Univerza v Mariboru

Fakulteta za naravoslovje in matematiko

UČNI NAČRT PREDMETA / COURSE SYLLABUS	
Predmet:	**Nihanje in valovanje**
Course title:	**Oscillation and waves**

Študijski program in stopnja Study programme and level	Študijska smer Study field	Letnik Academic year	Semester Semester
Fizika, 1. stopnja		**2**	**3**
Physics, 1st cycle			

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
60		**30**			**120**	**7**

Nosilec predmeta / Lecturer: Nataša Vaupotič

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

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:	**Prerequisites:**
Priporočljivo je predznanje iz mehanike, elektromagnetizma, osnov analize in algebre. Vsaka izmed naštetih obveznosti v načinih ocenjevanja mora biti opravljena s pozitivno oceno.	Recommended is preknowledge of Mechanics, Electromagnetism, fundamentals of calculus and algebra. Each of the listed obligations in the assessment methods must be completed with a positive grade.

Vsebina: **Content (Syllabus outline):**

1.*Nihanje*: harmonično nihanje, dušeno nihanje, vsiljeno nihanje in resonanca, sestavljeno nihanje, utripanje. 2. *Valovanje*: longitudinalno in transverzalno, valovna dolžina in frekvenca, hitrost otujočega vala, princip superpozicije, interferenca valovanj, stojno valovanje, zvok, utripanje, Dopplerjev pojav. 3. *Elektromagnetno valovanje*: spekter, izvor; Poytingov vektor; sončni tlak; polarizacija. 4. *Geometrijska optika*: področje veljavnosti in vpeljava žarka; odboj in lom; zrcala in leče; dvojni lom in optična aktivnost; optični elementi. 5. *Valovna optika*: Stefanov in Wienov zakon interferenca, koherentnost, polarizacija, Huygensovo načelo; optična pot; interferenca na dveh režah; interferenca na tankih plasteh, nevidnost, Michelsenov interferometer; Uklon, kvalitativen in kvantitativen opis, ločljivost in Rayleightov kriterij; kombinacija uklona in interference; optična mrežica; uklon x-žarkov.	1. *Oscillations*: harmonic oscillations, damped oscillations, forced oscillations and resonance, coupled oscillation, beats. 2. *Waves*: longitudinal and transverse, wavelength and frequency, speed of a travelling wave, principle of superposition, interference of waves, standing waves, sound, beats, Doppler effect. 3. *Electro-magnetic waves*: spectrum, source, radiation pressure, polarisation. 4. *Geometric optics*: range of validity, ray, refraction, reflection, mirrors and lenses, birefringence and optical activity, optic elements. 5. *Wave optics*: Stefan and Wien law, interference, coherence, polarization, Huygens principle; phase shift; interference on a double slit interference on thin films, invisibility; Michelson interferometer; diffraction, qualitative and quantitative description, Rayleigh criterion; interference and diffraction; diffraction gratings; x-ray diffraction.

Temeljni literatura in viri / Readings:

- D. Halliday, R. Resnick, J. Walker, Fundamentals of Physics, katerakoli izdaja, npr. 10. izdaja, (John Wiley & Sons, Inc., Hoboken, 2014).
- J. Strnad, Fizika, 1. del, (DMFA, Ljubljana, 2002).
- J. Strnad, Fizika, 2. del, (DMFA, Ljubljana, 1995).
- Z. Bradač, Naloge iz fizike (Pedagoška fakulteta Maribor, 1991).
- M. Gros, M. Hribar, A. Kodre, J. Strnad, Naloge iz fizike (DMFA, Ljubljana, 1991).
- B. Majaron, M. Mikuž, A. Ramšak, Kolokvijske naloge iz fizike 1 (DMFA, Ljubljana, 1998).
- J. Žitnik, Univerzitetne fizikalne naloge (TZS, Ljubljana, 2002-2003).

Cilji in kompetence:	**Objectives and competences:**
Študenti usvojijo temeljna teoretična znanja s področja mehanskega nihanja in valovanja, elektromagnetnega valovanja ter valovne in geometrijske optike in jih znajo uporabiti pri reševanju ustreznih problemov z rabo matematičnih orodij.	Students acquire basic theoretical knowledge from mechanical oscillations and waves, electromagnetic waves, wave and geometrical optics and are able to use the knowledge to solve problems with the use of mathematical tools.

Predvideni študijski rezultati:	**Intended learning outcomes:**

Znanje in razumevanje:	**Knowledge and understanding:**
Po uspešno zaključeni učni enoti bodo študenti zmožni: - uporabiti Newtonove zakone in ohranitvene zakone za opis, analizo in vrednotenje periodičnega gibanja telesa/sistema v odvisnosti od spremenljivk in parametrov, od katerih so odvisne lastnosti telesa in okolice; - opisati razširjanje valovanja v eni, dveh in treh dimenzijah ter ga povezati z lastnostmi snovi, po kateri se valovanje razširja; - napovedati lastnosti slike po preslikavi z lečami in zrcali v odvisnosti od lastnosti leč in zrcal; - razlikovati med koherentno in nekoherentno svetlobo; - uporabiti princip superpozicije valovanj za kvantitativno obravnavo uklona in interference z delitvijo valovnega čela in delitvijo amplitude; - kvalitativno napovedati lastnosti svetlobe po razširjanju skozi optično anizotropno snov.	On completion of this course students will be able to: - use Newton's laws and conservation laws to describe, analyse and evaluate periodic motion of a body/system as a function of variables and parameters, which determine properties of the system and surrounding; - describe wave propagation in one, two and three dimensions and relate it to the properties of the medium; - predict properties of an image obtained by a lens and mirror imaging as a function of properties of lenses and mirrors; - differentiate between the coherent and incoherent light; - use the principle of superposition of waves to quantitatively study diffraction and interference of waves obtained by splitting a wave front or division of amplitude; - qualitatively predict properties of light upon transition through an optically anisotropic medium.
Prenesljive/ključne spretnosti in drugi atributi: Po uspešno zaključeni učni enoti bodo študenti zmožni: - uporabljati sodobno računalniško programsko opremo kot pomoč pri kvantitativnem računanju, za izrisovanje odvisnosti med spremenljivkami v odvisnosti od vrednosti parametrov ter za napoved trendov; - pripravljati miselne vzorce in risbe ter smiselno poročati (vzrok/posledica) o izbrani temi; - uporabiti osnovno znanje linearne algebre in analize za obravnavo fizikalnih problemov.	**Transferable/Key Skills and other attributes:** On completion of this course students will be able to: - use modern computer software for quantitative calculations and for plotting dependencies among variables at different values of parameters and to foresee trends; - prepare mind flowcharts and sketches and report (cause/consequence) on a selected topic; - use elementary knowledge from linear algebra and linear analysis to tackle physical problems.

Metode poučevanja in učenja:	**Learning and teaching methods:**
eksperimentalna predavanja teoretične vaje razlaga razgovor demonstracija	lectures with experiments theoretical exercises explanation discussion demonstration

delo s tekstom metoda pisnih in grafičnih del uporaba simulacij elementi obrnjenega poučevanja Poučevanje in učenje potekata z didaktično uporabo informacijsko-komunikacijske tehnologije.	work with text work with graphic elements use of simulations elements of flipped learning Teaching and learning are done through the didactic use of ICT.

Načini ocenjevanja:	Delež (v %) / Weight (in %)	**Assessment:**
pisni izpit	**50**	written exam
ustni izpit	**50**	oral exam

Opombe:
Pisni izpit se lahko nadomesti z dvema pisnima kolokvijema.
Ustni izpit se lahko nadomesti z dvema ustnima kolokvijema.

Comments:
Written exam can be replaced by two written midterm examinations.
Oral exam can be replaced by two oral midterm examinations.

Reference nosilca / Lecturer's references:

1. VAUPOTIČ, Nataša, KRAJNC, Tine, GÓRECKA, Ewa, POCIECHA, Damian, MATKO, Vojko. Ferroelectric nematics: materials with high permittivity or low resistivity?. *Liquid crystals*. [Online ed.]. Published online: 31 Mar 2025, 13 str., ilustr. ISSN 1366-5855. DOI: 10.1080/02678292.2025.2484234. [COBISS.SI-ID 231098115]

2. MATKO, Vojko, GÓRECKA, Ewa, POCIECHA, Damian, MATRASZEK, Joanna, VAUPOTIČ, Nataša. Interpretation of dielectric spectroscopy measurements of ferroelectric nematic liquid crystals. *Physical review research*. 2024, vol. 6, iss. 4, [article no.] l042017, 6 str. ISSN 2643-1564. DOI: 10.1103/PhysRevResearch.6.L042017, [COBISS.SI-ID 212927491]

3. VAUPOTIČ, Nataša, POCIECHA, Damian, RYBAK, Paulina, MATRASZEK, Joanna, ČEPIČ, Mojca, WOLSKA, Joanna M., GÓRECKA, Ewa. Dielectric response of a ferroelectric nematic liquid crystalline phase in thin cells. *Liquid crystals*. [Online ed.]. 2023, vol. 50, no. 4, str. 584-595, ilustr. ISSN 1366-5855. DOI: 10.1080/02678292.2023.2180099. [COBISS.SI-ID 147790083]

4. SZYDŁOWSKA, Jadwiga, ČEPIČ, Mojca, VAUPOTIČ, Nataša, et al. Ferroelectric nematic-isotropic liquid critical end point. *Physical review letters*. [Print ed.]. 2023, vol. 130, no. 21, str. 216802-1-216802-5. ISSN 0031-9007. DOI: 10.1103/PhysRevLett.130.216802. [COBISS.SI-ID 153660675]