UČNI NAČRT PREDMETA / COURSE SYLLABUS (leto / year 2016/17)			
Predmet:	Modeliranje in upravljanje sistemov		
Course title:	Modelling and control of systems		

Študijski program in stopnja **Study programme and level**	**Študijska smer** **Study field**	**Letnik** **Academic year**	**Semester** **Semester**
Visokošolski strokovni študijski program Praktična matematika	ni smeri	3	prvi ali drugi
First cycle professional study programme Practical Mathematics	none	3	first or second

Vrsta predmeta / Course type	izbirni / elective
Univerzitetna koda predmeta / University course code:	M0457

Predavanja **Lectures**	**Seminar** **Seminar**	**Vaje** **Tutorial**	**Klinične vaje** **work**	**Druge oblike študija**	**Samost. delo** **Individ. work**	**ECTS**
30		**15**			**105**	**5**

Nosilec predmeta / Lecturer:	doc. dr. Mirko Dobovišek, prof. dr. Jasna Prezelj	
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):**

Nelinearni sistemi diferencialnih enačb: fazna ravnina, kvalitativna analiza, ravnotežja, ničelne izokline, limitni cikli, linearizacija, stabilnost. Diskretni dinamični sistemi: iterativne enačbe prvega in drugega reda, logistični model, cikli, kaos (seminarske ali domače naloge: obresti, kontrola ribolova, širjenje bolezni,volkovi - jeleni, izumrtje, kontrola nivoja sladkorja v krvi ...) Osnove teorije upravljanja sistemov: povratna zanka, proporcionalna odmiku, proporcionalna odvodu, integralska (seminarske ali domače naloge: kontrola gretja, fermentacije ...) Optimalno upravljanje sistemov: modeliranje optimalne kontrole, izbira funkcionala, Pontrjaginov princip maksima, kontrola z minimalno enargijo, minimalni čas, »bang-bang kontrola« (seminarske ali domače naloge: dirkalni avto, ustavljanje vesoljske ladje, ustavljanje nihala ...)	Nonlinear systems of differential equations: phase plane, qualitative analysis, equilibrium, nullclines, limit cycles, linearization, stability. Discrete dynamical systems: first and second order iterative equations, logistic equation, cycles, kaos. (project(seminar): money for the future, controlled fishery, spread of disease, wolf/moose system , extinction diabetes mode, etc) Fundaments of the control of system: proportional, derivative and integral feedback. (project(seminar): heating control, fermentation, etc) Optimal control of systems: modeling optimal control, choice of objective function, Pontryagin maximus principle, control with minimal energy, minimal time, »bang-bang control«. (project(seminar): hotrod problem, stopping a space ship, controlling the harmonic oscillator, etc)

Temeljni literatura in viri / Readings:

J.Farlow, J.E.Hall, J.M.McDill, B.H.West: Differential Equations & Linear Algebra, Prentice Hall, New Jersey, 2002.

F. Križanič: Navadne diferencialne enačbe in variacijski račun, DZS, 1974, str. 457- 484.

D.J.Higham, N.J.Higham: Matlab Guide, SIAM, Philadelphia, 2000.

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

Študenti bodo spoznali in osvojili osnovne načine regulacije in optimalnega vodenja linearnih in nelinearnih sistemov (diskretnih in zveznih) ter prijeme za reševanje problemov s tega področja s pomočjo programskega paketa Matlab.	Students will acquire elementary knowledge about regulation and optimal control of linear and non linear systems (discrete and continuous), and some skill how to solve this problems with program Matlab. They will be able to use the acquired knowledge at posing and resolving problems that appears in practices, such as, mechanics, environment sciences, and economics.
Predvideni študijski rezultati:	**Intended learning outcomes:**
Znanje in razumevanje: Razumevanje pojma regulacije, vodenja ter optimalnega vodenja sistema. Sposobnost povezovanja znanj iz matematike in računalništva. Osnovno znanje programiranja v Matlabu. Uporaba razvitih metod v naravoslovju in tehniki. Uporaba: Pojmi, obdelani pri predmetu Modeliranje in vodenje sistemov se v praksi pojavljajo tako rekoč povsod (v naravoslovju, tehniki, biologiji, kemiji, družboslovju ...) Refleksija: Razumevanje teorije na podlagi primerov in uporabe Prenosljive spretnosti – niso vezane le na en predmet: Postavitev problema, izbira primerne metode, reševanje problema, analiza doseženega	Knowledge and understanding: Knowledge and understanding of the basic concepts of control of the systems. Capacity to connect their mathematical knowledge and programming in Matlab, and to implement developed methods in natural sciences and technics. Application: Modeling and control of systems is one of the basic subjects necessary to understand mechanics and other subjects of biological, technical and social sciences. Knowledge is necessary in modeling of almost all systems. Reflection: Integrating theory and practical applications in solving problems. Transferable skills: Posing a problem, selection of a method and its application in solving the problem. Analysis of the results from the cases. Skills in using literature. Knowledge is transmitted to virtually

rezultata na primerih. Spretnost uporabe domače in tuje literature.	all sciences.

Metode poučevanja in učenja:	**Learning and teaching methods:**
predavanja, vaje, domače naloge, konzultacije	Lectures, exercises, homeworks, consultations

Načini ocenjevanja:	Delež (v %) / Weight (in %)	**Assessment:**
Način (pisni izpit, ustno izpraševanje, naloge, projekt): pogoj za pristop k teoretičnemu izpitu je izdelan projekt in njegova predstavitev na seminarju ocena iz teoretičnega izpita Ocene: 1-5 (negativno), 6-10 (pozitivno) (po Statutu UL)	 50% 50%	Type (examination, oral, coursework, project): positive mark on the project (seminar) is precondition to seed the theoretical part of the exam. oral exam Grading: 1-5 (fail), 6-10 (pass) (according to the Statute of UL)

Reference nosilca / Lecturer's references:

Jasna Prezelj:

FORSTNERIČ, Franc, IVARSSON, Björn, KUTZSCHEBAUCH, Frank, PREZELJ-PERMAN, Jasna. An interpolation theorem for proper holomorphic embeddings. Mathematische Annalen, ISSN 0025-5831, 2007, bd. 338, hft. 3, str. 545-554. [COBISS.SI-ID 14335065]

PREZELJ-PERMAN, Jasna. A relative Oka-Grauert principle for holomorphic submersions over 1-convex spaces. Transactions of the American Mathematical Society, ISSN 0002-9947, 2010, vol. 362, no. 8, str. 4213-4228. [COBISS.SI-ID 15641433]

Jasna Prezelj:

PREZELJ-PERMAN, Jasna, SLAPAR, Marko. The generalized Oka-Grauert principle for 1-convex manifolds. Michigan mathematical journal, ISSN 0026-2285, 2011, vol. 60, iss. 3, str. 495-506.

[COBISS.SI-ID 16134745]

Mirko Dobovišek:

DOBOVIŠEK, Mirko, KUZMA, Bojan, LEŠNJAK, Gorazd, LI, Chi-Kwong, PETEK, Tatjana. Mappings that preserve pairs of operators with zero triple Jordan product. Linear Algebra and its Applications, ISSN 0024-3795. [Print ed.], 2007, vol. 426, iss. 2-3, str. 255-279. [COBISS.SI-ID 11598870]

DOBOVIŠEK, Mirko. Maps from M [sub] n(F) to F that are multiplicative with respect to the Jordan triple product. Publicationes mathematicae, ISSN 0033-3883, 2008, vol. 73, fasc. 1-2, str. 89-100. [COBISS.SI-ID 14914393]

DOBOVIŠEK, Mirko. Nekaj o diferencialnih enačbah, (Izbrana poglavja iz matematike in računalništva, 47). 1. natis. Ljubljana: DMFA - založništvo, 2011. 131 str., ilustr. ISBN 978-961-212-221-8. [COBISS.SI-ID 254805760]

DOBOVIŠEK, Mirko. Maps from M[sub]2(F) to M[sub]3(F) that are multiplicative with respect to the Jordan triple product. Aequationes mathematicae, ISSN 0001-9054, 2013, vol. 85, iss. 3, str. 539-552. [COBISS.SI-ID 16473433]

DOBOVIŠEK, Mirko. Matematika 2, (Izbrana poglavja iz matematike in računalništva, 48). Ljubljana: DMFA - založništvo, 2013. 337 str., ilustr. ISBN 978-961-212-254-6. [COBISS.SI-ID 269141248]