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		3	6
Physics		3	6

Vrsta predmeta / Course type	Izbirni
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):
Osnove mehanike kontinuov. Hidrostatika: osnovne enačbe. Plimovanje. Hidrodinamika: osnovne enačbe. Idealne tekočine: Eulerjeva enačba. Vrtinčnost. Bernoullijeve enačbe. Nestisljive tekočine. Dvodimenzionalni idealni tok.	Basics of continuum mechanics. Hydrostatics: basic equations. Tide oscillations. Hydrodynamics: basic equations. Ideal liquids: Euler equations. Vorticity Bernoulli equations. Uncompressible liquids. Two-dimensional ideal stream.

Teorija kril. Kapilarni efekt. Turbulenca. Tekoči kristali. Superfluidi.	Theory of wings. Capilar effect. Turbulence. Liquid crystals. Superfluids.

Temeljni literatura in viri / Readings:

1. L. D. Landau, E. M. Lifshitz, Fluid Mechanics (Pergamon Press, Oxford, 1989).
2. I. G. Currie, Fundamental mechanics of fluids (McGraw Hill, New York, 1993).
3. D. J. Acheson, Elementary fluid dynamics (Oxford university press, Oxford, 1990).

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. Študent dobi z analogijo med enačbami iz elastomehanike in hidrodinamike širši vpogled na fizikalne sisteme in probleme.	**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. 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.	**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.

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.	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; Domače računske vaje; Posamični razgovori (npr. kontaktne ure za pripravo samostojne naloge); Prikaz računalniških simulacij.	They are based on: Theoretical introduction and analytic or numerical solving of specific problems; Lectures; 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):		Type (examination, oral, coursework, project):
2 pisna kolokvija ali pisni izpit	**25**	2 written tests or written exam
ustni izpit	**25**	oral exam
daljša samostojna naloga	**50**	longer individual work
Za uspešno zaključeno učno enoto mora biti vsak del posebej pozitiven. Opravljena daljša samostojna naloga je pogoj za pristop k izpitu.		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:

AMBROŽIČ, Milan, KOSMAČ, Tomaž. Optimization of the bend strength of flat-layered alumina-zirconia composites. *J. Am. Ceram. Soc.*, vol. 90, 2007, str. 1545-1550. [COBISS.SI-ID 20741415]

AMBROŽIČ, Milan, KRALJ, Samo, VIRGA, Epifanio G. Defect-enhanced nematic surface order reconstruction. *Phys. rev., E Stat. nonlinear soft matter phys. (Print)*, 2007, vol. 75, no. 3, str. 031708-1-031708-9. [COBISS.SI-ID 20736807]

CVETKO, Matej, AMBROŽIČ, Milan, KRALJ, Samo. Competition between local disordering and global ordering fields in nematic liquid crystals. *Beilstein journal of organic chemistry*, 2010, vol. 6, no. 2, str. 1-14. http://dx.doi.org/10.3762/bjoc.6.2, doi: 10.3762/bjoc.6.2. [COBISS.SI-ID 17410312]

ZIDANŠEK, Aleksander, AMBROŽIČ, Milan, MILFELNER, Maja, BLINC, Robert, LIOR, Noam. Solar orbital power : sustainability analysis. *Energy (Oxford)*. [Print ed.], 2011, vol. 36, no. 4, str. 1986-1995. [COBISS.SI-ID 24602919]
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GORJAN, Lovro, AMBROŽIČ, Milan. Bend strength of alumina ceramics : a comparison of Weibull statistics with other statistics based on very large experimental data set. *J. Eur. Ceram. Soc.*. [Print ed.], 2012, vol. 32, no. 6, str. 1221-1227, doi: 10.1016/j.jeurceramsoc.2011.12.010. [COBISS.SI-ID 25578279