UČNI NAČRT PREDMETA / COURSE SYLLABUS (leto / year 2017/18)			
Predmet:	Matematično modeliranje		
Course title:	Mathematical modelling		
Študijski program in stopnja Study programme and level	**Študijska smer Study field**	**Letnik Academic year**	**Semester Semester**
Univerzitetni študijski program Finančna matematika	ni smeri	3	drugi
First cycle academic study programme Financial Mathematics	none	3	second

Vrsta predmeta / Course type	izbirni / elective
Univerzitetna koda predmeta / University course code:	M0325

Predavanja Lectures	**Seminar Seminar**	**Vaje Tutorial**	**Klinične vaje work**	**Druge oblike študija**	**Samost. delo Individ. work**	**ECTS**
30		**30**			**90**	**5**

Nosilec predmeta / Lecturer:	doc. dr. George Mejak, prof. dr. Emil Žagar

Jeziki / Languages:	**Predavanja / Lectures:**	slovenski / Slovene
	Vaje / Tutorial:	slovenski / Slovene

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:	**Prerequisites:**
Vpis v letnik študija.	Enrolment in the programme.
Vsebina:	**Content (Syllabus outline):**

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. Optimizacija: reševanje problemov, vezanih na iskanje ekstremov funkcij (diskretna verižnica, simetrična diskretna verižnica, simetrična verižnica s sodo in liho mnogo členki, nihanje paličja). Variacijski račun: problem brahistohrone, zvezna verižnica, minimalna rotacijska ploskev. Statistika: test $\chi 2$ (hi-kvadrat), statistične simulacije, simulacije iger.	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 sytems 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. 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). Calculus of variations: brachistochrone problem, catenary, minimal rotational surface. Statistics: $\chi 2$ test (chi square test), statistical simulations, simulation of games.

Temeljni literatura in viri / Readings:

E. Zakrajšek: Matematično modeliranje, DMFA-založništvo, Ljubljana, 2004.

D. J. Higham, N. J. Higham: Matlab Guide, 2nd edition, SIAM, Philadelphia, 2005.

B. Jurčič Zlobec, A. Berkopec: Matlab z uvodom v numerične metode, Založba FE in FRI, Ljubljana, 2005.

V. M. Tikhomirov: Stories About Maxima and Minima, AMS, Providence, 1991.

D. E. Knuth: The Art of Computer Programming II : Seminumerical Algorithms, Addison-Wesley, Reading, 1981.

Cilji in kompetence:	**Objectives and competences:**
Slušatelj spozna osnovne pristope za reševanje problemov matematičnega modeliranja, nauči se uporabljati Matlab kot orodje in kritično presojati dobljene rezultate. Podrobneje spozna nekaj problemov, ki temeljijo na iskanju ekstremov gladkih funkcij, problemov iz	A student is faced with bacis 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

variacijskega računa, statistike in simulacij.	obtained in solving problems based on finding extrema, calculus or variations and statistical simulations.

Predvideni študijski rezultati:	**Intended learning outcomes:**
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 ...)	Knowledge and understanding: Basic programming in Matlab. Capability of solving some simple problems of mathematical modelling using Matlab. Understandig 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

Načini ocenjevanja:	Delež (v %) / Weight (in %)	**Assessment:**
Način (pisni izpit, ustno izpraševanje, naloge, projekt):		Type (examination, oral, coursework, project):
2 domači nalogi in projekt namesto izpita iz vaj, izpit iz vaj,		2 homeworks and a project instead of written exam, written exam
izpit iz teorije	50%	oral exam
ocene: 1-5 (negativno), 6-10 (pozitivno) (po Statutu UL)	50%	grading: 1-5 (fail), 6-10 (pass) (according to the Statute of UL)

Reference nosilca / Lecturer's references:

George Mejak:

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]

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. 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]

Emil Žagar:

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, 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. 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]