UČNI NAČRT PREDMETA / COURSE SYLLABUS	
Predmet:	**Matematične metode v fiziki**
Course title:	**Mathematical methods in physics**

Študijski program in stopnja Study programme and level	Študijska smer Study field	Letnik Academic year	Semester Semester
Enovit magistrski študijski program druge stopnje Predmetni učitelj	**/**	**3**	**6**
Five-year master's degree program Subject Teacher	**/**		

Vrsta predmeta / Course type Izbirni / Elective

Univerzitetna koda predmeta / University course code:

Predavanja Lectures	Seminar Seminar	Vaje Tutorial	Lab. vaje Laboratory work	Terenske vaje Field work	Samost. delo Individ. work	ECTS
45		**30**			**135**	**7**

Nosilec predmeta / Lecturer: Mitja Slavinec

Jeziki / Languages:		
	Predavanja / Lectures:	slovensko / Slovenian
	Vaje / Tutorial:	slovensko / Slovenian

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:	**Prerequisits:**
Pogojev ni. Priporočljivo predznanje na področjih matematične analize, algebre, mehanike, elektromagnetizma.	None. Recommended preknowledge in the field of mathematical analysis, algebra, mechanics, electromagnetism.

Vsebina:	**Content (Syllabus outline):**
1.) Funkcije ene in več spremenljivk. Posebne funkcije (trigonometrična, eksponentna, logaritemska, hiperbolična), polinomi, grafi funkcij, funkcije kompleksne spremenljivke 2.) Odvod in integral. Hitrost, pospešek, moč, iskanje ekstremov, integriranje in določeni integral (delo, pot, energija), parcialni odvodi, klasifikacija	1.) Functions of one and multiple variables. Special functions (trigonometric, exponential, Logarithmical, hyperbolic), polynomial, function's diagrams, function properties, functions of complex variable. 2.) Derivative and integration. Velocity, acceleration, power), extreme finding, integration (work, length, energy), partial derivative (use in thermodynamics),

ekstremov funkcij dveh spremenljivk, dvojni in trojni integral (masa, težišče, vztrajnostni moment), računanje z diferenciali, Taylorjeva vrsta. 3.) Fouriereva analiza. Opis sinusnih nihanj, Fouriereve vrste, Fouriereva transformacija. 4.) Matrike in tenzorji Vektorska in tenzorska algebra, determinanta, inverzne matrike, kompleksne in hermitsko konjugirane matrike, lastni vektorji in lastne vrednosti, linearne transformacije in operatorji, sistemi linearnih enačb, fizikalna uporaba tenzorjev (vztrajnostni moment, dielektrična konstanta, toplotna prevodnost), Jonesove matrike. 5.) Navadne diferencialne enačbe. Enačbe prvega reda, primeri enačb prvega reda, mehanska nihanja (harmonsko nihanje, dušeno nihanje, vsiljeno nihanje, sklopljeno nihanje, majhna nihanja, aharmonska nihanja).	classification of two variable extremes, double triple integration (mass, center of gravity, moment of inertia), Taylor series. 3.) Fourier analysis. Description of sinusoidal oscillations, Fourier series, Fourier transformation. 4.) Matrices and tensors Vectorial and tensorial algebra, determinants, reciprocal matrices, complex and Hermitian conjugated matrices, eigenvectors, eigenvalues, Linear transformations and operators, linear systems of equations, use of tensors in physics (moment of inertia, dielectric constants, heat conductivity), Jones matrices. 5.) Ordinary differential equations First order ordinary differential equations, examples of ordinary differential equations, used in physics, mechanic oscillations (harmonic oscillations, damped oscillations, forced oscillations, coupled oscillations, small oscillations, nonharmonic oscillations).

Temeljni literatura in viri / Readings:

- Kuščer, A. Kodre: Matematika v fiziki in tehniki; DMFA; Ljubljana 1994.
- S. Pahor: Uvod v analitično mehaniko. DMFA, Ljubljana 1989.
- Vidav: Variacijski račun. DMFA, Ljubljana 1991.
- K.F. Riley, M.P. Hobson, S.J. Bence: Mathematical Methods for Physics and Engineering; Cambridge University Press; Cambridge 2000.
- Brešar: Matematika III; Fakulteta za elektrotehniko, računalništvo in informatiko Maribor, Maribor 1995.
- C. Harper: Introduction to Mathematical Physics. Englewood Cliffs, New Jersey: Prentice-Hall Inc., 1976.
- Arfken: Mathematical Methods for Physicists. New York, S. Francisco, London: Academic Press, 1970.
- B. M. Budak, A. A. Samarskii, A. N. Tikhonov: A collection of problems on Mathematical Physics. New York: Pergamon Press, 1980.
- V. Bitsadze, D. F. Kalinichenko: A Collection of problems on the Equations of Mathemammtical Physics. Moscow: Mir Publishers, 1980.
- Slavinec M., Ambrožič M., Repnik R., Matematična fizika 1, UM, 2016.

Cilji in kompetence:	**Objectives and competences:**

Cilj predmeta je kompleksno razumevanje fizikalnih zakonitosti in pridobitev sposobnosti za kvantitativni opis fizikalnih zakonitosti in napovedati ter izračunati rezultate.	The goal of this subject is complex understanding of physical laws and ability to qualitatively describe them, predict and calculate results.

Predvideni študijski rezultati:	**Intended learning outcomes:**
Znanje in razumevanje: Po uspešno zaključeni učni enoti je študent zmožen: • Uporabiti ustrezna matematična orodja in principe za reševanje fizikalnih problemov, • Tvoriti ustrezne matematične modele za fizikalne probleme, • formulirati ustrezne robne pogoje, • vrednotiti in interpretirati dobljene rezultate. **Prenesljive/ključne spretnosti in drugi atributi:** Reševanje fizikalnih in tehničnih problemov z matematičnimi orodji in postopki.	**Knowledge and understanding:** On completion of this course student will be able to: • use demanding mathematical tools to solve physical problems, • form appropriate mathematical models for physical problems, • formulate boundary conditions, • evaluate and interpret obtained solutions. **Transferable/Key Skills and other attributes:** Solution of physical and technical problems using the mathematical tools and methods.

Metode poučevanja in učenja:	**Learning and teaching methods:**
Predavanja (razlaga, razgovor, demonstracija) in eksperimentalna predavanja Problemski pouk (postavitev problema, izbira potrebnih matematičnih orodij za reševanje, postavitev matematičnega modela, analitično in numerično reševanje, interpretacija dobljenih rešitev) Seminarske vaje (metoda dela s tekstom, metoda pisnih in grafičnih del, uporaba programskih orodij) Poučevanje in učenje potekata z didaktično uporabo informacijsko-komunikacijske tehnologije.	Lectures (explanation, discussion, demonstration) and experimental lectures Problem based learning (setting up physical problem, selection of appropriate mathematical tools, setting up a mathematical model, finding of an analytical or numerical solution, interpretation of obtained solutions) Seminar work (work with text, work with graphic elements, use of computer tools) Teaching and learning are done through the didactic use of ICT.

Načini ocenjevanja:	Delež (v %) / Weight (in %)	**Assessment:**
Način (pisni izpit, ustno izpraševanje, naloge, projekt):		Type (examination, oral, coursework, project):
Pisni izpit (lahko se nadomesti z dvema pisnima kolokvijema)	**50**	Written exam (can be replaced by two written tests)
Ustni izpit	**50**	Oral exam

Vsaka izmed naštetih obveznosti mora biti opravljena s pozitivno oceno. Pozitivna ocena iz pisnega izpita je pogoj za pristop k ustnemu izpitu.		Each of the mentioned commitments must be assessed with a passing grade. Positive grade of written exam is a prerequisite for access to the oral exam.

Reference nosilca / Lecturer's references:

WEI, Zhouchao, ZHU, Bin, YANG, Jing, PERC, Matjaž, SLAVINEC, Mitja. Bifurcation analysis of two disc dynamos with viscous friction and multiple time delays. *Applied mathematics and computation*, ISSN 0096-3003. [Print ed.], 2019, vol. 347, str. 265-281, doi: 10.1016/j.amc.2018.10.090. [COBISS.SI-ID 24361480]

FISTER, Iztok, IGLESIAS, Andres, GÁLVEZ, Akemi, DEL SER, Javier, OSABA, Eneko, FISTER, Iztok, PERC, Matjaž, SLAVINEC, Mitja. Novelty search for global optimization. *Applied mathematics and computation*, ISSN 0096-3003. [Print ed.], 2019, vol. 347, str. 865-881, doi: 10.1016/j.amc.2018.11.052. [COBISS.SI-ID 24211976]

ÜLEN, Simon, GERLIČ, Ivan, SLAVINEC, Mitja, REPNIK, Robert. Evaluating the effectiveness of physlet-based materials in supporting conceptual learning about electricity. *Journal of science education and technology*, ISSN 1059-0145, 2017, vol. 26, iss. 2, str. 151-160, tabele, doi: 10.1007/s10956-016-9661-1. [COBISS.SI-ID 22803208]