

UČNI NAČRT PREDMETA / COURSE SYLLABUS							
<b>Predmet:</b>		Matematično modeliranje					
<b>Course title:</b>		Mathematical modelling					
<b>Študijski program in stopnja</b> Study programme and level		<b>Študijska smer</b> Study field			<b>Letnik</b> Academic year		<b>Semester</b> Semester
Univerzitetni študijski program Matematika		ni smeri			3		drugi
First cycle academic study programme Mathematics		none			3		second
<b>Vrsta predmeta / Course type</b>					izbirni		
<b>Univerzitetna koda predmeta / University course code:</b>					M0233		
<b>Predavanja</b> Lectures	<b>Seminar</b> Seminar	<b>Vaje</b> Tutorial	<b>Klinične vaje</b> work	<b>Druge oblike</b> študija	<b>Samost. delo</b> Individ. work	<b>ECTS</b>	
30		30			90	5	
<b>Nosilec predmeta / Lecturer:</b>		doc. George Mejak, prof. Emil Žagar					
<b>Jeziki / Languages:</b>		<b>Predavanja / Lectures:</b>		slovenski/Slovene			
		<b>Vaje / Tutorial:</b>		slovenski/Slovene			
<b>Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:</b>				<b>Prerequisites:</b>			
<b>Vsebina:</b>				<b>Content (Syllabus outline):</b>			

<p>Reševanje problemov s programskim paketom Matlab: osnove programskega paketa Matlab, delo z matrikami in polji, grafika, pisanje programskih in funkcijskih datotek, pregled osnovnih Matlabovih knjižnic (reševanje linearnih in nelinearnih sistemov enačb, optimizacija, numerično integriranje in reševanje diferencialnih enačb, delo z razpršenimi matrikami), uporaba programskega paketa Matlab pri reševanju preprostih problemov.</p> <p>Optimizacija: reševanje problemov, vezanih na iskanje ekstremov funkcij (diskretna verižnica, simetrična diskretna verižnica, simetrična verižnica s sodo in liho mnogo členki, nihanje paličja).</p> <p>Variacijski račun: problem brachistohrone, zvezna verižnica, minimalna rotacijska ploskev.</p> <p>Statistika: test <math>\chi^2</math> (hi-kvadrat), statistične simulacije, simulacije iger.</p>	<p>Problem solving using Matlab package: introduction into Matlab package, manipulation of matrices and arrays, graphics, writing scripts and functions, overview of basic Matlab toolboxes (numerical solution of systems of linear and nonlinear equations, optimization, numerical integration and numerical solution of ordinary differential equations, sparse matrices), Matlab as a tool for solving some simple problems.</p> <p>Optimization: solving problems based on constrained optimization (discrete catenary, symmetric discrete catenary, symmetric discrete catenary having an odd or even number of segments, truss oscillation).</p> <p>Calculus of variations: brachistochrone problem, catenary, minimal rotational surface.</p> <p>Statistics: <math>\chi^2</math> test (chi square test), statistical simulations, simulation of games.</p>
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#### Temeljni literatura in viri / Readings:

<p>E. Zakrajšek: Matematično modeliranje, DMFA-založništvo, Ljubljana, 2004.</p> <p>D. J. Higham, N. J. Higham: Matlab Guide, 2nd edition, SIAM, Philadelphia, 2005.</p> <p>B. Jurčič Zlobec, A. Berkopec: Matlab z uvodom v numerične metode, Založba FE in FRI, Ljubljana, 2005.</p> <p>V. M. Tikhomirov: Stories About Maxima and Minima, AMS, Providence, 1991.</p> <p>D. E. Knuth: The Art of Computer Programming II : Seminumerical Algorithms, Addison-Wesley, Reading, 1981.</p>
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#### Cilji in kompetence:

<p>Slušatelj spozna osnovne pristope za reševanje problemov matematičnega modeliranja, nauči se uporabljati Matlab kot orodje in kritično presoja dobljene rezultate. Podrobneje spozna nekaj problemov, ki temeljijo na iskanju ekstremov gladkih funkcij, problemov iz</p>
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#### Objectives and competences:

<p>A student is faced with basic concepts of problem solving, particularly those arising from mathematical modelling. She or he is able to use matlab as a tool and learns how to evaluate obtained results. Some deeper skills are obtained in solving problems based on finding</p>
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variacijskega računa, statistike in simulacij.

extrema, calculus or variations and statistical simulations.

**Predvideni študijski rezultati:**

Znanje in razumevanje: Poznavanje osnov programiranja v programskem paketu Matlab. Sposobnost reševanja nekaterih preprostih problemov matematičnega modeliranja s pomočjo Matlaba. Poznavanje teoretičnih osnov za praktično iskanje ekstremov gladkih funkcij, reševanje nalog variacijskega računa ter izvajanje statističnih testov in simulacij.

Uporaba: Uporaba programskega paketa Matlab kot orodja za reševanje preprostejših problemov, ki slonijo na matematičnih modelih.

Refleksija: Razumevanje teorije na podlagi izkušenj praktičnega dela (programiranja).

Prenosljive spretnosti – niso vezane le na en predmet: Spretnost uporabe računalnika, posebej paketa Matlab. Poznavanje osnovnih pristopov za reševanje matematičnih problemov in kritično presojanje rezultatov. Predmet nadgrajuje znanja iz mnogih predmetov študija matematike (analiza, algebra, programiranje ...)

**Intended learning outcomes:**

Knowledge and understanding: Basic programming in Matlab. Capability of solving some simple problems of mathematical modelling using Matlab. Understanding of theoretical fundamentals to solve problems involving scalar field extrema, capability of solving problems in calculus of variations and skills in implementation of statistical simulations.

Application: Using Matlab package as a tool for solving some simple problems arising from mathematical models.

Reflection: Understanding theory through practical experiments (computer programme coding).

Transferable skills: Capability of using computer software, particularly Matlab package. Understanding of basic approaches for solving mathematical problems and evaluation of results. The subject upgrades the knowledge obtained from several other subjects of mathematical studies (analysis, algebra, programming,...)

**Metode poučevanja in učenja:**

**Learning and teaching methods:**

predavanja, vaje, domače naloge, laboratorijsko delo, konzultacije, samostojna izdelava projekta

Lectures, exercises, homework, laboratory work, consultations, individual projects

Delež (v %) /

Weight (in %)

**Načini ocenjevanja:**

**Assessment:**

<p>Način (pisni izpit, ustno izpraševanje, naloge, projekt): 2 domači nalogi in projekt namesto izpita iz vaj, izpit iz vaj, izpit iz teorije ocene: 1-5 (negativno), 6-10 (pozitivno) (po Statutu UL)</p>	<p>50% 50%</p>	<p>Type (examination, oral, coursework, project): 2 homeworks and a project instead of written exam, written exam oral exam grading: 1-5 (fail), 6-10 (pass) (according to the Statute of UL)</p>
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**Reference nosilca / Lecturer's references:**

George Mejak:

- MEJAK, George. Finite element solution of a model free surface problem by the optimal shape design approach. International journal for numerical methods in engineering, ISSN 0029-5981. [Print ed.], 1997, vol. 40, str. 1525-1550 [COBISS.SI-ID 9983833]
- MEJAK, George. Two scale finite element method. V: 21st International congress of theoretical and applied mechanics, August 15-21, 2004, Warsaw, Poland. ICTAM04 : abstracts and CD-ROM proceedings. Warszawa: IPPT PAN, 2004, str. 209 [COBISS.SI-ID 13216857]
- MEJAK, George. Eshebly tensors for a finite spherical domain with an axisymmetric inclusion. European journal of mechanics. A, Solids, ISSN 0997-7538. [Print ed.], 2011, vol. 30, iss. 4, str. 477-490 [COBISS.SI-ID 16025177]

Emil Žagar:

- JAKLIČ, Gašper, ŽAGAR, Emil. Curvature variation minimizing cubic Hermite interpolants. Applied mathematics and computation, ISSN 0096-3003. [Print ed.], 2011, vol. 218, iss. 7, str. 3918-3924 [COBISS.SI-ID 16049241]
- JAKLIČ, Gašper, KOZAK, Jernej, KRAJNC, Marjetka, VITRIH, Vito, ŽAGAR, Emil. An approach to geometric interpolation by Pythagorean-hodograph curves. Advances in computational mathematics, ISSN 1019-7168, 2012, vol. 37, no. 1, str. 123-150 [COBISS.SI-ID 16051289]
- JAKLIČ, Gašper, KOZAK, Jernej, KRAJNC, Marjetka, VITRIH, Vito, ŽAGAR, Emil. Hermite geometric

interpolation by rational Bézier spatial curves. SIAM journal on numerical analysis, ISSN 0036-1429, 2012, vol. 50, no. 5, str. 2695-2715 [COBISS.SI-ID 16449369]