Univerza v Mariboru

Fakulteta za naravoslovje in matematiko

UČNI NAČRT PREDMETA / COURSE SYLLABUS	
Predmet:	**Fizika tekočin**
Course title:	**Fluid Physics**

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

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 izpitu.	Recommended is pre-knowledge 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 exam.

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

Osnove mehanike kontinuov. Hidrostatika: osnovne enačbe. Plimovanje. Hidrodinamika: osnovne enačbe. Idealne tekočine: Eulerjeva enačba. Vrtinčnost. Bernoullijeve enačbe. Nestisljive tekočine. Dvodimenzionalni idealni tok. Teorija kril. Kapilarni efekt. Turbulenca. Tekoči kristali. Superfluidi.	Fundamentals of continuum mechanics. Hydrostatics: basic equations. Tide oscillations. Hydrodynamics: basic equations. Ideal liquids: Euler equations. Vorticity Bernoulli equations. Incompressible liquids. Two-dimensional ideal stream. Theory of wings. Capillary action. Turbulence. Liquid crystals. Superfluids.

Temeljni literatura in viri / Readings:

L. D. Landau, E. M. Lifshitz, Fluid Mechanics (Pergamon Press, Oxford, 1989).

Dodatna literatura / Additional readings:
1. M. Hriberšek, Mehanika tekočin: primeri z rešitvami (Fakulteta za strojništvo UM, Maribor, 2001).
2. M. Hriberšek: Uvod v računalniško dinamiko tekočin (Univerzitetna založba Univerze, Maribor, 2017).

Cilji in kompetence:	**Objectives and competences:**
Študenti usvojijo bolj poglobljeno znanje s področja fizike tekočin.	Students acquire deeper knowledge on fluid physics.

Predvideni študijski rezultati:	**Intended learning outcomes:**
Znanje in razumevanje: Študent zna uporabiti Navier-Stokesovo enačbo za reševanje problemov o pretakanju tekočin v različnih geometrijah. Študent uspešno rešuje matematično dovolj preproste probleme iz hidrostatike in hidrodinamike. Študent kvalitativno razume težja poglavja iz fizike tekočin, kot so turbulenca, teorija kril in tekoči kristali. Študent zna kvalitativno oceniti približke pri gibanju tekočin za poenostavljeno obravnavo. Študent zna uporabiti obravnavane modele za različne praktične probleme in aplikacije.	**Knowledge and understanding:** The student is able to use Navier-Stokes equation for solving problems in the area of the flow of fluids in various geometries. The student is successful in solving mathematically simple enough problems in hydrostatics and hydrodynamics. The student understands qualitatively more complex topics in the physics of fluids, such as turbulence, the theory of wings and liquid crystals. The student is able to make qualitative estimation of approximations in regard to the flow of fluids for simplified teratment.

Študent dobi z analogijo med enačbami iz elastomehanike in hidrodinamike širši vpogled na fizikalne sisteme in probleme.	The student is able to use the treated models for different practical problems and applications. Using the analogy between the equations in the areas of elasto-mechanics and hydrodynamics, the student acquires a deeper insight into physical systems and problems.
Prenesljive/ključne spretnosti in drugi atributi: Razumevanje procesov v tehnologiji povezanih s fiziko tekočin. Študent utrdi znanje in spretnost uporabe vektorskih diferencialnih operatorjev na skalarnih in vektorskih poljih. Študent pridobi več spretnosti pri reševanju parcialnih diferencialnih enačb v različnih ortogonalnih koordinatnih sistemih. 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.	**Transferable/Key Skills and other attributes:** Understanding of technological processes related to fluids. The student solidifies knowledge and skills for using vector differential operators on scalar and vector fields. The student gains more skills in solving partial differential equations in different orthogonal coordinate systems. 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 existing (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:**
Metodika obsega: Teoretičen uvod v problematiko in analitično ali numerično reševanje posameznih problemov; Predavanja; Vaje; Domače teoretične in računske vaje;	They are based on: Theoretical introduction and analytic or numerical solving of specific problems; Lectures; Tutorial; Home theoretical and calculation excercises; Individual discussions (e.g., contact hours for preparation of individual work);

Posamični razgovori (npr. kontaktne ure za pripravo samostojne naloge); Prikaz računalniških simulacij.	Demonstration of computer simulations.

Načini ocenjevanja:	Delež (v %) / Weight (in %)	**Assessment:**
pisni izpit	**25**	written exam
ustni izpit	**50**	oral exam
seminarska naloga	**25**	seminar paper

Opombe:
Ustni izpit se lahko nadomesti s štirimi pisnimi kolokviji.

Comments:
Oral exam can be replaced by four written midterm examinations.

Reference nosilca / Lecturer's references:

1. HAUKO, Robert, PADEŽNIK GOMILŠEK, Jana, KODRE, Alojz, ARČON, Iztok, LUIN, Uroš. Iodine K- and L-edge X-ray absorption spectra of HI : the effect of molecular orbitals and core subshells. *Radiation physics and chemistry*. [Print ed.]. 2025, vol. 229, [article no.] 112509, str. 1-8, ilustr. ISSN 0969-806X. DOI: 10.1016/j.radphyschem.2025.112509. [COBISS.SI-ID 221442051]

HAUKO, Robert, DAJNKO, Matic, GAČEVIĆ, Dino, MARINKO, Peter, POTRČ, Melani, REPNIK, Robert. From speed of sound to vapour pressure : an undergraduate school experiment as an example of systematic error research. European journal of physics. 2022, vol. 43, no. 4, str. 1-14. ISSN 0143-0807. DOI: 10.1088/1361-6404/ac6cb9. [COBISS.SI-ID 117802755]

HAUKO, Robert, PADEŽNIK GOMILŠEK, Jana, KODRE, Alojz, ARČON, Iztok. X-ray absorption spectroscopy set-up for unstable gases : a study of 5p hydrides. Radiation physics and chemistry. 2020, vol. 171, str. 1-4, ISSN 0969-806X. DOI: 10.1016/j.radphyschem.2020.108743. [COBISS.SI-ID 5564411]

HAUKO, Robert, PADEŽNIK GOMILŠEK, Jana, KODRE, Alojz, ARČON, Iztok, AQUILANTI, Giuliana. Effects of the molecular potential on coexcitations of valence electrons in the K-shell photoeffect of 3p and 4p elements. Physical review. A. 2019, vol. 99, no. 6, str. 062501-1-062501-10. ISSN 2469-9926. DOI: 10.1103/PhysRevA.99.062501. [COBISS.SI-ID 22395158]