Univerza v Mariboru

Fakulteta za naravoslovje in matematiko

UČNI NAČRT PREDMETA / COURSE SYLLABUS	
Predmet:	**Analitična mehanika**
Course title:	**Analytical Mechanics**

Študijski program in stopnja Study programme and level	Študijska smer Study field	Letnik Academic year	Semester Semester
Fizika, 1. stopnja		**3**	**6**
Physics, 1st cycle		**3**	**6**

Vrsta predmeta / Course type Izbirni / elective

Univerzitetna koda predmeta / University course code:

Predavanja Lectures	Seminar Seminar	Vaje Tutorial	Klinične vaje work	Druge oblike študija	Samost. delo Individ. work	ECTS
45		**15**			**120**	**6**

Nosilec predmeta / Lecturer: Milan Ambrožič

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

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:	**Prerequisits:**
Pogojev ni. Priporočljiva znanja so: znanje iz Mehanike in Matematične fizike.	None. Recommended knowledge: knowledge in Mechanics and Mathematical physics.

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

Pregled osnovnih zakonov mehanike. Lagrangejeve enačbe. Centralne sile in problem dveh teles. Kinematika togega telesa. Nihanje. Problemi iz strojništva. Hamiltonove enačbe. Zanimivi eksotični problemi.	Survey of the basic principles in mechanics. Lagrange equations. Central forces and 2-body problem. Rigid body kinematics. Vibrations. Problems from mechanical engineering. Hamilton equations. Interesting exotic problems.

Temeljni literatura in viri / Readings:

- L. D. Landau, E. M. Lifshitz, Mechanics, Vol. 1 of Course in Theoretical Physics (Pergamon Press, Oxford, 1976).
- H. Goldstein, C. Poole, J. Safko, Classical Mechanics, (Addison Wesley, Reading, 2002).
- G. M. Calkin, Lagrangian and Hamiltonian Mechanics (World Scientific, Singapore, 1998).

Cilji in kompetence:	**Objectives and competences:**
Študenti pridobijo bolj poglobljeno znanje s področja klasične in analitične mehanike.	Students acquire deeper knowledge from classical and analytical mechanics.

Predvideni študijski rezultati:	**Intended learning outcomes:**
Znanje in razumevanje: Študent zna pretvori problem iz mehanike v kompleksnejši geometriji v formalizem z Lagrangianom ali Hamiltonianom in ga tudi uspešno rešiti: analitično ali numerično. Študent je uspešen pri generaliziranju osnovnih pojmov, kot sta koordinata in gibalna količina. Študent poglobi prostorsko predstavo o rotaciji teles v prostoru, po analogiji pa prenese pojem rotacije tudi v prostor višje dimenzije; podobno velja za nihanje. Pri temi gravitacije zna v splošnem rešiti problem dveh teles in razume pogoje za njuno vezanost ali nevezanost. Pri težavnejših nalogah si zna pomagati z numeričnimi simulacijami. Študent bolj sistematično poveže med seboj osnovne fizikalne količine, opredeljene pri mehaniki. Študent razume povezave med več različnimi vejami fizike.	**Knowledge and understanding:** The student is able to transform the problem in the mechanics with more complex geometry into the formalism using Lagrangian or Hamiltonian, and is also able to solve it either in analytical or numerical way. The student is succesful in generalization of basic concepts, such as coordinate and linear momentum. The student gets a deeper insight about the rotation of bodies in space, and also uses the analogy to translate the concept of rotation to the space of higher dimenisonality; similarly holds for oscillation. In regard to the topi cof gravitation, the student is able to solve in general the problem of two bodies in understands the conditions when the bodies are either bound or unbound. The student is more systematic in relating the basic physics quantities, defined within mechanics. The student understands relations between some different areas of physics.

Prenesljive/ključne spretnosti in drugi atributi:	**Transferable/Key Skills and other attributes:**
Rešitev problemov z matematičnimi orodji in celosten pristop k reševanju problemov. Študent pridobi več spretnosti pri reševanju sistemov navadnih diferencialnih enačb. Študent spretno uporablja tehnologijo IKT za numerično reševanje problemov, prikaz grafov, urejevanje besedil z veliko enačbami, predstavitev rezultatov (PowerPoint itd.) in iskanje podatkov ali morebitnih (delnih) rešitev problemov na spletnih straneh. Študent se dodatno izuri v sklepanju od preprostih problemov k bolj zapletenim in nasprotno, dedukcije od splošnejših h konkretnem problemom. Študent dobro povezuje matematično podobne modele v različnih vejah fizike in potencialno tudi drugih naravoslovnih vedah. Pri pripravi samostojnih nalog se študent usposablja tudi v drugih generičnih in ključnih kompetencah, npr. sposobnosti iskanja informacij, analize, sinteze sklepov itd.	Solving of problems with mathematical tools and gained global approach on solving a problem. The student gains more skills in solving the systems of ordinary differential equations. The student is skilled in using ICT technology for numerical solution of problems, representation of graphs, working with text with many equations, presentation of results (PowerPoint etc.) and searching data or (partial) solutions on web pages. The student gains additional skills in the argumentation from the simple problems to more complicated ones, and vice versa, deduction from the more general to specific problems. The student is good in relating mathematically similar models in different areas of physics and potentially other natural sciences. During preparation of individual work the students gains abilities also in regard to other generic and key competences, e.g., the ability of searching information, analysis, synthesis of conclusions etc.

Metode poučevanja in učenja:	**Learning and teaching methods:**
Predavanja Teoretične računske vaje Domače računske vaje Posamični razgovori (npr. kontaktne ure za pripravo samostojne naloge) Prikaz računalniških simulacij	Lectures Theoretical excercises Home theoretical excercises Individual discussions (e.g., contact hours for preparation of individual work) Demonstration of computer simulations

Načini ocenjevanja:	Delež (v %) / Weight (in %)	**Assessment:**
Način (pisni izpit, ustno izpraševanje, naloge, projekt): • 2 pisna kolokvija ali pisni izpit • ustni izpit • daljša samostojna naloga Za uspešno zaključeno učno enoto mora biti vsak del posebej pozitiven. Opravljena daljša samostojna naloga je pogoj za pristop k izpitu.	 **25** **25** **50**	Type (examination, oral, coursework, project): • 2 written tests or exam • oral exam • longer individual work For a successfully completed course, each part of the assessment has to be positive. Successfully completed longer

		individual work is required for admission to the exam.

Reference nosilca / Lecturer's references:

DOBOVIŠEK, Andrej, AMBROŽIČ, Milan, KUTNJAK, Zdravko, KRALJ, Samo. Liquid crystal based active electrocaloric regenerator. *Heliyon*. Mar. 2023, vol 9, iss. 3, [article no.] e14035, str. 1-12, ilustr. ISSN 2405-8440. https://www.sciencedirect.com/science/article/pii/S2405844023012422?via%3Dihub, DOI: 10.1016/j.heliyon.2023.e14035. [COBISS.SI-ID 143422211]

AMBROŽIČ, Milan, PAL, Kaushik, KRALJ, Samo, HÖLBL, Arbresha. Nanoparticle controlled nematic macroscopic properties. *Journal of molecular structure*. [Print ed.]. Apr. 2021, vol. 1230, str. 1-7. ISSN 0022-2860. DOI: 10.1016/j.molstruc.2021.129878. [COBISS.SI-ID 47621891]

AMBROŽIČ, Milan, NIKONOV, Anatolij. Dynamic biaxial stress analysis of flat layered ceramic composites = Analiza dvoosnih dinamičnih napetosti v ravnih plastovitih keramičnih kompozitih. *Materiali in tehnologije*. [Tiskana izd.]. mar.-apr. 2021, letn. 55, št. 2, str. 195-200, ilustr. ISSN 1580-2949. https://mater-tehnol.si/index.php/MatTech/article/view/118/34, DOI: 10.17222/mit.2020.055. [COBISS.SI-ID 60426755]

AMBROŽIČ, Milan, GUDIMALLA, Apparao, ROSENBLATT, Charles, KRALJ, Samo. Multiple twisted chiral nematic structures in cylindrical confinement. *Crystals*. Jul. 2020, vol. 10, no. 7, str. 1-15. ISSN 2073-4352. DOI: 10.3390/cryst10070576. [COBISS.SI-ID 29663747]

KLEMENČIČ, Eva, KURIOZ, Pavlo, AMBROŽIČ, Milan, ROSENBLATT, Charles, KRALJ, Samo. Annihilation of highly-charged topological defects. *Crystals*. Aug. 2020, vol. 10, no. 8, str. 1-13, ilustr. ISSN 2073-4352. DOI: 10.3390/cryst10080673. [COBISS.SI-ID 27325443]