



Univerza v Mariboru

Fakulteta za naravoslovje
in matematiko

UČNI NAČRT PREDMETA / COURSE SYLLABUS

Predmet:	Mehanika
Course title:	Mechanics

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		1	1
Five-year master's degree program Subject Teacher			

Vrsta predmeta / Course type

Obvezni/Obligatory

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
45		30	15		120	7

Nosilec predmeta / Lecturer:

Nataša Vaupotič

Jeziki /

Predavanja / Lectures:

slovenski / Slovenian

Languages:

Vaje / Tutorial:

slovenski / Slovenian

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

Pogoji za vključitev v delo:

Pogojev ni.

Priporočeno je predznanje maturitetnega programa matematike in fizike.

Pogoji za opravljanje študijskih obveznosti:

Vsaka izmed naštetih obveznosti v načinih ocenjevanja mora biti opravljena s pozitivno oceno. Opravljene laboratorijske vaje so pogoj za pristop k pisnemu in ustnemu izpitu.

Prerequisites:

Conditions for Inclusion in the Course:

None.

Prior knowledge of the mathematics and physics high school graduation program is recommended.

Conditions for Fulfilling Study Obligations:

Each of the listed obligations in the assessment methods must be completed with a positive grade. Completed laboratory exercises are a prerequisite for taking the written and oral exams.

Vsebina:

Kinematika in dinamika gibanja točkastega telesa, premo in krivo gibanje. Sila, Newtonovi zakoni. Kinetična energija in delo sile, potencialna energija, delo konservativne sile, izrek o ohranitvi vsote kinetične in potencialne energije, delo nekonservativnih sil, zakon o ohranitvi energije. Sistemi delcev. Gibalna količina, sunek sile, zakon o ohranitvi gibalne količine. Elastični in neelastični trki v 1D in 2D. Vrtenje in kotaljenje: opis gibanja, kinetična energija pri vrtenju, vztrajnostni moment, navor, 2. Newtonov zakon za vrtenje. Vrtilna količina točkastega in razsežnega telesa, zakon o ohranitvi vrtilne količine. Ravnoesje togega telesa. Mehanika trdnih teles, ki se deformirajo. Gravitacija: gravitacijska sila, gravitacijska potencialna energija, Keplerjevi zakoni, gravitacija med obsežnimi telesi, plimske sile. Hidrodinamika: Tekočine: hidrostatični tlak, Pascalovo načelo, vezne posode, Arhimedov zakon, Bernoullijeva enačba, viskozne tekočine, Poiseuillov zakon, površinska napetost.

Laboratorijske vaje: osnove merjenja in obdelave dobljenih podatkov, eksperimenti iz merjenj mehanskih fizikalnih količin.

Content (Syllabus outline):

Kinematics and dynamics of motion, motion along a straight line, motion in two and three dimensions. Force, Newton laws. Kinetic energy and work, potential energy, conservative and dissipative forces, conservation of mechanical energy, conservation of energy. Systems of particles. Linear momentum, impulse, conservation of linear momentum. Elastic and nonelastic collisions in one and two dimensions. Rotation and rolling: kinematics, kinetic energy, rotational inertia, torque, Newton's second law in angular form. Angular momentum of a point particle and of a rigid body, conservation of angular momentum. Equilibrium and elasticity. Gravitation: gravitational force, gravitational energy, Kepler laws, gravitation between two large bodies, tides. Hydrodynamics: fluids, hydrostatic pressure, Pascal's principle, coupled vessels, Archimedes' law, Bernoulli's equation, viscosity, Poiseuille law, surface tension.

Lab work: basic measurements and data processing, measurements of mechanical physical quantities.

Temeljni literatura in viri / Readings:

1. D. Halliday, R. Resnick, J. Walker, Fundamentals of Physics, poljubna izdaja, npr. 10. izdaja, (John Wiley & Sons, Inc., Hoboken, 2014).
2. J. Strnad, Fizika, 1. del, (DMFA, Ljubljana, 2002).
3. R. Kladnik, Visokošolska fizika. 1. del, Mehanski in toplotni pojavi (DZS, Ljubljana, 1985).
4. Z. Bradač, Naloge iz fizike (Pedagoška fakulteta Maribor, 1991).
5. M. Gros, M. Hribar, A. Kodre, J. Strnad, Naloge iz fizike (DMFA, Ljubljana, 1991).
6. B. Majaron, M. Mikuž, A. Ramšak, Kolokvijske naloge iz fizike 1 (DMFA, Ljubljana, 1998).
7. J. Žitnik, Univerzitetne fizikalne naloge (TZS, Ljubljana, 2002-2003).
8. A. Dobovišek, Osnovna merjenja : uvod v merske napake in kvantitativno analizo fizikalnih meritev (Univerzitetna založba Univerze v Mariboru, Maribor, 2021).

Cilji in kompetence:

Študenti usvojijo temeljna teoretična znanja s področja mehanike in jih znajo uporabiti pri

Objectives and competences:

Students acquire basic theoretical knowledge from mechanics and are able to use it for

reševanju ustreznih problemov z rabo matematičnih orodij in za razumevanje meritev osnovnih fizikalnih količin.

solving problems with the use of mathematical tools and to understand measurements of basic physical quantities.

Predvideni študijski rezultati:

Znanje in razumevanje:

Po uspešno zaključeni učni enoti bodo študenti sposobni

- definirati fizikalni sistem, opredeliti dejavnike v okolici, ki vplivajo na stanje sistema, in kvalitativno ter kvantitativno napovedati spreminjanje stanja izbranega fizikalnega sistema v odvisnosti od parametrov in spremenljivk v sistemu in okolici;
- uporabiti Newtonove zakone in ohranitvene zakone (zakoni o ohranitvi energije, gibalne in vrtilne količine) za analiziranje krivega gibanja, vrtenja, kotaljenja in gibanja astronomskih teles ter za določitev mehanskega ravnovesja togih in elastičnih teles;
- obravnavati laminarni tok idealne in viskozne tekočine ter napovedati gibanje teles skozi tekočino v odvisnosti od lastnosti telesa in tekočine; izbrati ustrezen preprost merilni sistem za merjenje osnovnih fizikalnih količin, meritvi dodati sistematično in slučajno napako ter izračunati željeno fizikalno količino ob upoštevanju merskih napak meritev;
- meritve prikazati v grafu, graf linealizirati ter prilagoditi linearno funkcijo.

Prenesljive/ključne spretnosti in drugi atributi:

Po uspešno zaključeni učni enoti bodo študenti zmožni:

- uporabljati sodobno računalniško programsko opremo kot pomoč pri kvantitativnem računanju ter za izrisovanje odvisnosti med

Intended learning outcomes:

Knowledge and understanding:

On completion of this course students will be able to:

- define a physical system, define the elements in the surrounding that affect the system and qualitatively and quantitatively predict changes of the system state as a function of parameters and variables defining the properties of the system and surrounding;
- use Newton's laws and conservation laws (conservation of energy, linear momentum, angular momentum) to analyse translational motion in 3D, rotation and rolling and motion of astronomical bodies, as well as for defining the mechanical equilibrium of rigid and elastic bodies;
- study lamellar flow of ideal and viscous fluids and predict a motion of bodies through a fluid as a function of the properties of the body and fluid.
- choose a proper simple measuring system for measurements of elementary physical quantities, add experimental errors to the measured quantities and calculate the needed physical quantity by considering experimental errors of the measured quantities;
- present measured quantities in a graph, linearize the graph and fit a linear function.

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;

spremenljivkami v odvisnosti od vrednosti parametrov; - pripravljati miselne vzorce in skice ter smiselno poročati (vzrok/posledica) o izbrani temi; - uporabiti osnovno znanje linearne algebre in analize za obravnavo fizikalnih problemov.	- prepare mind flow charts and sketches and report (cause/consequence) on a selected topic; - use elementary knowledge from linear algebra and linear analysis to tackle physical problems.
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Metode poučevanja in učenja:

Learning and teaching methods:

eksperimentalna predavanja teoretične vaje laboratorijske vaje razlaga razgovor demonstracija delo s tekstom metoda pisnih in grafičnih del uporaba programov za obdelavo podatkov uporaba simulacij Poučevanje in učenje potekata z didaktično uporabo informacijsko-komunikacijske tehnologije.	lectures with experiments theoretical exercises lab work explanation discussion demonstration work with text work with graphic elements use of software for data analysis use of simulations Teaching and learning are done through the didactic use of ICT.
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Delež (v %) /

Načini ocenjevanja:

Weight (in %)

Assessment:

Laboratorijsko delo	20	Laboratory work
Pisni izpit	40	Written exam
Ustni izpit	40	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. 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.] I042017, 6 str. ISSN 2643-1564. DOI: [10.1103/PhysRevResearch.6.L042017](https://doi.org/10.1103/PhysRevResearch.6.L042017), [COBISS.SI-ID [212927491](https://cobiss.si/id/212927491)]
2. 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](https://doi.org/10.1080/02678292.2023.2180099). [COBISS.SI-ID [147790083](#)]

3. 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](https://doi.org/10.1103/PhysRevLett.130.216802). [COBISS.SI-ID [153660675](#)]

4. POCIECHA, Damian, VAUPOTIČ, Nataša, MAJEWSKA, Magdalena, CRUICKSHANK, Ewan, WALKER, Rebecca, STOREY, John M. D., IMRIE, Corrie T., WANG, Cheng, GÓRECKA, Ewa. Photonic bandgap in achiral liquid crystals - a twist on a twist. *Advanced materials*. [Online ed.]. 2021, vol. 33, no. 39, str. 2103288-1-2103288-7. ISSN 1521-4095. DOI: [10.1002/adma.202103288](https://doi.org/10.1002/adma.202103288). [COBISS.SI-ID [80061955](#)]