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	**Izobraževalna fizika**	**1**	**1**
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
45		**30**	**15**		**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:	**Prerequisits:**
Pogojev ni. Priporočeno je predznanje maturitetnega programa matematike in fizike.	None. Knowledge on the level of the secondary school program of Physics and Mathematics is recommended for a successful work.

Vsebina:

Content (Syllabus outline):

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. Ravnovesje 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.	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 noneleastic 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. R. Kladnik, Visokošolska fizika. 3. del, Akustika in optika : valovni pojavi (DZS, Ljubljana, 1989).
5. Z. Bradač, Naloge iz fizike (Pedagoška fakulteta Maribor, 1991).
6. M. Gros, M. Hribar, A. Kodre, J. Strnad, Naloge iz fizike (DMFA, Ljubljana, 1991).
7. B. Majaron, M. Mikuž, A. Ramšak, Kolokvijske naloge iz fizike 1 (DMFA, Ljubljana, 1998).
8. J. Žitnik, Univerzitetne fizikalne naloge (TZS, Ljubljana, 2002-2003).

Cilji in kompetence:	**Objectives and competences:**
Študenti usvojijo temeljna teoretična znanja s področja mehanike in jih znajo uporabiti pri reševanju ustreznih problemov z rabo matematičnih orodij in za razumevanje meritev osnovnih fizikalnih količin.	Students acquire basic theoretical knowledge from mechanics and are able to use it for solving problems with the use of mathematical tools and to understand measurements of basic physical quantities.

Predvideni študijski rezultati:	Intended learning outcomes:
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.	**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.
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 spremenljivkami v odvisnosti od vrednosti parametrov; - pripravljati miselne vzorce in skice ter smiselno poročati (vzrok/posledica) o izbrani temi;	**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; - 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.

- uporabiti osnovno znanje linearne algebre in analize za obravnavo fizikalnih problemov.	

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 elementi obrnjenega poučevanja 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 elements of flipped learning Teaching and learning are done through the didactic use of ICT.

Načini ocenjevanja:	Delež (v %) / Weight (in %)	**Assessment:**
Način (pisni izpit, ustno izpraševanje, naloge, projekt):		Type (examination, oral, coursework, project):
pisni izpit (lahko se nadomesti z dvema pisnima kolokvijema)	**40**	written exam (can be replaced by two written tests)
ustni izpit (lahko se nadomesti z dvema ustnima kolokvijema)	**40**	oral exam (can be replaced by two oral tests)
opravljene laboratorijske vaje, urejen in zagovorjen dnevnih vaj	**20**	done experiments and the lab diary and oral avocation of experiments
Za uspešno zaključeno učno enoto mora vsak del posebej biti pozitiven.		For a successfully finished course, both oral and written exams have to be positive.

Reference nosilca / Lecturer's references:

1. SALAMONCZYK, Miroslaw, VAUPOTIČ, Nataša, POCIECHA, Damian, WALKER, Rebecca, STOREY, John M. D., IMRIE, Corrie T., WANG, Cheng, ZHU, Chenhui, GÓRECKA, Ewa. Multi-level chirality in

liquid crystals formed by achiral molecules. *Nature communications*, ISSN 2041-1723, 2019, vol. 8, str. 1922-1-1922-8, doi: 10.1038/s41467-019-09862-y. [COBISS.SI-ID 32322855.

2. VAUPOTIČ, Nataša, ALI, Muhammad, MAJEWSKI, P., GÓRECKA, Ewa, POCIECHA, Damian. Polarization gratings spontaneously formed from a helical twist-bend nematic phase. *ChemPhysChem : a European journal of chemical physics and physical chemistry*, ISSN 1439-4235. [Print ed.], [in press] 2018, 15 str., doi: 10.1002/cphc.201800360. [COBISS.SI-ID 31667751].

3. POCIECHA, Damian, CRAWFORD, Catriona A., PATERSON, Daniel A., STOREY, John M. D., IMRIE, Corrie T., VAUPOTIČ, Nataša, GÓRECKA, Ewa. Critical behavior of the optical birefringence at the nematic to twist-bend nematic phase transition. *Physical review. E*, ISSN 2470-0045, 2018, vol. 98, no. 5, str. 052706-1-052706-5, doi: 10.1103/PhysRevE.98.052706. [COBISS.SI-ID 31948071].

4. SALAMONCZYK, Miroslaw, VAUPOTIČ, Nataša, POCIECHA, Damian, WANG, Cheng, ZHU, Chenhui, GÓRECKA, Ewa. Structure of nanoscale-pitch helical phases : blue phase and twist-bend nematic phase resolved by resonant soft X-ray scattering. *Soft matter*, ISSN 1744-683X, 2017, vol. 13, no. 38, str. 6694-6699, doi: 10.1039/c7sm00967d. [COBISS.SI-ID 30804519].

5**.** GÓRECKA, Ewa, VAUPOTIČ, Nataša, ZEP, Anna, POCIECHA, Damian. From sponges to nanotubes : a change of nanocrystal morphology for acute-angle bent-core molecules. *Angewandte Chemie*, ISSN 1521-3773. [Online ed.], 2016, vol. 55, no. 40, str. 12238-12242, doi: 10.1002/anie.201604915. [COBISS.SI-ID 29763367].

6. VAUPOTIČ, Nataša, CURK, Samo, OSIPOV, Mikhail, ČEPIČ, Mojca, TAKEZOE, Hideo, GÓRECKA, Ewa. Short-range smectic fluctuations and the flexoelectric model of modulated nematic liquid crystal. *Physical review. E, Statistical, nonlinear, and soft matter physics*, ISSN 1539-3755, 2016, vol. 93, no. 2, str. 022704-1-022704-5, doi: 10.1103/PhysRevE.93.022704. [COBISS.SI-ID 29301799].