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 Svetec

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

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:	**Prerequisites:**
Priporočljivo je predznanje iz mehanike in matematične fizike. Vsaka izmed naštetih obveznosti v načinih ocenjevanja mora biti opravljena s pozitivno oceno. Opravljena seminarska naloga je pogoj za pristop k pisnemu in ustnemu izpitu.	Recommended is preknowledge from mechanics and mathematical physics. Each of the listed obligations in the assessment methods must be completed with a positive grade. Completed seminar paper is a prerequisite for taking the written and oral exams.

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

Pregled osnovnih zakonov mehanike. Lagrangejeve enačbe. Centralne sile in problem dveh teles. Kinematika togega telesa. Pospešeni koordinatni sistemi Hamiltonove enačbe. Posebna teorija relativnosti	Survey of the basic principles in mechanics. Lagrange equations. Central forces and 2-body problem. Rigid body kinematics. Accelerated frames of reference Hamilton equations. Special theory of relativity

Temeljni literatura in viri / Readings:

- M. Ambrožič in A. Hölbl, Analitična mehanika (Univerzitetna založba Univerze v Mariboru, Maribor, 2023).
- L. D. Landau, E. M. Lifshitz, Mechanics (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:**
• pisni izpit	**25**	written exam
• ustni izpit	**25**	• oral exam
seminarska naloga	**50**	• seminar paper

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

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

Reference nosilca / Lecturer's references:

SVETEC, Milan, HARKAI, Saša, PAL, Kaushik, KRALJ, Samo. Twist disclinations mediated transformations in confined nematic liquid crystals. *Journal of molecular liquids*. [Online ed.]. 15 Nov. 2024, part b, [article no.] 126138, 10 str., ilustr. ISSN 1873-3166. https://www.sciencedirect.com/science/article/pii/S0167732224021974?via%3Dihub, DOI: 10.1016/j.molliq.2024.126138. [COBISS.SI-ID 214061315]

JELEN, Žiga, SVETEC, Milan, MAJERIČ, Peter, KAPUN, Stanko, RESMAN, Lara, ČEH, Tatjana, HAJRA, Granit, RUDOLF, Rebeka. Contaminants in the soil and typical crops of the Pannonian region of Slovenia. *Sustainability*. Oct. 2024, vol. 16, iss. 19, [article no.] 8678, 15 str., ilustr. ISSN 2071-1050. https://dk.um.si/IzpisGradiva.php?id=91211, https://www.mdpi.com/2071-1050/16/19/8678, dCOBISS, DOI: 10.3390/su16198678. [COBISS.SI-ID 214094851]

SHAHRIARI, Zahra, NAZARIMEHR, Fahimeh, RAJAGOPAL, Karthikeyan, JAFARI, Sajad, PERC, Matjaž, SVETEC, Milan. Cryptocurrency price analysis with ordinal partition networks. *Applied mathematics and computation*. [Print ed.]. Oct. 2022, vol. 430, str. 1-14. ISSN 0096-3003. DOI: 10.1016/j.amc.2022.127237. [COBISS.SI-ID 110070019]

KLINSHOV, Vladimir, KOVALCHUK, Andrey V., FRANOVIĆ, Igor, PERC, Matjaž, SVETEC, Milan. Rate chaos and memory lifetime in spiking neural networks. *Chaos, solitons and fractals*. [Print ed.]. May 2022, vol. 158, str. 1-7. DOI: 10.1016/j.chaos.2022.112011. [COBISS.SI-ID 102476291]