UČNI NAČRT PREDMETA / COURSE SYLLABUS	
Predmet:	Modeliranje v okolju
Course title:	Modeling in the Environment

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:	EKO3-758

Predavanja Lectures	Seminar Seminar	Vaje Tutorial		Druge oblike Other	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. Rudolf Rajar
Jeziki / Languages:	slovenščina, angleščina Slovenian, English

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:	**Prerequisites:**
Zaključena druga stopnja bolonjskega študija ali univerzitetni študijski program.	Completed Bologna second level program or university type of undergraduate education.

Vsebina:	**Content (Syllabus outline):**
Splošno o modelih. Modeliranje procesov v okolju. Uporabnost, koristnost modeliranja procesov. Vrste modelov. Stohastični, deterministični modeli. Dimenzije modelov: 0 dim., 1,2,3 dimenzijski modeli. Moduli: hidrodinamični, transportni, biokemični modul. Osnovne enačbe (kratek pregled). Kontinuitetna, dinamična, advekcijsko-difuzijska enačba. Monod-ova enačba razpada snovi. Izračuni masne bilance kontaminanta. Primeri uporabe: (1) Transportni procesi in pretvorbe živega srebra (Hg) v Idrijci in Soči ter v Tržaškem zalivu. (2) Simulacije Hg v morju Yatsushiro in zalivu Minamata. (3) Simuliranje transporta sedimentov in plutonija v laguni Mururoa. (4) Modeliranje onesnaževanja s pesticidi v lagunah SZ Mehike. (5) Modeliranje gibanja	Introduction: General description of models. Modeling of environmental processes. Applicability and usefulness of environmental models. Types of models. Stochastic, deterministic models. Dimensions of models: 0 dim, 1,2,3 dim. models. Modules: hydrodynamic, transport/dispersion and biochemical modules. Basic equations (short overview). Equation of continuity, dynamic equation, advection-diffusion equation. Monod equation for degradation of matter. Calculation of mass balance of a pollutant. Case studies: (1) Transport processes and transformation of mercury (Hg) in Idrijca and Soča rivers and in the Gulf of Trieste. (2) Modeling of Hg in the Yatsushiro Sea and Minamata bay. (3) Simulations of transport of sediment and plutonium in the Mururoa lagoon. (4) Modeling of agricultural

zemeljskega plazu v Logu pod Mangartom.	pollution in the lagoons of the NW Mexico (5) Modeling of dynamic of a landslide in Log pod Mangartom.

Temeljni literatura in viri / Readings:

- Rajar R., Četina M., Matematično modeliranje v hidrotehniki (3). Najpomembnejša je izbira pravega modela, s katerim simuliramo pojav, Delo, Ljubljana, Znanje za razvoj, 2. 3. 1994.
- Žagar Dušan Žagar, Gregor Petkovšek, Rudi Rajar, Nataša Sirnik, Milena Horvat,Antigoni Voudouri, George Kallos, Matjaž Četina. (2007) Modeling of mercury transport and transformations in the water compartment of the Mediterranean Sea, Marine Chemistry, 107,2007.
- Rajar, R. The Role of Physical Models, Mathematical Models and Field Measurements in Water Pollution Problems, 4th International Conference Water Pollution, Bled, Slovenia, June 1997.
- An Introduction to the Practice of Ecological Modeling By Leland J. Jackson , Anett S. Trebitz, And Kat H Ryn L. Cottingham (2017) (https://watermark.silverchair.com/50-8-694.pdf)
- Ecological models supporting environmental decision making: a strategy for the future Amelie Schmolke1 , Pernille Thorbek2 , Donald L. DeAngelis3 and Volker Grimm1(2018) (http://cescos.fau.edu/gawliklab/papers/TREE_Schmolkeetal2010.pdf)

Cilji in kompetence:	**Objectives and competences:**
Študent mora razumeti principe modeliranja procesov v okolju. Na osnovi pridobljenega znanja mora biti sposoben simulirati določen fizikalni proces, bodisi z lastno izdelanim modelom ali osvojiti in uporabiti že izdelani model.	The student must understand the principles of the modeling in the environment. He must be able to simulate a physical process either by a commercial model or by a model, created by himself.

Predvideni študijski rezultati:	**Intended learning outcomes:**
• Študent mora znati sestaviti enostavni 0-dimenzijski model na osnovi Monodove enačbe razpada. • Študent mora biti sposoben razumeti in opisati vsak že izdelani ekološki model. • Mora biti sposoben jasno presoditi, katere vrste modelov so najprimernejše za rešitev konkretnih problemov s področja ekologije. • Mora biti sposoben uporabljati že izdelane komercialne modele za reševanje problemov s tega področja.	• The student must be able to carry out a 0-dimensional model on the basis of Monod decay equation. • The student must understand and be able to describe any environmental model. • He must be able to decide for each case, which model is the most suitable for the application. • He must be able to understand and use commercial models from this field.

Metode poučevanja in učenja:	**Learning and teaching methods:**
V primeru, da je vpisanih več kot 10 študentov: predavanja, študenti dobijo krajše naloge, rešitev katerih predelajo skupaj s predavateljem na ustnem izpitu, kjer dobijo še dodatna vprašanja. V primeru, da je vpisanih manj kot 10 študentov: nekaj urni sestanek predavatelja s študenti, kjer študenti opišejo svoje dotedanje študijske in (eventualno) praktične izkušnje. Vsak študent dobi individualno seminarsko nalogo. Rešitev in zagovor naloge je pogoj za priznanje izpita.	If more than 10 students: lectures, the students obtain individual tasks. At the exam students present the solution of the tasks, and together with answers to additional questions the lecturer decides for the exam. If less than 10 students: Meeting with students, where they describe their previous education and practical work. Each student obtains an individual seminar. Solution and presentation of the seminar is the condition for the acknowledgement of the exam.

Načini ocenjevanja:	Delež (v %) / Weight (in %)	Assessment:
Seminarska naloga Zagovor seminarske naloge, pri katerem se dokaže osvojitev predvidenih študijskih rezultatov	50 % 50 %	Seminar work. Defence of the seminar work where the students demonstrate they master the learning outcomes of the course

Reference nosilca / Lecturer's references:

- Rajar, Rudolf, Četina, Matjaž, Horvat, Milena, Žagar, Dušan. Mass Balance Of Mercury In The Mediterranean Sea. Marine Chemistry, Issn 0304-4203. [Print Ed.], 2007, Vol. 107, No. 1, Str. 89-102. [Cobiss.Si-Id 20322343]
- Horvat, Milena, Kotnik, Jože, Ogrinc, Nives, Rajar, Rudolf, Žagar, Dušan, Fajon, Vesna, Živković, Igor, Bratkič, Arne, Begu,Ermira, Snoj Tratnik, Janja, Mazej, Darja, Jagodic, Marta, Kocman, David, Stajnko, Anja, Falnoga, Ingrid, Sprovieri, Francesca, Pirrone, Nicola. Mercury In The Mediterranean : Environment And Health Implications. V: Ogrinc, Nives (Ur.), Potočnik, Doris (Ur.), Faganeli, Jadran (Ur.). Dynamics Of Biogeochemical Systems : processes and modeling : conference program and abstracts. [Ljubljana]: National Institute of Biology: Jožef Stefan Institute, [2015], str. 41. [COBISS.SI-ID 28914983]
- ČETINA, Matjaž, RAJAR, Rudolf, HATIĆ, Vanja, ŠIRCA, Andrej. Matematično modeliranje toplotne obremenitve spodnje Save pri nuklearni elektrarni Krško = Mathematical modeling of thermal pollution of lower Sava river at the nuclear power plant Krško. Gradbeni vestnik, ISSN 0017-2774. [Tiskana izd.], jun. 2013, letn. 62, str. 131-139, ilustr. [COBISS.SI-ID 6284641]
- Hatić, Vanja, Širca, Andrej, Rajar, Rudolf. Determination of mixing length of a strong thermal discharge in a planned run-of-the-river reservoir. V: Sharing experience for safe and sustainable water storage : proceedings [of the] 9th ICOLD European Club Symposium, 10-12 April 2013, Venice, Italy. Roma: ITCOLD (Italian Committee on Large Dams), cop. 2013, str. [1-6]. [COBISS.SI-ID 36837125]
- Calibration Of Three-Dimensional Model PCFLOW3D – A Comparison With Measurements From The Yatsushiro Sea And The Sea Of Japan. Rudi Rajar, Matjaž Četina , Acta hydrotechnica, vol. 30, no. 52, pp. 37-50, 2017.