



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

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:

Jeziki / Languages:	Predavanja / Lectures:	<input type="text" value="slovenski/Slovene"/>
	Vaje / Tutorial:	<input type="text" value="slovenski/Slovene"/>

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:

Pogojev ni. Priporočljiva znanja so: znanje iz Mehanike in Matematične fizike.

Prerequisites:

None. Recommended knowledge: knowledge in Mechanics and Mathematical physics.

Vsebina:

Osnove mehanike kontinuov.
Hidrostatika: osnovne enačbe.
Plimovanje.
Hidrodinamika: osnovne enačbe.
Idealne tekočine: Eulerjeva enačba.
Vrtinčnost.
Bernoullijeve enačbe.
Nestisljive tekočine.
Dvodimenzionalni idealni tok.

Content (Syllabus outline):

Basics of continuum mechanics.
Hydrostatics: basic equations.
Tide oscillations.
Hydrodynamics: basic equations.
Ideal liquids: Euler equations.
Vorticity
Bernoulli equations.
Incompressible 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. M. Hriberšek, Mehanika tekočin: primeri z rešitvami (Fakulteta za strojništvo UM, Maribor, 2001).
3. M. Hriberšek: Uvod v računalniško dinamiko tekočin (Univerzitetna založba Univerze, Maribor, 2017).

Cilji in kompetence:

Študenti usvojijo bolj poglobljeno znanje s področja fizike tekočin.

Objectives and competences:

Students acquire deeper knowledge on fluid physics.

Predvideni študijski rezultati:

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 hidrostatične 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.

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.

Intended learning outcomes:

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 treatment.
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.

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:

Metodika obsega:
 Teoretičen uvod v problematiko in analitično ali numerično reševanje posameznih problemov;
 Predavanja;
 Vaje;
 Domače teoretične in računske vaje;
 Posamični razgovori (npr. kontaktne ure za pripravo samostojne naloge);
 Prikaz računalniških simulacij.

Learning and teaching methods:

They are based on:
 Theoretical introduction and analytic or numerical solving of specific problems;
 Lectures;
 Tutorial;
 Home theoretical and calculation exercises;
 Individual discussions (e.g., contact hours for preparation of individual work);
 Demonstration of computer simulations.

Delež (v %) /

Weight (in %)

Načini ocenjevanja:

Assessment:

<p>Način (pisni izpit, ustno izpraševanje, naloge, projekt): pisni računski izpit 4 teoretični kolokviji ali ustni izpit samostojna naloga</p> <p>Za uspešno zaključeno učno enoto mora biti vsak del posebej pozitiven. Opravljena samostojna naloga je pogoj za pristop k izpitu.</p>	<p>25 5025</p>	<p>Type (examination, oral, coursework, project): written calculus exam 4 written theoretical tests or oral exam individual work</p> <p>For a successfully completed course, each part of the assessment has to be positive. Successfully completed</p>
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		individual work is required for admission to the exam.
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Reference nosilca / Lecturer's references:

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]

HAUKO, Robert, REPNIK, Robert. Damped harmonic oscillation: Linear or quadratic drag force?. American journal of physics : a publication of American association of physics teachers. [Print ed.]. Nov. 2019, vol. 87, no. 11, str. 910-914, ilustr. ISSN 0002-9505. DOI: 10.1119/1.5124978. [COBISS.SI-ID 22717974]

HAUKO, Robert, ANDREEVSKI, Damjan, PAUL, Domen, ŠTERK, Marko, REPNIK, Robert. Teaching of the harmonic oscillator damped by a constant force: The use of analogy and experiments. American journal of physics : a publication of American association of physics teachers. [Print ed.]. Sep. 2018, vol. 86, no. 9, str. 657-662, ilustr. ISSN 0002-9505. <https://aapt.scitation.org/doi/pdf/10.1119/1.5044654>, DOI: 10.1119/1.5044654. [COBISS.SI-ID 21676822]