UČNI NAČRT PREDMETA / COURSE SYLLABUS	
Predmet:	Avtomatizirano modeliranje dinamičnih sistemov s primeri uporabe v ekologiji
Course title:	Automated Modeling of Dynamic Systems with Ecological Applications

Študijski program in stopnja Study programme and level	Študijska smer Study field	Letnik Academic year	Semester Semester
Ekotehnologije, 3. stopnja		1	1
Ecotechnologies, 3rd cycle		1	1

Vrsta predmeta / Course type Izbirni/Elective

Univerzitetna koda predmeta / University course code: EKO3-787

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

**Navedena porazdelitev ur velja, če je vpisanih vsaj 15 študentov. Drugače se obseg izvedbe kontaktnih ur sorazmerno zmanjša in prenese v samostojno delo. / This distribution of hours is valid if at least 15 students are enrolled. Otherwise the contact hours are linearly reduced and transfered to individual work.*

Nosilec predmeta / Lecturer: Prof. dr. Sašo Džeroski

Jeziki / Languages:	**Predavanja / Lectures:**	slovenščina, angleščina/ Slovenian, English
	Vaje / Tutorial:	

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:	**Prerequisites:**
Izpolnjeni morajo biti pogoji za vpis na doktorski študij: zaključena druga stopnja bolonjskega študija ali diploma univerzitetnega študijskega programa. Potrebna so tudi osnovna znanja biologije oz. ekologije ter računalništva oz. informatike.	Students must fulfill the formal requirements for enrolling to the doctoral study program: completed Bologna second level study program or an equivalent pre-Bologna university study program. Basic knowledge of biology or ecology and computer science or informatics is also required.

Vsebina:	**Content (Syllabus outline):**
Uvod: Modeliranje dinamičnih sistemov Modeliranje prostora stanj in vhodov-izhodov Modeli v diskretnem in zveznem času Parametrični in neparametrični modeli Kvalitativni in kvantitativni modeli	Introduction: Modeling dynamic systems State-space and input-output models Discrete and continuous-time models Parametric and non-parametric models Qualitative and quantitative models
Sklepanje s parametričnimi modeli Simulacija Identifikacija oz. optimizacija parametrov Strukturna identifikacija	Reasoning with parametric models Simulation Parameter fitting/ identification Structure identification
Učenje neparametričnih modelov v diskretnem času	Learning nonparametric discrete time models

Učenje procesno osnovanih modelov Predstavitev procesnih modelov Metode za učenje procesnih modelov Primeri uporabe oz. študije primerov avtomatiziranega modeliranja ekosistemov in epidemij.	Learning process-based models Representation: Entities, Processes, Libraries Learning methods: LAGRAMGE, ProBMoT Applications: Case studies in automated modeling of aquatic ecosystems and epidemiology

Temeljni literatura in viri / Readings:

Izbrana poglavja iz naslednjih knjig: / Selected chapters from the following books:

- Mobus, G.E., and Kalton, M.C. Principles of Systems Science. Springer, 2015. ISBN 978-1-493-91919-2.
- Joergensen, S.E., and Fath, B. Fundamentals of Ecological Modelling: Applications in Environmental Management and Research. Elsevier, 2011. ISBN 978-0-444-53567-2.
- Džeroski S., and Todorovski L., editors. Computational Discovery of Scientific Knowledge: Introduction, Techniques, and Applications in Environmental and Life Sciences. Springer, 2007. ISBN 978-3-540-73919-7.
- Hannon, B., and Ruth, M. Modeling Dynamic Biological Systems. 2nd edition. Springer, 2014. ISBN 978-3-319-05614-2.

Cilji in kompetence:	**Objectives and competences:**
Cilj predmeta je seznaniti študenta s področjem avtomatiziranega modeliranja dinamičnih sistemov, vključno z osnovnimi pojmi in sodobnimi metodami. Kompetence študenta z uspešno zaključenim predmetom bodo vključevale razumevanje osnovnih pojmov, poznavanje sodobnih metod in sposobnost samostojne uporabe teh metod pri novih nalogah modeliranja ekosistemov in okoljskih sistemov.	The course objective is to familiarize the student with the field of automated modeling of dynamic systems, including basic concepts and state of the art methods. The competencies of the students successfully completing this course will include the understanding of basic concepts from the field, familiarity with the state-of-the art methods, and capability of independent use of the methods in new practical projects of modeling ecological and environmental systems.

Predvideni študijski rezultati:	**Intended learning outcomes:**
• Dobiti pregled obstoječih nalog in metod avtomatiziranega modeliranja dinamičnih sistemov ter primerov njihove uporabe v ekologiji • Pridobiti sposobnost uporabe obstoječih metod na novih problemih • Pridobiti sposobnost ugotavljanja primernosti različnih pristopov za avtomatizirano modeliranje različnih ekosistemov	• Acquiring an overview of existing tasks and methods in automated modelling of dynamic systems and case studies of their use in ecology • Obtaining the ability to apply existing methods to new problems • Obtaining the ability to identify the best methodological approach available for solving specific problems of automated modeling of different ecosystems

Metode poučevanja in učenja:	**Learning and teaching methods:**
Predavanja, konzultacije, samostojno delo	Lectures, consultancy, individual work

Načini ocenjevanja:	Delež (v %) / Weight (in %)	Assessment:
• ustni izpit	50 %	• oral exam
• seminarska naloga	25 %	• seminar work
• ustni zagovor	25 %	• oral defense

Reference nosilca / Lecturer's references:

Aleksovski, D., Kocijan, J., and **Džeroski, S**. (2015). Model-tree ensembles for noise-tolerant system identification. Advanced Engineering Informatics, 29(1): 1-15. DOI: 10.1016/j.aei.2014.07.008

Simidjievski, N., Todorovski, L., and **Džeroski, S.** (2015). Learning ensembles of population dynamics models and their application to modelling aquatic ecosystems. Ecological Modelling, 306: 305-317. DOI: 10.1016/j.ecolmodel.2014.08.019

Simidjievski, N., Todorovski, L., and **Džeroski, S.** (2015). Predicting long-term population dynamics with bagging and boosting of process-based models. Expert Systems with Applications, 42(22): 8484-8496. DOI: 10.1016/j.eswa.2015.07.004

Škerjanec, M., Atanasova, N., Čerepnalkoski, D., **Džeroski, S.**, and Kompare, B. (2014). Development of a knowledge library for automated watershed modeling. Environmental Modelling and Software, 54: 60-72. DOI: 10.1016/j.envsoft.2013.12.017

Taškova, K., Šilc, J., Atanasova, N., and **Džeroski, S.** (2012). Parameter estimation in a nonlinear dynamic model of an aquatic ecosystem with meta-heuristic optimization. Ecological Modelling, 226(1): 36-61. DOI: 10.1016/j.ecolmodel.2011.11.029