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**
Enovit magistrski študijski program druge stopnje Predmetni učitelj	Izobraževalna fizika	**2**	**4**
Five-year master's degree program Subject Teacher	Educational 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**
1	**4**		**35**		**50**	**3**

Nosilec predmeta / Lecturer:	Robert Repnik

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

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:	**Prerequisits:**
Pogoji za vključitev v delo: Pogojev ni.	Conditions for Inclusion in the Course: There are no conditions.

Priporočljivo predznanje iz klasične fizike, predvsem iz nihanja, valovanja in optike. Pogoji za opravljanje študijskih obveznosti: Vsaka izmed naštetih obveznosti mora biti opravljena s pozitivno oceno. Pozitivno ocenjeno poročilo laboratorijskih vaj z zagovorom, pozitivno ocenjeno preverjanje pripravljenosti na vaji in uspešno izdelan in predstavljen projekt so pogoji za pristop k ustnemu izpitu.	Recommended preknowledge of classical physics, especially of oscillations, waves and optics. Conditions for Fulfilling Study Obligations: Each of the mentioned commitments must be assessed with a passing grade. Positive grade of laboratory report and advocacy, positive grade of readiness assessment and a successfully created and presented project are a prerequisite for access to oral examination.

Vsebina:	**Content (Syllabus outline):**
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 izdela meritev, pripravi navodila za izvajanje meritve, izvede meritev in napiše poročilo.e. **Seminar** Predstavitev projektnega dela.	**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.

Temeljni literatura in viri / Readings:

1. Repnik, R., & Hauko, R. (2022). Fizikalni eksperimenti 3: zbirka laboratorijskih vaj [elektronski vir]. Maribor: Univerza v Mariboru, Univerzitetna založba. ISBN 978-961-286-624-2. [COBISS.SI-ID 114276355] https://plus.cobiss.net/cobiss/si/sl/bib/pefmb/114276355
2. Koškin, N. I., & Širkevič, M. G. (1988). Priročnik elementarne fizike (1. slov. prev. po 3. predelani in izpopolnjeni izd., 6. ponatis). Ljubljana: Tehniška založba Slovenije. ISBN 86-365-0035-4. [COBISS.SI-ID 3996416] https://plus.cobiss.net/cobiss/si/sl/bib/pefmb/3996416

3. Halliday, D., Resnick, R., & Walker, J. (2008). Fundamentals of Physics (8th ed.). Hoboken, NJ: J. Wiley & Sons. ISBN 978-0-470-04472-8. [COBISS.SI-ID 62414337] https://plus.cobiss.net/cobiss/si/sl/bib/pefmb/62414337
4. Strnad, J. (2014). Fizika. Del 1: Mehanika, toplota (12. natis). Ljubljana: DMFA – založništvo. ISBN 978-961-212-047-4. [COBISS.SI-ID 271411200] https://plus.cobiss.net/cobiss/si/sl/bib/pefmb/271411200
5. Strnad, J. (2014). Fizika. Del 2: Elektrika, optika (7. natis). Ljubljana: DMFA – založništvo. ISBN 978-961-212-048-1. [COBISS.SI-ID 271410944] https://plus.cobiss.net/cobiss/si/sl/bib/pefmb/271410944

Dodatna literatura / Additional readings:

1. Elektronska gradiva, objavljena v spletni učilnici / Teaching material available in the e-classroom.

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

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 theoretial knowledge in oscillations, waves and optics as well as professional literature and computer simulation tolls 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,

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,

- precizno in adekvatno poročati o svojih eksperimentalnih ugotovitvah.	accurate and adequate reporting on their experimental work.
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 seznani z iskanjem, sortiranje in ustrezno rabo virov, - 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 in skupinskega strokovnega in raziskovalnega dela, - spozna didaktične pristope pri obravnavi naravnih pojavov ter pridobi sposobnost prenesti znanje laiku.	**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 acqainted 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, - is capable to judge the effective use of approximations. - is capable of collaborative learning, - develops skills of individual and group proffesional-research work. - gets acquainted with didactic approaches to studyto real-life phenomena and the ability to transfer this knowledge to a non-specialist.
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)	-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)

-projektno delo (individualizacija poučevanja) -seminar (razlaga, razgovor) - elementi obrnjenega poučevanja	-project work (individualization in teaching) -seminar work (explanation, discussion) - elements of flipped learning

Načini ocenjevanja:	Delež (v %) / Weight (in %)	**Assessment:**
Laboratorijsko delo		Laboratory work
Projekt		Project
Ustni izpit	**80** **10** **10**	Oral exam

Reference nosilca / Lecturer's references:

- PANAHI, Shirin, NAZARIMEHR, Fahimeh, JAFARI, Sajad, SPROTT, Julien Clinton, PERC, Matjaž, REPNIK, Robert. Optimal synchronization of circulant and non-circulant oscillators. *Applied mathematics and computation*. [Print ed.]. Apr. 2021, vol. 394, art. no. 125830, str. 1-8. ISSN 0096-3003. DOI: 10.1016/j.amc.2020.125830. [COBISS.SI-ID 43339779]

- OSRAJNIK, Damjan, GRUBELNIK, Vladimir, REPNIK, Robert. Multirhythmicity but no deterministic chaos in vibrating strings. *Chaos, solitons and fractals*. [Print ed.]. Sep. 2021, vol. 150, str. 1-5. DOI: 10.1016/j.chaos.2021.111206. [COBISS.SI-ID 73698819]

- SALIBAŠIĆ GLAMOČIĆ, Džana, MEŠIĆ, Vanes, NEUMANN, Knut, SUŠAC, Ana, BOONE, William J., AVIANI, Ivica, HASOVIĆ, Elvedin, ERCEG, Nataša, REPNIK, Robert, GRUBELNIK, Vladimir. Maintaining item banks with the Rasch model: an example from wave optics. *Physical review. Physics education research*. 2021, vol. 17, iss. 1, str. 010105-1-010105-18. ISSN 2469-9896. DOI: 10.1103/PhysRevPhysEducRes.17.010105. [COBISS.SI-ID 54415363]

- JOZIČ, Primož, ZIDANŠEK, Aleksander, REPNIK, Robert. Fuel conservation for launch vehicles: Falcon Heavy case study. *Energies*. 2020, vol. 13, no. 3, str. 1-10. ISSN 1996-1073. DOI: 10.3390/en13030660. [COBISS.SI-ID 25125640]

- HAUKO, Robert, DAJNKO, Matic, GAČEVIĆ, Dino, MARINKO, Peter, POTRČ, Melani, REPNIK, Robert. From speed of sound to vapour pressure : an undergraduate school experiment as an example of systematic error research. *European journal of physics*. 2022, vol. 43, no. 4, str. 1-14. ISSN 0143-0807. DOI: 10.1088/1361-6404/ac6cb9. [COBISS.SI-ID 117802755]