Univerza v Mariboru

Fakulteta za naravoslovje in matematiko

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 / Slovene
	Vaje / Tutorial:	slovensko / Slovene

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:	Prerequisits:
predznanje na področjih matematične analize, algebre, mehanike	preknowledge in the field of mathematical analysis, algebra, mechanics.

Vsebina:

1) Funkcije ene in več spremenljivk. Posebne funkcije (trigonometrične, eksponentna, logaritemska, hiperbolične,), polinomi, grafi funkcij, lastnosti funkcij, funkcije kompleksne spremenljivke, vektorji.

2) Odvod in integral. Odvajanje (hitrost, pospešek, moč), iskanje ekstremov, integriranje (delo, pot, energija), dvojni in trojni integral (masa, težišče).

3) Vektorji

Vektorska polja, gradient (tokovi), divergenca, rotor, drugi odvodi, Gaussov teorem, Stokesov teorem, konzervativna polja in potenciali, Maxwellove enačbe

4) Analitične aproksimacije

Lineralizacija, računanje z diferenciali, Taylorjeva vrsta funkcije ene in

funkcije večih spremenljivk, limite, Variacijski račun, Euler-Lagrangejeve enačbe.

5) Fourierova analiza

Opis sinusnih nihanj, Fourierove vrste, Fourierova transformacija.

6) Navadne diferencialne enačbe, primeri uporabe diferencialnih enačb v fiziki.

Content (Syllabus outline):

1) Functions of one and multiple variables

Special functions (trigonometric, exponential,

logarithmical, hyperbolic), polynomial, function

graph, function properties, functions of complex variable, vectors.

2) Derivative and integration Derivation (velocity, acceleration, power), extreme finding, integration (work, length, energy), double triple integration (mass, centre of gravity).

3) Vectors

Vector fields, gradient, divergence, rotational,

second derivatives, Gauss theorem, Stokes theorem, conservative fields and potentials, Maxwell equations.

4) Analytical approximations

Linearization, differential calculus,

Taylor series of one or multiple variables, limits', variational calculus, Euler – Lagrange equations.

5) Fourier analysis

Description of sinusoidal oscillations, Fourier series, Fourier transformation.

6) Ordinary differential equations, few examples of ordinary differential equations, used in physics.

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.

Cilji in kompetence:	**Objectives and competences:**
Študentje ponovijo osnovna matematična orodja in principe ter razširijo uporabo na fizikalne probleme. Tvorijo ustrezne matematične modele za fizikalne probleme, formulirajo ustrezne robne pogoje in fizikalno interpretirajo dobljene rezultate.	The students refresh their knowledge about several mathematical tools and expand their application to physical problems. They form appropriate mathematical models for physical problems, formulate boundary conditions and interpret the obtained solutions

Predvideni študijski rezultati:	**Intended learning outcomes:**
Znanje in razumevanje: Kompleksno razumevanje fizikalnih zakonitosti in sposobnost le-te kvantitativno opisati, napovedati in izračunati rezultate. **Prenesljive/ključne spretnosti in drugi atributi:** Reševanje fizikalnih in tehničnih problemov z matematičnimi orodji in postopki.	**Knowledge and understanding:** Complex understanding of physical laws and ability to qualitatively describe them, predict and calculate results. **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:**
Postavitev problema, izbira potrebnih matematičnih orodij za reševanje, postavitev matematičnega modela, analitično in numerično reševanje. Interpretacija dobljenih rešitev.	Setting up of a physical problem, selection of appropriate mathematical tools, setting up a mathematical model, finding of an analytical or numerical solution. Interpretation of obtained solutions.

Načini ocenjevanja:	Delež (v %) / Weight (in %)	**Assessment:**
Način (pisni izpit, ustno izpraševanje, naloge, projekt)	**40** **40**	Type (examination, oral, coursework, project):

Pisni izpit	**20**	Written exam
Ustno izpit		Oral exam
Seminarska naloga		Seminar pape

Reference nosilca / Lecturer's references:

SVETEC, Milan, SLAVINEC, Mitja. Nematic liquid crystal locking menisci. Adv. Condens. Matter Phys., 2013, vol. 2013, art. ID 756902, str. 1-6. http://dx.doi.org/10.1155/2013/756902. [COBISS.SI-ID 19802888]

SLAVINEC, Mitja, FRAS, Maja, ZAVEC PAVLINIČ, Daniela, MEKJAVIĆ, Igor B. Toplotno prevajanje skozi vlažne plasti = Heatconducting through the damplayer. Anali PAZU, 2012, letn. 2, št. 2, str. 62-69, ilustr. [COBISS.SI-ID 19802632]

SVETEC, Milan, SLAVINEC, Mitja. Structural transition of nematic liquid crystal in cylindrical capillary as a result of the annihilation of two point defects. J. chem. phys., 2008, vol. 128, no. 8, str. 084704-1-084704-6, ilustr. http://link.aip.org/link/?JCPSA6/128/084704/1, http://dx.doi.org/10.1063/1.2839301. [COBISS.SI-ID 15899400]

SLAVINEC, Mitja, KRALJ, Samo, ŽUMER, Slobodan, SLUCKIN, T. J. Surface depinning of smectic-A edge dislocations. Phys. rev., E Stat. phys. plasmas fluids relat., 2001, 63, str. 031705-1-031705-6. [COBISS.SI-ID 1277796]

SLAVINEC, Mitja, KRALJ, Samo, ŽUMER, Slobodan. Formation of edge dislocations in the surface constrained smectic a film. Mol. cryst. liq. cryst. sci. technol., A Mol. cryst. liq. cryst., 2000, vol. 351, str. 153-160, ilustr. [COBISS.SI-ID 10579464]