**

Each student works on a project. The work involves planning the experiment, building the experiment, performing the measurements and writing report.

**Seminar**

Oral presentation of project work.

**Temeljna literatura in viri / Readings:**

- 1) Navodila za izvedbo vaj/ Guidelines for the experiments
- 2) Sirkevič, Koškin: Priročnik elementarne fizike. Ljubljana: TZS, 1988.
- 3) D. Halliday, R. Resnick, K. S. Krane, Physics, 5. izdaja, vol 1 in 2 (John Wiley & Sons, Inc., New York, 2002).
- 4) J. Strnad, Fizika, 1. in 2. del, (DMFA, Ljubljana, 2002).
- 5) 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 študentje usvojijo temeljna znanja o merilnih tehnikah in metodah na področju nihanja, valovanja in optike. Študentje se usposobijo za samostojno reševanje zahtevnejših problemov s področja nihanja, valovanja in optike, pri čemer znajo predlagati, izdelati ter izvesti ustrezen fizikalni eksperiment. Na osnovi eksperimentalno pridobljenih podatkov, v kombinaciji z ustreznim teoretičnim znanjem iz

**Objectives and competences:**

The objective of this course is for students to acquire basic knowledge in measuring techniques and methods used in oscillations, waves and optics. Students are competent to find appropriate solutions of advanced problems in oscillations, waves and optics. They are able to propose, prepare and perform appropriate physical experiments and on the basis of experimentally obtained data combined with their theoretical knowledge in

nihanja, valovanja in optike in drugimi informacijskimi viri ter računalniškimi simulacijskimi okolji so sposobni smiselno oblikovati končno rešitev problema.

oscillations, waves and optics as well as professional literature and computer simulation tools reasonably formulate the final solution of the problem.

#### **Predvideni študijski rezultati:**

##### **Znanje in razumevanje:**

Po uspešno zaključeni učni enoti je študent zmožen:

- uporabiti znanje s področja nihanja in valovanja ter optike,
- aplicirati teoretična znanja o merilnih tehnikah,
- uporabiti ustrezne metode za obdelavo in analizo podatkov,
- vrednotiti 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 nihanja, valovanja in optike,
- 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 nihanja, valovanja in optike,
- se seznanj z iskanjem, sortiranjem in ustrezno rabo virov,

#### **Intended learning outcomes:**

##### **Knowledge and understanding:**

On completion of this course students will be able to:

- use the knowledge from oscillations and waves and optics 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 oscillations, wave and optics,
- 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 oscillation, wave and optics,

- pridobi spretnosti uporabe programskih orodij za analizo podatkov eksperimentov s področja nihanja, valovanja in optike,
- je zmožen presoje smiselnosti uporabe približkov,
- je sposoben sodelovalnega učenja,
- razvija spretnost samostojnega strokovnega in raziskovalnega dela.

- is capable to judge the effective use of approximations.
- is capable of collaborative learning,
- develops skills of individual professional-research work.

### 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

Delež (v %) /

### Načini ocenjevanja:

Weight (in %)

### Assessment:

Način (pisni izpit, ustno izpraševanje, naloge, projekt):		Type (examination, oral, coursework, project):
Opravljene vse laboratorijske vaje, izdelan dnevnik vaj in ustni zagovor vaj	20	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
Projekt (izdelek in predstavitev)	20	Project (work and presentation)
Ustni izpit	20	Oral exam

<p>Vsaka izmed naštetih obveznosti mora biti opravljena s pozitivno oceno.</p> <p>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.</p>		<p>Each of the mentioned commitments must be assessed with a passing grade.</p> <p>Positive grade of laboratory report and advocacy, positive grade of readiness assessment, positive grade of test and positive grade of project are a prerequisite for access to oral examination.</p>
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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>, 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) REPNIK, Robert, GRUBELNIK, Vladimir, ZIDANŠEK, Aleksander. Modelling of Drava river flow for flood protection. V: BAN, Marko. 2nd SEE SDEWES Conference Piran 2016 : digital proceedings, 2nd South East European Conference on Sustainable Development of Energy, Water and Environment Systems, June 15-18, 2016, Piran, Slovenia, (CD proceedings (Dubrovnik Conference on Sustainable Development of Energy, Water and Environment Systems), ISSN 1847-7178). [S. l.]: SDEWES. 2016, str. 1-8. [COBISS.SI-ID 23011848]