Univerza v Mariboru

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Fakulteta za naravoslovje in matematiko

UČNI NAČRT PREDMETA / COURSE SYLLABUS	
Predmet:	**Matematično modeliranje**
Course title:	**Mathematical modelling**

Študijski program in stopnja **Study programme and level**	**Študijska smer** **Study field**	**Letnik** **Academic year**	**Semester** **Semester**
Izobraževalna matematika – dvopredmetni, 1. stopnja		**3.**	**6.**
Educational mathematics – Double-major, 1st degree		**3.**	**6.**

Vrsta predmeta / Course type

Univerzitetna koda predmeta / University course code:

Predavanja **Lectures**	**Seminar** **Seminar**	**Sem. vaje** **Tutorial**	**Lab. vaje** **Laboratory work**	**Teren. vaje** **Field work**	**Samost. delo** **Individ. work**	**ECTS**
30	**15**		**15**		**120**	**6**

Nosilec predmeta / Lecturer: Drago Bokal

Jeziki / Languages:		
	Predavanja / Lectures:	SLOVENSKO/SLOVENE
	Vaje / Tutorial:	SLOVENSKO/SLOVENE

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:	**Prerequisits:**
Opravljene obveznosti pri predmetih, ki pokrivajo vsebine predmetov Algebraične strukture, Analiza, Osnove računalništva.	Completed courses that covers the contents of the courses Algebraic structures, Analysis, Basic Computer Science.

Vsebina:	**Content (Syllabus outline):**
● Modeliranje sprememb z diferenčnimi enačbami. ● Matematično obnašanje dinamičnih sistemov. ● Sistemi diferenčnih enačb. ● Proces modeliranja. ● Kombinatorika in modeliranje. ● Algoritmi. Psevdokoda. Drevo rešitev. ● Izrazi, funkcije, enačbe, izjave.	● Modeling change with difference equations. ● Mathematical behavior of dynamic systems. ● Systems of difference equations. ● The process of modeling. ● Combinatorics and modeling. ● Algorithms, pseudocode, the tree of solutions. ● Expressions, functions, equations, propositions.

● Problem izpolnjevanja omejitev. ● Matematični program, linearni program, celošte-vilski program. ● Graf kot model omrežja. Problemi na grafih. ● Analiza podatkov, verjetnost, Monte Carlo simulacija. ● Parametriziranje modelov. ● Analitični modeli.	● Constraint satisfaction problems. ● Mathematical program, linear program, integer program. ● Graph as a model of a network. Problems on graphs. ● Data analysis, probability, Monte Carlo simulations. ● Model parametrization. ● Analytical models.

Temeljni literatura in viri / Readings:

Osnovno / basic:

● Dossey, Giordano, McCrone, Weir, Mathematics Methods and Modelling for today's Mathematics Classroom, Brooks/Cole, Pacific Grove, 2002.

Dodatno / additional:

● E. Zakrajšek, *Matematično modeliranje,* DMFA – Založništvo, Ljubljana, 2004.
● J.D. Murray, *Mathematical biology I. An introduction*, Springer,New York, 2002.
● G. Polya, *Kako rešujemo matematične probleme*, DMFA, 1989.

Cilji in kompetence:	**Objectives and competences:**
● Spoznati osnovne tehnike in prijeme matema-tičnega modeliranja. ● Seznaniti se s teoretičnimi ozadji matematičnega modeliranja. ● Seznaniti se s osnovnimi algoritmi in hevristikami reševanja matematičnih problemov. ● Uporabiti znanje drugih matematičnih predmetov pri analizi praktičnih problemov. ● Pridobiti izkušnje pri izdelavi matematičnega modela. ● Spoznati vire literature o problemih, ki jih srečamo pri obravnavi modela. ● Seznaniti se z načini prepoznavanja za model pomembnih podatkov o problemu. ● Pridobiti izkušnje pri pojasnjevanju matematične-ga modela in zagovarjanju njegovih predpostavk.	● Understanding of basic techniques of mathematical modeling. ● Acquaintance with the theoretical background of mathematical modeling. ● Understanding of basic applications of algorithms and heuristics to solve mathematical problems. ● Apply the knowledge from other mathematical areas in analysis of practical problems. ● Gain experience in developing a mathematical model. ● Learn about sources of bibliography on problems related to studying mathematical models. ● Learn to distinguish the relevant data for the model under study. ● Gain experience in explaining and presenting the mathematical model and defending its assumptions.

Predvideni študijski rezultati:	**Intended learning outcomes:**
Znanje in razumevanje: • Usvojenost matematičnih znanj potrebnih za izdelavo in obravnavo matematičnih modelov, ki so predstavljena med	Knowledge and Understanding: • Adoption of special mathematical knowledge needed for developing and studying mathematical models, as presented

Vsebinami in Cilji. • Usvojenost didaktičnih znanj potrebnih za predstavitev matematičnih modelov, ki so predstavljena med Vsebinami in Cilji. • Poznavanje matematičnih modelov, s katerimi se učitelj matematike pri pouku najpogosteje sreča in tehnik za njihovo obravnavo. Prenosljive/ključne spretnosti in drugi atributi: • Pridobljena znanja in spretnosti, ki so navedene med Vsebinami in Cilji, so podlaga za uspešno soočanje z matematičnimi modeli, ki jih učitelji srečajo tekom izvajanja pedagoške prakse. • Pridobljena spretnost povezovanja abstraktnega matematičnega znanja s primeri iz okolja, v katerem učitelj poučuje. • Pridobljena spretnost motiviranja poglabljanja abstraktnega znanja s primeri uporabe teh znanj pri praktičnih problemih. • Pridobljena spretnost uporabe sodobnih modelirnih orodij in tehnologij za namen študija matematičnih modelov.	in rubrics Contents and Objectives. • Adoption of didactic knowledge and experience needed for presenting mathematical models, as presented in rubrics Contents and Objectives. • Understanding basic mathematical models that a teacher of mathematics most commonly meets while teaching mathematics, as well as techniques for their studying. Transferrable/Key skills and other attributes: • Adopted knowledge and skills, presented in the rubrics Contents and Objectives, are the basis for successful treatment of mathematical models that the teachers meet during teaching practice. • Adopted the skill of connecting abstract mathematical knowledge with examples from the environment in which the teacher is teaching. • Adopted the skill of motivating for deepening the understanding of abstract mathematical knowledge by applying this knowledge to practical problems. • Adopted the skill of using modern modeling tools and technologies to study mathematical models. •

Metode poučevanja in učenja:	**Learning and teaching methods:**
• Predavanje, • laboratorijske in seminarske vaje, • razgovor, • praktična demonstracija, • uporaba IKT.	• Lectures, • lab- and seminar exercises, • discussion, • practical demonstration, • applications of IT.

Načini ocenjevanja: **Assessment:**

Način (pisni izpit, ustno izpraševanje, naloge, projekt)	Delež (v %) / Weight (in %)	Type (examination, oral, coursework, project):
Pisni test – problemi	30%	Written test - problems
Izpit (pisni) - teorija	30%	Exam (written) – theory
Seminarska naloga	40%	Seminar thesis
Vsaka izmed naštetih obveznosti mora biti opravljena s pozitivno oceno.		Each of the mentioned commitments must be assessed with a passing grade.
Pozitivni oceni pri pisnem testu in		Passing grades of the written test and

nalogah sta pogoj za pristop k izpitu.		coursework are required for taking the exam.
Reference nosilca / Lecturer's references:		

1. BOKAL, Drago, BREŠAR, Boštjan, JEREBIC, Janja. A generalization of Hungarian method and Hall's theorem with applications in wireless sensor networks. *Discrete appl. math.*. [Print ed.], 2012, vol. 160, iss. 4-5, str. 460-470. http://dx.doi.org/10.1016/j.dam.2011.11.007. [COBISS.SI-ID 16191577]

2. KOS, Andrej, PRISTOV, Damijan, SEDLAR, Urban, STERLE, Janez, VOLK, Mojca, VIDONJA, Tomaž, BAJEC, Marko, BOKAL, Drago, BEŠTER, Janez. Open and scalable IoT platform and its applications for real time access line monitoring and alarm correlation. *Lect. notes comput. sci.*, str. 27-38, ilustr. [COBISS.SI-ID 9370964]
tipologija 1.08 -> 1.01

3. BOKAL, Drago, DEVOS, Matt, KLAVŽAR, Sandi, MIMOTO, Aki, MOOERS, Arne Ø. Computing quadratic entropy in evolutionary trees. *Comput. math. appl. (1987)*. [Print ed.], 2011, vol. 62, no. 10, str. 3821-3828. http://dx.doi.org/10.1016/j.camwa.2011.09.030. [COBISS.SI-ID 16059481]

4. ŽUNKO, Matjaž, BOKAL, Drago, JAGRIČ, Timotej. Testiranje modelov VaR v izjemnih okoliščinah. *IB rev. (Ljubl., Tisk. izd.)*. [Tiskana izd.], 2011, letn. 45, št. 3, str. 57-67, tabele, graf. prikazi. [COBISS.SI-ID 10777884]

5. BOKAL, Drago, CZABARKA, Éva, SZÉKELY, László, VRT'O, Imrich. General lower bounds for the minor crossing number of graphs. *Discrete comput. geom.*, 2010, vol. 44, no. 2, str. 463-483. http://dx.doi.org/10.1007/s00454-010-9245-4. [COBISS.SI-ID 15636057]