Univerza *v Ljubljani*
Fakulteta *za gradbeništvo in geodezijo*

Učni načrti

Magistrski študijski program druge stopnje

VODARSTVO IN OKOLJSKO INŽENIRSTVO (MA)

Course Syllabi

2nd Cycle Master Study

WATER SCIENCE AND ENVIRONMENTAL ENGINEERING (MA)

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POPLAVE IN UPRAVLJANJE Z VODAMI (MODUL) / FLOOD RISK MANAGEMENT (MODULE)

2. LETNIK / 2ND YEAR

UL FGG, Vodarstvo in okoljsko inženirstvo (MA), 2. stopnja | Water Science and Environmental Engineering (MA), 2nd Cycle

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UČNI NAČRT PREDMETA/COURSE SYLLABUS

Predmet:	
	HIDRAVLIČNO MODELIRANJE
Course title:	
	HYDRAULIC MODELLING

Študijski programi in stopnja	Študijska smer	Letnik	Semestri
Vodarstvo in okoljsko inženirstvo, druga stopnja, magistrski	Ni členitve (študijski program)	1. letnik	1. semester

Univerzitetna koda predmeta/University course code:	0035019
Koda učne enote na članici/UL Member course code:	1325

Predavanja	Seminar	Vaje	Klinične vaje	Druge oblike študija	Samostojno delo	ECTS
45	15	0	60	0	120	8

Nosilec predmeta/Lecturer:	Gašper Rak, Gorazd Novak, Matjaž Četina

Vrsta predmeta/Course type:	Obvezni strokovni/Obligatory professional

Jeziki/Languages:	Predavanja/Lectures:	Slovenščina
	Vaje/Tutorial:	Slovenščina

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:	Prerequisites:
Opravljena izpita iz predmetov Hidromehanika in Hidravlika oz. osvojena ustrezna primerljiva znanja.	Passed exams in Hydromechanics and Hydraulics or adequate comparable knowledge.

Vsebina:	Content (Syllabus outline):
a. Sklop "Hidravlika nestalnega toka" Predavanja:	a. The "Hydraulics of unsteady flow" Lectures:
Nestalni tok s prosto gladino (vrste valov, osnovne Saint Venantove enačbe, metode reševanja – metoda karakteristik, eksplicitne in implicitne metode končnih razlik, začetni in robni pogoji, osnove dvodimenzijskih problemov, osnove in primeri gibanja nenewtonskih tekočin – snežni plazovi, drobirski tokovi). Vodni udar v ceveh pod tlakom (opis pojava, izpeljava dinamične in	Unsteady free surface flow (types of waves, basic Saint Venant equations, solving methods - the method of characteristics, explicit and implicit finite difference methods, initial and boundary conditions, basics of two-dimensional problems, basics and examples of the movement of non- Newtonian fluids - avalanches, debris flows). Water hammer in pipes under pressure (description of the phenomenon, the

kontinuitetne enačbe, metoda karakteristik, začetni in robni pogoji, ukrepi za blažitev vodnega udara). Vodostani (opis, izpeljava kontinuitetne in dinamične enačbe, enačba nedušenega nihanja, metode reševanja, stabilnost vodostanov, vrste vodostanov, njihova izbira in način računanja). Teorija valov malih amplitud, analitične rešitve osnovnih enačb.

Vaje

Laboratorijske vaje (potujoči vodni skok, meritve na fizičnem modelu vodostana, uporaba računalniških programov za račun poplavnih, obratovalnih in poplavnih valov ter vodnega udara – delo v računalniški učilnici).

b. "Hidravlika II" Predavanja:

Stalni neenakomerni tok (zahtevni primeri robnih pogojev, opis programske opreme). Fizični hidravlični modeli (dimenzijska analiza, principi teorije podobnosti, distorzirani modeli, proces konstruiranja modela, kriteriji za izbiro fizičnega ali matematičnega modela). Modeliranje hidravličnih objektov (opis hidravličnih lastnosti posameznih objektov oz. naprav, njihovo modeliranje, robni pogoji in načrtovanje ter preverjanje tehničnih zahtev). Modeliranje zahtevnejših cevovodnih sistemov z orodji umetne inteligence (opis hidravličnih lastnosti, karakteristike elementov modeliranja in obratovalnih razmer, verifikacija-umerjanje-validacija modelov cevovodnih sistemov).

Vaje

Laboratorijske vaje (modelna podobnost, osnove merilne tehnike in enostavni merilni sistemi, meritve na fizičnih modelih pregrad, usedalnikov ipd., hidravlično dimenzioniranje sistemov).

Seminar

Izdelava samostojne seminarske naloge, ki obsega: uporabo 1D ali 2D modela za račun zahtevnejšega primera neenakomernega toka v vodotoku ali hidravlično modeliranje zahtevnejšega cevovodnega sistema ali hidravlično modeliranje zahtevnejšega hidrotehničnega objekta.

derivation of the dynamic and continuity equations, method of characteristics, initial and boundary conditions, measures to mitigate water hammer). Surge tanks (description and derivation of the dynamic equation, equation of undamped oscillations, solution methods, stability of surge tanks, types of surge tanks and their selection and methods of computation).

The theory of waves of small amplitude, analytic solutions of basic equations.

Tutorials

Laboratory tutorials (travelling hydraulic jump, measurements on a physical model of a surge tank, the use of computer programs for examples of flood, operating and flood waves and water hammer - work in the computer lab).

b. "Hydraulics II" Lectures:

Steady non-uniform flow (complex cases of boundary conditions, simulation software). Physical hydraulic models (dimensional analysis, principles of the theory of similarity, distorted models, model design processes, criteria for the selection of a physical or mathematical model). Modelling of hydraulic structures (description of the hydraulic properties of objects or devices and their modelling, boundary conditions and the design and verification of technical requirements). Modelling of complex pipe systems using the tools of artificial intelligence (description of hydraulic properties, characteristic elements of modelling and operating conditions, verification – calibration - validation of hydraulic models of pipe systems).

Tutorials

Laboratory work (model similarity, measurement techniques and simple measuring systems, measurements on physical models of dams, sedimentation tanks, etc.., hydraulic dimensioning of systems).

Seminar

Elaboration of individual seminar/project report comprising: use of 1D or 2D models for complex case of steady non-uniform flow in open channels or hydraulic modelling of complex pipe systems or hydraulic modelling of complex hydraulic structure.

Temeljna literatura in viri/Readings:

UL FGG, Vodarstvo in okoljsko inženirstvo (MA), 2. stopnja | Water Science and Environmental Engineering (MA), 2nd Cycle   5

Steinman, F. 2010. Hidravlika, učbenik. Ljubljana, UL FGG, str. 295.

Rajar, R. 1980. Hidravlika nestalnega toka, univerzitetni učbenik. Ljubljana, UL FGG, str. 279.

Ivetić, M. 1996. Računska hidraulika – tečenje u cevima. Beograd, Građevinski fakultet, str. 306.

US Army Corps of Engineers: HEC-RAS 4.0.

Dostopno na: http://www.hec.usace.army.mil/software/hec-ras .

US Environmental Protection Agency: EPANET 2.0.

Dostopno na: http://www.epa.gov/nrmrl/wswrd/dw/epanet.html .

Cilji in kompetence:

Objectives and competences:

Cilji

a. Sklop "Hidravlika nestalnega toka"

- Nadgraditi znanje hidravlike stalnega toka s teoretičnimi osnovami in načini reševanja nestalnega toka s prosto gladino in nestacionarnih pojavov v ceveh pod tlakom.

- Podati načine uporabe matematičnih modelov oz. računalniških programov za račun poplavnih, obratovalnih in porušitvenih valov kot osnove za dimenzioniranje hidrotehničnih objektov.

b. Sklop "Hidravlika II"

- Spoznati zahtevnejše primere stalnega neenakomernega toka v odprtih vodotokih in v vodnogospodarskih sistemih ter njihova obratovalna stanja, z upoštevanjem specifičnih robnih pogojev.

- Podati proces izdelave hidravličnih fizičnih modelov, prikaz ustreznih merilnih metod in opreme s podpornimi računalniškimi programi.

- Nadgraditi osnovno znanje hidravlike z modeliranjem zahtevnejših hidravličnih objektov in naprav.

- Podati načine hidravličnega modeliranja zahtevnejših sistemov, vključno z verifikacijo, kalibracijo in validacijo modelov.

Kompetence

a. Sklop "Hidravlika nestalnega toka"

- Sposobnost pravilne definicije gonilnih sil, njim primerne izbire ustreznih osnovnih enačb in pravilne uporabe računalniških programov za določanje merodajnih količin pri nestalnih tokovih.

- Sposobnost posploševanja in razumevanja sorodnih pojavov nestalnega toka s prosto gladino in v cevnih sistemih pod tlakom.

Objectives

a. "Hydraulics of unsteady flow "

- Upgrade the knowledge of hydraulics of steady flow with theoretical foundations and methods of solving unsteady free surface flow and non-stationary phenomena in pipes under pressure.

- Provide uses of mathematical models or computer programs for the calculation of flood, operating and dam-break flood waves as the basis for the design of hydraulic structures.

b. "Hydraulics II"

- Knowledge of complex steady non-uniform flows in open channels and in water management systems, their operating modes and specific boundary conditions.

- Provide process of planning and construction of hydraulic physical models, appropriate measuring methods and equipment to support computer programs.

- Upgrade the basic knowledge of hydraulic modelling to handle with complex hydraulic structures and facilities.

- Overview of the diversity of hydraulic modelling for complex systems or structures, including verification, calibration and validation procedures for particular hydraulic model.

Competences

a. "Hydraulics of unsteady flow"

- Ability to correctly define the driving forces, appropriate selection of the relevant basic equations and the correct application of computer programs for unsteady flows.

b. Sklop "Hidravlika II" - Sposobnost oceniti, kdaj zadošča matematični model in kdaj je nujen fizični model. - Razumeti negotovost rezultatov fizičnega modeliranja oz. izračunov. - Obvladovanje procesov umerjanja, validacije in kritične ocene rezultatov matematičnih modelov ter prenosa s fizičnih modelov v naravo za najzahtevnejše primere tokov v hidrotehnični praksi.	- Ability to generalize and to understand the related phenomena of unsteady free surface flow and flow in pipe systems under pressure. b. "Hydraulics II" - Ability to assess whether the use of mathematical model is appropriate or physical models are necessary. - Understand the uncertainty of the results (from physical or mathematical models). - Acquire adequate skills for calibration and validation processes, critical evaluation of the results of mathematical models and the transfer of results of physical models to nature for complex flows in the field of hydraulics.

Predvideni študijski rezultati: **Intended learning outcomes:**

- Pridobljeno poglobljeno znanje za račun najzahtevnejših primerov stalnega neenakomernega toka v odprtih koritih. - Razumevanje in sposobnost analize cevovodnih sistemov in naprav z naprednimi orodji. - Razumevanje in sposobnost analize zahtevnejših postrojev hidrotehničnih objektov. - Poznavanje lastnosti nestalnega toka v odprtih koritih (valovi) in ceveh pod tlakom (vodni udar). - Doseženo znanje uporabljajo pri izdelavi najzahtevnejših hidravličnih izračunov pri urejanju vodotokov, energetski izrabi rek ter načrtovanju vodovodov in kanalizacij. - Študentje morajo dobro razumeti fizikalne osnove prehodnih pojavov v hidravličnih sistemih, iskati analogijo med pojavi v odprtih koritih in ceveh pod tlakom ter spoznati povezanost elementov na hidrotehničnih objektih. Tako razumejo, kaj poenostavitve enačb pomenijo za točnost rezultatov. - Sposobnost sestave lastnih računalniških programov na osnovi ustrezno izbranih enačb. - Sposobnost zasnovati hidravlični fizični model z ustrezno merilno opremo in analize veličin. - Sposobnost uporabe in kritične presoje tujih računalniških programov za hidravlične izračune. - Sposobnost upoštevanja prehodnih pojavov pri pravilnem dimenzioniranju hidravličnih sistemov.	- Acquired in-depth knowledge of complex cases of steady non-uniform flow in open channels. - Understanding of and ability to analyse pipe systems and facilities with advanced tools. - Understanding of and ability to analyse complex devices or installations at hydro- technical facilities. - Knowledge of the characteristics of unsteady flow in open channels (waves) and pressurized pipes (water hammer). - Achieved knowledge used for the elaboration of complex hydraulic calculations in water river management, energy utilization of rivers and planning of water supply systems and sewer systems - Students need profound understanding of the physical basis of transient phenomena in hydraulic systems, search for analogies between the phenomena in open channels and pressurised pipe systems and identify the connection of elements of hydraulic structures. This facilitates their understanding of the equation simplification for the accuracy of the results. - Ability to structure their own computer programs based on appropriately selected equations. - Ability to design hydraulic physical models with an appropriate measuring equipment and analysis variables. - Ability to use and critically assess foreign computer programs for hydraulic calculations.

	- Ability to take into account transient phenomena in the correct dimensioning of hydraulic systems.- Ability to take into account transient phenomena in the correct dimensioning of hydraulic systems.

Metode poučevanja in učenja: **Learning and teaching methods:**

Predavanja, seminar in laboratorijske vaje.	Lectures, seminar and laboratory tutorials.

Načini ocenjevanja: **Delež/Weight**   **Assessment:**

Seminarska naloga (pisno, oddaja seminarja sklopa b.)	25,00 %	Seminar work (written, submission of part b.)
Domače naloge (pisno, oddaja vaj sklopa a.)	25,00 %	Home practicals (written, submission of practicals part a.)
Pisni izpit (izpit iz teorije sklopov a. in b.)	50,00 %	Written exam (theory of part a. and b.)

Reference nosilca/Lecturer's references:

KRZYK, Mario, ČETINA, Matjaž. Analysis of flow in a curved channel using the curvilinear orthogonal numerical mesh. Strojniški vestnik. Sep. 2018, vol. 64, no. 9, str. 536-542. DOI: 10.5545/sv-jme.2017.5183.

BOMBAČ, Martin, NOVAK, Gorazd, MLAČNIK, Jure, ČETINA, Matjaž. Extensive field measurements of flow in vertical slot fishway as data for validation of numerical simulations. Ecological engineering. [Print ed.]. 2015, letn. 84, str. 476-484. DOI: 10.1016/j.ecoleng.2015.09.030.

DŽEBO, Elvira, ŽAGAR, Dušan, KRZYK, Mario, ČETINA, Matjaž, PETKOVŠEK, Gregor. Different ways of defining wall shear in smoothed particle hydrodynamics simulations of a dam-break wave. Journal of hydraulic research. 2014, letn.52, št. 4, str.453-464. DOI: 10.1080/00221686.2013.879611.

NOVAK, Gorazd, PENGAL, Polona, SILVA T., Ana, DOMINGUEZ, Jose Manuel, TAFUNI, Angel, ČETINA, Matjaž, ŽAGAR, Dušan. Interdisciplinary design of a fish ramp using migration routes analysis. Ecological modelling. [Print ed.]. jan. 2023, vol. 475, 12 str. DOI: 10.1016/j.ecolmodel.2022.110189.

NOVAK, Gorazd, DOMÍNGUEZ, José M., TAFUNI, Angel, SILVA T., Ana, PENGAL, Polona, ČETINA, Matjaž, ŽAGAR, Dušan. 3-D numerical study of a bottom ramp fish passage using smoothed particle hydrodynamics. Water. 1 Jun. 2021, vol. 13, iss. 11, [article no.] 1595, str. 1-19. DOI: 10.3390/w13111595.

BOMBAČ, Martin, ČETINA, Matjaž, NOVAK, Gorazd. Study on flow characteristics in vertical slot fishways regarding slot layout optimization. Ecological engineering. [Print ed.]. okt. 2017, letn. 107, str. 126-136. DOI: 10.1016/j.ecoleng.2017.07.008.

ŠKERJANEC, Mateja, KREGAR, Klemen, ŠTEBE, Gašper, RAK, Gašper. 2022. Analysis of floating objects based on non-intrusive measuring methods and machine learning. Geomorphology: an international journal of pure and applied geomorphology, 408. DOI: 10.1016/j.geomorph.2022.108254.

RAK, Gašper, HOČEVAR, Marko, STEINMAN, Franci. 2018. Construction of water surface topography using LIDAR data. Strojniški vestnik, 64 (9): 555-565. DOI: 10.5545/sv-jme.2017.4619.

RAK, Gašper, HOČEVAR, Marko, STEINMAN, Franci. 2020. Non-intrusive measurements of free-water-surface profiles and fluctuations of turbulent, two-phase flow using 2-D laser scanner. Measurement science & technology: 1-14. DOI: 10.1088/1361-6501/ab727f.

UČNI NAČRT PREDMETA/COURSE SYLLABUS

Predmet:	
	HIDROLOŠKO MODELIRANJE
Course title:	
	HYDROLOGICAL MODELLING

Študijski programi in stopnja	Študijska smer	Letnik	Semestri
Vodarstvo in okoljsko inženirstvo, druga stopnja, magistrski	Ni členitve (študijski program)	1. letnik	1. semester

Univerzitetna koda predmeta/University course code:	0035020
Koda učne enote na članici/UL Member course code:	1587

Predavanja	Seminar	Vaje	Klinične vaje	Druge oblike študija	Samostojno delo	ECTS
30	0	0	60	0	90	6

Nosilec predmeta/Lecturer:	Mojca Šraj

Vrsta predmeta/Course type:	Obvezni strokovni/Obligatory professional

Jeziki/Languages:	Predavanja/Lectures:	Slovenščina
	Vaje/Tutorial:	Slovenščina

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:	**Prerequisites:**
Opravljen izpit iz predmeta Hidrologija ali ustrezna primerljiva znanja.	Passed exam in Hydrology or adequate comparable knowledge.

Vsebina:	**Content (Syllabus outline):**
Predavanja Modeli, klasifikacija, uporaba osnov teorije sistemov. Osnove uporabe stohastike v hidrologiji. Hidrogram enote in sintetični hidrogram enote. Metode za oceno točnosti rezultatov modeliranja. Regionalizacija hidroloških pojavov. Poplave in hidrološke prognoze. Modeliranje podzemnih voda. Vplivi posameznih objektov na spremembo režima voda. Vaje	Lectures Models, classification, application of basics of systems theory. Basics of application of stochastic in hydrology. Unit hydrograph (UH) and synthetic unit hydrograph. Methods for estimating accuracy of modelling results. Regionalisation in hydrology. Floods and hydrological forecast. Groundwater modelling. Influence of individual structures on changes in water regime.

Laboratorijske vaje v računalniški učilnici z uporabo hidroloških modelov (HEC-HMS, HBV ipd.) in modelov podtalnice (MODFLOW, PESTAN – avtomatska kalibracija) v kombinaciji z osnovnimi GIS orodji (SAGA) za določitev vhodnih podatkov v modele.	Tutorials Lab tutorials in computer classroom using hydrological models (HEC-HMS, HBV, etc.) and groundwater flow models (MODFLOW, PESTAN – automatic calibration) in combination with the basic GIS tools for the model input data assessment.

Temeljna literatura in viri/Readings:

BRILLY, Mitja, ŠRAJ, Mojca. 2006. Modeliranje površinskega odtoka in navodila za program HEC-HMS. Ljubljana, Univerza v Ljubljani, Fakulteta za gradbeništvo in geodezijo, VII, 172 str.

ŠRAJ, Mojca. 2010. Model podzemnega toka = Ground water flow model. Ljubljana, Fakulteta za gradbeništvo in geodezijo, 22 str.

ŠRAJ, Mojca, NARTNIK, Miha, BRILLY, Mitja. 2009. Priročnik za uporabo programa MODFLOW in 3D Groundwater Explorerja. Ljubljana Fakulteta za gradbeništvo in geodezijo, VI, 247 str.

Maidment, D. R. 1992. Handbook of Hydrology, izbrana poglavja. McGraw-Hill, 1424 str.

Kresic, N. 1997. Quantitative Solutions in Hydrogeology and groundwater modeling, izbrana poglavja. New York, Lewis Publishers, 461 str.

Strani ARSO z bazami hidroloških in meteoroloških podatkov.

Dostopno na: http://www.arso.gov.si/ .

Hidrološko izrazje v slovenskem, angleškem, francoskem in nemškem jeziku.

Dostopno na: ftp://ksh.fgg.uni-lj.si/acta/a32_1.pdf .

Učno gradivo v spletni učilnici UL FGG.

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

Cilji	Objectives
- Nadgraditi osnovno znanje hidrologije pri uporabi hidroloških modelov.	- Upgrading of basic knowledge in hydrology by application of hydrologic models.
- Podati osnove izdelave hidroloških modelov.	- Basics of hydrological modelling.
- Podati teoretične osnove za analizo rezultatov hidroloških modelov.	- Theoretical background of analysing the results of hydrological models.
Kompetence	Competences
- Sposobnost kritične uporabe različnih hidroloških modelov pri urejanju vodnega režima.	- Ability of using different hydrological models for water regime managemen.

Predvideni študijski rezultati: | **Intended learning outcomes:**

- Pridobljeno poglobljeno znanje iz hidrološkega modeliranja.	- Advanced knowledge in hydrological modeling.
- Osvojene računske spretnosti za pripravo podatkov, umerjanje hidroloških modelov in analizo rezultatov.	- Computer skills in data preparation, model calibration and results analysing. - Using knowledge for the preparation of master degree and/or in engineering practice. Reflection:

- Doseženo znanje uporabljajo pri izdelavi diplomskega dela oz. v inženirski praksi. Refleksija: - Dobro razumevanje gibanja vode in vpliva različnih ukrepov na hidrološki vodni režim. - Sposobnost abstraktne formulacije naravnih procesov. - Sposobnost kritične presoje vhodnih podatkov in dobljenih računskih rezultatov pri načrtovanju ukrepov. - Sposobnost ugotavljanja skladnosti modelov dogajanja z opazovanim razvojem v naravi. - Sposobnost upoštevanja dinamike naravnih procesov pri načrtovanju človekove dejavnosti v prostoru. - Sposobnost uporabe računalniških programov za analizo hidroloških pojavov.	- Good understanding of water motion and influence of different measures on water regime. - Ability of abstract formulation of natural processes. - Ability of critical judgment of input data and calculated results for planning measures. - Ability to assess compliance of models with observations in nature. - Ability to consider the dynamic of hydrological processes for planning human activity in space. - Ability of using software for hydrologic analyses.

Metode poučevanja in učenja: **Learning and teaching methods:**

Predavanja, laboratorijske vaje, meritve, uporaba IKT, skupinsko in problemsko zasnovano delo, interaktivno delo preko spletne učilnice (forumi, klepetalnice, kvizi, lekcije, dnevniki, individualno reševanje nalog, Wiki).	Lectures, lab tutorials, measurements, using ICT, group and problem-based work, interactive work through e-classroom (forums, chats, quizzes, lessons, blogs, individual exercises, Wiki).

Načini ocenjevanja: **Delež/Weight** **Assessment:**

Načini ocenjevanja:	Delež/Weight	Assessment:
Teoretični del	20,00 %	Theoretical part
Oddane vaje	40,00 %	Coursework/lab exercises
Računski del	40,00 %	Practical part

Reference nosilca/Lecturer's references:

ŠRAJ, Mojca, VIGLIONE, Alberto, PARAJKA, Juraj, BLÖSCHL, Günter. The influence of non-stationarity in extreme hydrological events on flood frequency estimation. Journal of Hydrology and Hydromechanics, 2016, letn. 64, št. 4, str. 426-437.

ŠRAJ, Mojca, BEZAK, Nejc, BRILLY, Mitja. Bivariate flood frequency analysis using the copula function : a case study of the Litija station on the Sava River. *Hydrological processes*, 2015, letn. 29, št. 2, str. 225-238.

PESTOTNIK, Simona, HOJNIK, Tomaž, ŠRAJ, Mojca. Analiza možnosti uporabe distribuiranega dvodimenzijskega modela Flo-2D za hidrološko modeliranje = Analysis of the possibility of using the distributed two-dimensional model Flo-2D for hydrological modeling. Acta hydrotechnica, 2012, letn. 25, št. 43, str. 85-103.

UČNI NAČRT PREDMETA/COURSE SYLLABUS

Predmet:	
	VODOVOD IN PRIPRAVA PITNE VODE
Course title:	
	DRINKING WATER SUPPLY AND TREATMENT

Študijski programi in stopnja	Študijska smer	Letnik	Semestri
Vodarstvo in okoljsko inženirstvo, druga stopnja, magistrski	Ni členitve (študijski program)	1. letnik	1. semester

Univerzitetna koda predmeta/University course code:	0035021
Koda učne enote na članici/UL Member course code:	1588

Predavanja	Seminar	Vaje	Klinične vaje	Druge oblike študija	Samostojno delo	ECTS
45	15	0	55	5	120	8

Nosilec predmeta/Lecturer:	Nataša Atanasova

Vrsta predmeta/Course type:	Obvezni strokovni/Obligatory professional

Jeziki/Languages:	Predavanja/Lectures:	Slovenščina
	Vaje/Tutorial:	Slovenščina

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:	**Prerequisites:**
Opravljen izpit iz predmetov Hidravlika in Osnove zdravstvene hidrotehnike ali ustrezna primerljiva znanja.	Passed exams in Hydraulics and Basics of Sanitary Engineering or adequate comparable knowledge.

Vsebina:	**Content (Syllabus outline):**
Predavanja	Lectures
Uvod, poslanstvo, zgodovinski razvoj. Analiza porabe vode, norma porabe. Vodni viri in zajetja. Vrste in razdelitev vodovodnih sistemov. Objekti na vodovodnih sistemih. Karakteristike cevi in črpalk. Hidravlični izračun vodovodnega sistema. Kakovost vode. Osnovni koncepti priprave pitne vode. Grobo in fino precejanje, filtracija na zrnavih filtrih,	Introduction, mission, history. Water demand and analysis of water uses. Water sources. Types and classification of water supply systems. Elements of water supply systems. Pipes and pumps. Hydraulics of water supply systems. Water Quality. Basic concepts of water treatment. Filtration – sand and membranes. Settling and flotation, coagulation and

membranski filtri. Usedanje in plavljenje, koagulacija in flokulacija. Mehčanje, ionska izmenjava, razželezenje in razmanganjenje, aktivno oglje. Primarna in sekundarna dezinfekcija vode, stranski produkti dezinfekcije. Napredni postopki čiščenja voda.

Laboratorijske vaje

Laboratorijske določitve kakovosti vode: mikrobiološki parametri; fizikalno-kemijski parametri; senzorični parametri. Fizikalno-kemijski postopki.

Študentje izvajajo vaje v laboratoriju pod vodstvom asistenta in laboranta, nato pa izvajajo individualne preračune kot vaje. Študentje izdelujejo vaje pod vodstvom asistenta, ki izvaja vajo na tabli, oz. s projekcijo v računalnici. Uporaba matematičnih modelov: Hardy-Cross, EPANET.

Seminar

Študentje dobijo individualno situacijo, za katero morajo narediti projekt zajema in priprave pitne vode ter razvoda po primarnih in sekundarnih cevovodih. Izvesti morajo hidravlični preračun za značilne obremenitve.

flocculation. Softening, ion exchange, treatment of iron and manganese. Primary and secondary disinfection, disinfection by-products. Advanced water treatment processes.

Laboratory tutorials

Laboratory measurements of water quality: microbiological parameters, physical and chemical parameters; sensor parameters. Physical and chemical procedures.

The laboratory tutorials are done under supervision of an assistant and lab technician, followed by individual calculations. Tutorials are held by an assistant in a classroom. Use of mathematical models: Hardy-Cross, EPANET.

Seminar work

Students are expected to elaborate a project for water catchment, water treatment and water distribution for given situation (small town). Within the work they perform hydraulic calculation for all characteristic loads of the water supply system.

Temeljna literatura in viri/Readings:

Kompare, B. Rismal M. 1996, 2013. Priprava pitne vode (skripta).

Viessman, W., Hammer, M.J., Chadik, P., Perez, E.M. 2008. Water Supply and Pollution Control: International Version. Pearson Education.

Malcolm J. Brandt, K. Michael Johnson, Andrew, J. Elphinston, Don D. Ratnayaka (2017). Water Supply. 2017 Elsevier Ltd. ISBN 978-0-08-100025-0. DOI https://doi.org/10.1016/C2012-0-06331-4 .

John C. Crittenden, R. Rhodes Trussell, David W. Hand, Kerry J. Howe, George Tchobanoglous. MWH's Water Treatment: Principles and Design, Third Edition: Principles and Design. ISBN:9780470405390. DOI:10.1002/9781118131473.

Cilji in kompetence:

Cilji

- Cilj predmeta je študentom dati znanja in spretnosti za načrtovanje in izvedbo vodovodnih sistemov.

Kompetence

- Študent se nauči načrtovati zajem vode, pripravo pitne vode in razdelitev po naselju. Nauči se izvajati iterativni preračun vodovodnega omrežja v excelu in

Objectives and competences:

Objectives

- To gain knowledge and skills for the design and implementation of water supply systems.

Competences

- Design of water catchment elements, water treatment utilities, and water distribution networks, hydraulics calculations of water supply systems in

uporabljati EPANET. Razume in zna preveriti dobljene rezultate modeliranja.	spreadsheet SW and EPANET. Students are qualified to understand and interpret modelling results.

Predvideni študijski rezultati:

Intended learning outcomes:

- Znanje reševanja vodooskrbe naselij. - Izvajanje projektov vodooskrbe.	- Knowledge about solving water supply for residential areas. - Implementing water supply projects.

Metode poučevanja in učenja:

Learning and teaching methods:

Predavanja in laboratorijske vaje. Uporaba pridobljenih znanj pri izdelavi individualne seminarske naloge. Predvideni so ogledi objektov in naprav v okolici Ljubljane in ekskurzija po Sloveniji.	Lectures and laboratory tutorials. Use of the acquired knowledge for the elaboration of individual seminar work. Foreseen are visits to objects and devices in the vicinity of Ljubljana and field trip in Slovenia.

Načini ocenjevanja: | **Delež/Weight** | **Assessment:**

Načini ocenjevanja:	Delež/Weight	Assessment:
Pisni in/ali ustni izpit	50,00 %	Written and/or oral exam
Seminarska naloga	20,00 %	Seminar work
Vaje	30,00 %	Tutorials

Reference nosilca/Lecturer's references:

NIKA, Elisa, GUSMAROLI, Lucia, GHAFOURIAN, Matia, ATANASOVA, Nataša, BUTTIGLIERI, Gianluigi, KATSOU, Evina. Nature-based solutions as enablers of circularity in water systems - a review on assessment methodologies, tools and indicators. Water research. 2020, letn. 183, št. sept. 115988, str. 1-19, ilustr. ISSN 0043-1354. DOI: 10.1016/j.watres.2020.115988. [COBISS.SI-ID 23012099].

ATANASOVA, Nataša, DALMAU, Montserrat, COMAS, Joaquim, POCH ESPALLARGAS, Manel, RODRIGUEZ-RODA, Ignasi, BUTTIGLIERI, Gianluiggi. Optimized MBR for greywater reuse systems in hotel facilities. Journal of environmental management, ISSN 0301-4797, 2017, letn. 193, št. maj, str. 503-511, ilustr., doi: 10.1016/j.jenvman.2017.02.041. [COBISS.SI-ID 8125793].

ATANASOVA, Nataša, RADINJA, Matej. Krožno upravljanje z vodo v urbanem okolju. Slovenski vodar. 2020, 30, str. 6-10, ilustr. ISSN 1318-6051. [COBISS.SI-ID 45191171]

RADINJA, Matej, ATANASOVA, Nataša. Alternativni vodni viri v mestih. V: CERKVENIK, Stanka (ur.), ROJNIK, Enisa (ur.). Vodni dnevi 2019 : simpozij z mednarodno udeležbo : zbornik referatov: 17.-18. oktober 2019, Portorož, Kongresni center Bernardin. Str. 161-172, ilustr. ISBN 978-961-6631-14-3. [COBISS.SI-ID 8932449].

DALMAU, Montserrat, MONCLÚS, Hèctor, ESPASA, Joan, ATANASOVA, Nataša, POCH ESPALLARGAS, Manel, PERE, Emiliano, CAPDEVILA, Oriol, GONZÁLEZ, Santiago, VALERO, Fernando. Fuzzy vs neural network models for environmental decision support system implementation aiming to standardise the multiparametric decision in a "Drinking Water Plant" with electrodialysis reversal. V: SAUVAGE, Sabine (ur.). Supporting sustainable futures. Toulouse: International Environmental Modelling and Software Society, 2016. Str. 1-8, ilustr. https://scholarsarchive.byu.edu/cgi/viewcontent.cgi?article=1596&context=iemssconference. [COBISS.SI-ID 8543841].

UČNI NAČRT PREDMETA/COURSE SYLLABUS

Predmet:	
	VODENJE PROJEKTOV
Course title:	
	PROJECT MANAGEMENT

Študijski programi in stopnja	Študijska smer	Letnik	Semestri
Vodarstvo in okoljsko inženirstvo, druga stopnja, magistrski	Ni členitve (študijski program)	1. letnik	1. semester

Univerzitetna koda predmeta/University course code:	0035022
Koda učne enote na članici/UL Member course code:	1496

Predavanja	Seminar	Vaje	Klinične vaje	Druge oblike študija	Samostojno delo	ECTS
30	0	0	30	0	60	4

Nosilec predmeta/Lecturer:	Robert Klinc

Vrsta predmeta/Course type:	Obvezni strokovni/Obligatory professional

Jeziki/Languages:	Predavanja/Lectures:	Slovenščina
	Vaje/Tutorial:	Slovenščina

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:	Prerequisites:

Vsebina:

Content (Syllabus outline):

Predavanja

Projekt kot sistem, cilji projekta, komponente in relacije v projektu, odnos z okoljem. Organizacija izvajanja projektov, stalna in nestalna projektna organiziranost. Področja projektnega vodenja.

Specifika in faze projektov v gradbeništvu. Strukturiranje projekta, matrika odgovornosti.

Planiranje in spremljanje projektov. Oblikovanje projektnega tima. Upravljanje s tveganji.

Lectures

Project as a system, project goals, project components and their relationships, project environment interaction. Project execution organisation, permanent and temporary project organisation. Areas of project management

Specific features and project phases in construction projects. Project structuring, responsibility matrix

Vaje	Project planning and monitoring. Formation of a project team. Risk management
Izdelava lastnega projekta od zasnove do generalnega plana. Modeliranje tveganj pri projektih v gradbeništvu in simulacija vplivov.	Tutorial
	Preparation of a case study. Risk simulation in construction projects, impact simulation.

Temeljna literatura in viri/Readings:

Rant, M., Jeraj, M., & Ljubič, T. (1998). Vodenje projektov: projektni pristop, projektna organizacija, vodenje projektov, projektni proces, terminsko planiranje projektov, mrežno planiranje (2. izd.). POIS.

Česen, A., Kern, T., Bajec, M. (2008). Vodnik po znanju projektnega vodenja, 3. Izdaja. Založba Moderna organizacija

Golob, K. (2021). Investicijski procesi in vodenje projektov: [gradivo za strokovne izpite]. 2. ponatis. Ljubljana: Inženirska zbornica Slovenije.

Project Management Institute, ed. The Standard for Project Management and a Guide to the Project Management Body of Knowledge (PMBOK Guide). Seventh edition. Newtown Square, Pennsylvania: Project Management Institute, Inc, 2021.

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

Pridobitev znanj o posameznih udeležencih v procesu graditve, fazah projekta (s poudarkom na gradbenem projektu), in procesu vodenja projekta.	Acquisition of basic knowledge regarding construction project participants, project phases (with emphasis on construction projects), and the process of project management.

Predvideni študijski rezultati: **Intended learning outcomes:**

Osvojeno znanje s področja projektnega vodenja (proces, udeleženci, medsebojni odnosi, oblike sodelovanja), sposobnost uporabe računalniških orodij za vodenje projektov.	Acquired knowledge from the field of project management (process, stakeholders, participants' relations), ability to use computer – supported project management tools.

Metode poučevanja in učenja: **Learning and teaching methods:**

Predavanja, laboratorijske vaje	Lectures, laboratory tutorial

Načini ocenjevanja: **Delež/Weight**   **Assessment:**

Način ocenjevanja	Delež/Weight	Assessment
Pisni izpiti (računski del)	50,00 %	Written exam (examples)
Pisni izpit (teoretični del)	50,00 %	Written exam (theory)

Reference nosilca/Lecturer's references:

KLINC, Robert, TURK, Žiga. Construction 4.0 - digital transformation of one of the oldest industries. Economic and business review. 2019, vol. 21, no. 3, str. 393-410, ilustr. ISSN 1580-0466.

http://ojs.ebrjournal.net/ojs/index.php/ebr/article/view/786/pdf_163, https://repozitorij.uni-lj.si/IzpisGradiva.php?id=114085&lang=slv, DOI: 10.15458/ebr.92. [COBISS.SI-ID 9010017].

KLINC, Robert, DOLENC, Matevž, TURK, Žiga. Novi trendi na področju sodelovalnega inženirstva = New trends in collaborative engineering. Gradbeni vestnik : glasilo Zveze društev gradbenih inženirjev in tehnikov Slovenije. [Tiskana izd.]. nov. 2011, letn. 60, št. 11, str. 300-309, ilustr. ISSN 0017-2774. [COBISS.SI-ID 5623393].

KLINC, Robert, DOLENC, Matevž. Vpliv IT na produktivnost. Sistem : nove tehnologije za poslovni svet. [Tiskana izd.]. 2007, december, str. 12-14, barvne ilustr. ISSN 1318-9077. [COBISS.SI-ID 3786849].

UČNI NAČRT PREDMETA/COURSE SYLLABUS

Predmet:	
	OSNOVE PROSTORSKE SOCIOLOGIJE
Course title:	
	BASICS OF SPATIAL SOCIOLOGY

Študijski programi in stopnja	Študijska smer	Letnik	Semestri
Vodarstvo in okoljsko inženirstvo, druga stopnja, magistrski	Ni členitve (študijski program)	1. letnik	1. semester

Univerzitetna koda predmeta/University course code: 0035029

Koda učne enote na članici/UL Member course code: 1634

Predavanja	Seminar	Vaje	Klinične vaje	Druge oblike študija	Samostojno delo	ECTS
45	0	0	0	0	45	3

Nosilec predmeta/Lecturer: Matjaž Uršič

Vrsta predmeta/Course type: Obvezni strokovni/Obligatory professional

Jeziki/Languages:	Predavanja/Lectures:	Slovenščina
	Vaje/Tutorial:	Slovenščina

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:

Prerequisites:

Vsebina:

Konceptualno terminološka vprašanja.

Dinamika prostorskih sprememb in nastajanje novih prostorskih identitet. Načini družbene konstrukcije prostora. Vrednotne spremembe v »post/modernih« družbah. Novi prostorski trendi, suburbanizacija, dezurbanizacija, nova »kolonizacija« podeželja ipd. Nekatere posebnosti slovenskega prostorskega razvoja. Družbeni učinki posegov v prostor oz. problemi legitimizacije posegov v prostor

Content (Syllabus outline):

Conceptual and terminologica questions. Dynamics of spatial changes and emerging of new spatial identities. Different mode of social construction o space. Value changes in »post/modern« societies.

New spatial trends: suburbanisation, desurbanisation, new »colonisation of rural space« etc. Some specific characteristics of slovene spatial development. Social implications of spatial projects and the legitimisation problems. Case studies of past

Predstavitve konkretnih primerov preteklega, sedanjega in simulacije prihodnjega prostorskega razvoja.	and present spatial development and simulation of future development.

Temeljna literatura in viri/Readings:

Kos, D. 2002. Praktična sociologija za načrtovalce in urejevalce prostora. Ljubljana, FDV.
Kos, D. 1993. Racionalnost neformalnih prostorov. Ljubljana, Znanstvena knjižnjica, FDV, 264 str.
Gantar, P. 1994. Sociološka kritika teorij planiranja. Ljubljana, FDV.
Castells Manuel. 1997. The Information Age (I,II) The Rise of the Network Society; The Power of Identity. Oxford, Blackwell.
Urry John. 1995. Consuming Places. London, Routledge.

Cilji in kompetence:	**Objectives and competences:**
- Razumevanje inkrementalističnih sprememb v dojemanju grajenega okolja postmodernih družb. - Razumevanje novih družbenih trendov in njihovih vplivov na razvoj mest, regij in podeželja in obratno. - Razviti analitične in interpretacijske spretnosti. - Razviti interdisciplinarno komunikacijo v prostorskem načrtovanju in načrtovanju naselij.	- To understand incremental changes in perception of built environment in postmodern societies. - To understand new social trends and its influence on urban, regional and rural development and vice versa. - To develop analitical and interpretative skils. - To develop interdisciplinary communication in spatial and urban planning.

Predvideni študijski rezultati:	**Intended learning outcomes:**
- razumeti odnos družba in prostor, - znati načrtovati poseg v različnih okoljih tako, da bo družbeno sprejemljiv, - razvijati presoje družbenih vplivov pri posegih v prostor. Prenosljive/ključne spretnosti in drugi atributi: razumeti povezavo med družbeni subsistemi in načrtovanjem in regulacijo rabe prostora.	- to understand the relation between society and space, - to legitimise the planning and regulative processes and actions, - to develop social impact evaluations of spatial activity. Transferable/Key Skills and other attributes: to understand the correlation between the social subsystems and planning and regualtion of space.

Metode poučevanja in učenja:	**Learning and teaching methods:**
Predavanja, samostojno delo (domače naloge).	Lectures, individual work.

Načini ocenjevanja:	**Delež/Weight**	**Assessment:**
Pisno preverjanje	60,00 %	Written exam
Domače naloge	40,00 %	Individual work

Reference nosilca/Lecturer's references:

URŠIČ, Matjaž, HOČEVAR, Marjan. Protiurbanost kot način življenja, (Knjižna zbirka Ost, 02). 1. natis. Ljubljana: Fakulteta za družbene vede, 2007. 128 str., ilustr. ISBN 978-961-235-310-0. [COBISS.SI-ID 236570880]

URŠIČ, Matjaž. Urbani prostori potrošnje, (Knjižna zbirka Teorija in praksa). Ljubljana: Fakulteta za družbene vede, 2003. 133 str., ilustr., tabele. ISBN 961-235-144-9. [COBISS.SI-ID 128174848]

URŠIČ, Matjaž, KRIŽNIK, Blaž. Comparing urban renewal in Barcelona and Seoul : urban management in conditions of competition among global cities. Springer - Asia Europe journal, ISSN 1610-2932, 2012, vol. 10, no. 1, str. 21-39, ilustr., doi: 10.1007/s10308-012-0319-1. [COBISS.SI-ID 31219549]

URŠIČ, Matjaž. The problem of "expert interpretative vacuum" in media discourses - discourse analysis of texts on Ljubljana urbanism. V: ECKARDT, Frank (ur.). Media and urban space : understanding, investigating and approaching mediacity. Berlin: Frank & Timme. cop. 2008, str. 145-166, ilustr. [COBISS.SI-ID 27061341

URŠIČ, Matjaž. The importance of culture in urban regeneration practices. V: FISCHER, Katrin. Revitalisation through arts and culture : new developments for 5 European industrial complexes. Nürnberg: Second Chance. cop. 2012, str. 29-37, fotogr. [COBISS.SI-ID 31891037]

URŠIČ, Matjaž, MAKSUTI, Alem, DEŽELAN, Tomaž. The salience of local urban development in the political party arena : a longitudinal analysis of Slovenian parliamentary party programmes. V: Lex localis - Journal of Local Self Government. Maribor: Institute for Local Self-Government and Public Procurement. 2015, vol. 13, no. 3, str. 615-638, ilustr., doi: 10.4335/13.3.639-638(2015). [COBISS.SI-ID 33386077],

KUHAR, Metka, PETROVČIČ, Andraž. The quality of parliamentary deliberation : the case of the Family Code debates in the Slovenian Parliament. Javnost, ISSN 1318-3222, 2017, vol. 24, no. 1, str. 71-86, tabela. http://dx.doi.org/10.1080/13183222.2017.1267167, doi: 10.1080/13183222.2017.1267167. [COBISS.SI-ID 34587997],

KUHAR, Metka. Dialoške razsežnosti medosebnega komuniciranja v socialnem kontekstu. Teorija in praksa : revija za družbena vprašanja, ISSN 0040-3598, nov.-dec. 2015, letn. 52, št. 6, str. 1212-1230, 1249. http://dk.fdv.uni-lj.si/db/pdfs/TiP2015_6_Kuhar1.pdf. [COBISS.SI-ID 33787485],

Za še podrobnejši opis referenc glej spletni bibliografski sistem: WWW.COBISS.SI

UČNI NAČRT PREDMETA/COURSE SYLLABUS

Predmet:	
	UREJANJE VODOTOKOV
Course title:	
	RIVER ENGINEERING

Študijski programi in stopnja	Študijska smer	Letnik	Semestri
Vodarstvo in okoljsko inženirstvo, druga stopnja, magistrski	Ni členitve (študijski program)	1. letnik	2. semester

Univerzitetna koda predmeta/University course code:	0035023
Koda učne enote na članici/UL Member course code:	1651

Predavanja	Seminar	Vaje	Klinične vaje	Druge oblike študija	Samostojno delo	ECTS
60	30	15	0	15	120	8

Nosilec predmeta/Lecturer: Matjaž Mikoš , Simon Rusjan

Vrsta predmeta/Course type: Obvezni strokovni /Obligatory professional

Jeziki/Languages:

Predavanja/Lectures:	Slovenščina	
Vaje/Tutorial:	Slovenščina	

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:

Prerequisites:

Opravljen izpit iz predmetov Hidravlično modeliranje in Hidrološko modeliranje.	Passed exams in Hydraulic modelling, Hydrological modeling.

Vsebina:

Content (Syllabus outline):

Predavanja	Lectures
Osnove urejanja vodotokov: rečna hidravlika, rečna mehanika (prodonosnost in kalnost), rečna morfologija, erozija in sedimentacija. Klasično urejanje vodotokov: ukrepi varstva pred visokimi vodami, urejanje struge vodotoka, dimenzioniranje in vzdrževanje posameznih vodnih zgradb, jezovne zgradbe in ribji prehodi. Sonaravno urejanje vodotokov: rečni koridor, hidromorfološko stanje	River engineering basics: river hydraulics, river mechanics (bed load and suspended loads), river morphology, erosion and sedimentation. Classic river engineering: flood protection works, river channel works, dimensioning and maintenance of different river structures, weirs and fish passages. Natural river engineering: river corridor, hydromorphological status of rivers, basics of

vodotokov, osnove inženirske biologije, katalog sonaravnih ureditev, načrtovanje in vzdrževanje sonaravnih ureditev.	bioengineering, catalogue of river bioengineering river works, planning and maintenance of river bioengineering works.
Seminarske vaje	**Tutorials**
Računske vaje iz rečne hidravlike in mehanike. Modeliranje toka voda in plavin na fizičnem modelu za razumevanja osnov rečne morfologije in delovanja vodnih objektov.	Computational tutorials in river hydraulics and mechanics. Modelling of river water and sediment flow on a physical (hydraulic) model to understand basics of river morphology and effects of river training works.
Seminar	**Seminar**
Hidravlični račun izbranega odseka vodotoka z uporabo najnovejše različice programa HEC-RAS ali Flo-2D.	Hydraulic computation of a selected river reach using the newest version of the computer code HEC-RAS.
Terensko delo	**Field work**
Zasnova in izvedba tehničnih ureditev na rekah (ogled gradbišč in urejenih odsekov vodotokov). Analiza zrnavosti rečnih sedimentov.	Preliminary design and execution of technical river training works (construction sites). Grain-size anaysis of river sediments

Temeljna literatura in viri/Readings:

Mikoš, M. 2008. Urejanje vodotokov – skripta, verzija. Ljubljana, UL FGG, Katedra za splošno hidrotehniko, 220 str.

Patt, H., Jürging, P., Kraus, W. 2004. Naturnaher Wasserbau - Entwicklung und Gestaltung von Fließgewässern, Springer Verlag, 423 p.

Hydrologic Engineering Center. Dostopno na: http://www.hec.usace.army.mil/software/hec-ras/.

Spletne strani resornega ministrstva (MKO) s področja vodne infrastrukture (vodnih objektov).

Spletne strani Atlasa okolja. Dostopno na: http://gis.arso.gov.si/atlasokolja/.

Strokovna priporočila Nemškega združenja za vodno gospodarstvo, odpadne vode in odpadke (DWA). Dostopno v Knjižnici UL FGG.

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

Cilji:	Objectives:
- Nadgraditi osnovno znanje hidravlike z znanjem rečne hidravlike, mehanike in morfologije.	- Upgrade of basic knowledge of hydraulics with knowledge of river hydraulics, mechanics and morphology.
- Podati pregled klasičnih in modernih (sonaravnih) metod urejanja vodotokov z osnovami njihovega načrtovanja, dimenzioniranja in vzdrževanja.	- Giving an overview of classical and modern (bioengineering) river engineering methods with the basics of their planning, design and maintenance.
Kompetence:	Competencies:
- Sposobnost terenskega prepoznavanja razmer na vodotoku.	- Ability to field identification of conditions in a stream.
- Sposobnost izdelave ureditvenih načrtov odsekov vodotokov.	

	- Ability to prepare river engineering plans for stream reaches.

Predvideni študijski rezultati: **Intended learning outcomes:**

- Pridobljeno poglobljeno znanje iz rečne hidravlike in mehanike (dinamike). - Razumevanje procesov erozije in sedimentacije. - Osvojene računske spretnosti za hidravlično modeliranje in načrtovanje ureditvenih ukrepov na vodotokih. - Sposobnost abstraktne formulacije naravnih procesov in upoštevanja dinamike naravnih procesov pri načrtovanju človekove dejavnosti v prostoru. - Sposobnost kritične presoje vhodnih podatkov in računskih rezultatov pri načrtovanju ukrepov.	- Acquired in-depth knowledge of river hydraulics and mechanics (dynamics). - Understanding of erosion and sedimentation processes. - Learned numerical skills for hydraulic modelling and designing of training works in rivers. - Ability to abstract formulations of natural processes and taking into account the dynamics of natural processes in spatial planning of human activities. - Ability for critical analysis of input data and calculation results when planning interventions.

Metode poučevanja in učenja: **Learning and teaching methods:**

Predavanja, seminarske vaje, seminar, terensko delo.	Lectures, seminar tutorials, seminar work, field work.

Načini ocenjevanja:	**Delež/Weight**	**Assessment:**
Seminarske vaje	10,00 %	Seminar tutorials
Pisni in/ali ustni izpit	40,00 %	Written and/or oral examination
Terensko delo	10,00 %	Field work report
Seminar	40,00 %	Seminar coursework

Reference nosilca/Lecturer's references:

PETKOVSKA, V., URBANIČ, G., MIKOŠ, M., 2015. Variety of the guiding image of rivers - defined for ecologically relevant habitat features at the meeting of the alpine, mediterranean, lowland and karst regions. Ecological engineering 81, 373-386.

OJSTERŠEK ZORČIČ, P., MIKOŠ, M., KOŠMELJ, K., PINTAR, M., 2015. Nitrate concentration changes in a river and its reservoir within an agriculturally influenced watershed: the river Ledava (SE Austria and NE Slovenia) case study. Fresenius environmental bulletin 24(4b), 1537-1548.

SMOLAR-ŽVANUT, N., MIKOŠ, M., 2014. The impact of flow regulation caused by hydropower dams on the periphyton community in the Soča River, Slovenia. Hydrological sciences journal 59(5), 1032-1045.

RUSJAN, Simon, KOBOLD, Mira, MIKOŠ, Matjaž. Characteristics of the extreme rainfall event and consequent flash floods in W Slovenia in September 2007. Natural hazards and earth system sciences, 2009, letn. 9, pos. št., str. 947-956.

DŽEBO, Elvira, ŽAGAR, Dušan, RUSJAN, Simon, MIKOŠ, Matjaž, ČETINA, Matjaž. Computation of bed shear stresses in natural torrential channels using smooth particle hydrodynamics. V: Deltas of the future and what happens upstream : e-proceedings. Hague: IAHR, 2015, str. 1-10.

UČNI NAČRT PREDMETA/COURSE SYLLABUS

Predmet:	
	DRENIRANJE IN NAMAKANJE
Course title:	
	DRAINAGE AND IRRIGATION

Študijski programi in stopnja	Študijska smer	Letnik	Semestri
Vodarstvo in okoljsko inženirstvo, druga stopnja, magistrski	Ni členitve (študijski program)	1. letnik	2. semester

Univerzitetna koda predmeta/University course code: 0035024

Koda učne enote na članici/UL Member course code: 1652

Predavanja	Seminar	Vaje	Klinične vaje	Druge oblike študija	Samostojno delo	ECTS
40	0	0	45	5	90	6

Nosilec predmeta/Lecturer: Mojca Šraj

Vrsta predmeta/Course type: Obvezni strokovni /Obligatory professional

Jeziki/Languages:

Predavanja/Lectures:	Slovenščina
Vaje/Tutorial:	Slovenščina

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:

Prerequisites:

Opravljen izpit iz predmetov Hidrološko modeliranje in Hidravlika ali ustrezna primerljiva znanja.	Passed exams in Hydrological modeling and Hydraulics or adequate comparable knowledge.

Vsebina:

Content (Syllabus outline):

Predavanja

Uvod: pomen in vrsta melioracij, program osuševanja in namakanja v Sloveniji in v svetu. Vpliv podnebnih sprememb. Principi agrohidrologije: voda v naravi, vodna bilanca tal, analiza parametrov za potrebe osuševanja in namakanja, rastlina in voda, tla in voda.

Drenaža: vrste drenažnih sistemov, hidropedologija, talna voda, načrtovanje, izvedba in vzdrževanje

Lectures

Introduction: importance and types of drainage and irrigation systems, drainage and irrigation programme in Slovenia and abroad. Impact of climate changes. Principles of soil hydrology: water in nature, soil water balance, analysis of the parameters for the purpose of drainage and irrigation, plant and water, soil and water.

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drenažnih sistemov, drenaža v specifičnih pogojih, izdelava drenažnega načrta - program. Objekti za zaščito pred poplavami. Namakanje: pomen in vpliv namakanja na proizvodnjo hrane, vrste namakalnih sistemov, naravni viri in izbira sistema za namakanje, načini namakanja, načrtovanje, izvedba in vzdrževanje namakalnih sistemov, uporaba pesticidov in herbicidov. Objekti v sistemu za namakanje.

Ekonomika osuševanja in namakanja: rentabilnost naložb v melioracije, načini financiranja. Melioracije in varstvo okolja: prostorski in

naravovarstveni aspekti osuševanja in namakanja (vegetacijski pasovi). Integralne melioracije: celovit pristop urejanja zemljišč in kmetijske infrastrukture, urejanje kmetijskega prostora. Zaščita in varovanje vodnih virov. Načrtovanje izkoriščanja vodnih virov in njihova porazdelitev.

Vaje

Laboratorijske vaje v računalniški učilnici z uporabo programov ter različnih modelov vodne bilance za izračun posameznih elementov drenažnega sistema in izračuna potrebne količine vode za namakanje v kombinaciji z osnovnimi GIS orodji za določitev vhodnih podatkov v modele. Izdelava idejnih zasnov za projekt osuševanja in namakanja in ogled namakalnih in osuševalnih sistemov na terenu.

Drainage: types of drainage systems, soil science, groundwater, planning, construction and maintenance of drainage systems, drainage in specific circumstances, project of the drainage system. Structures for flood protection. Irrigation: the importance and impact of the irrigation on food production, types of irrigation systems, natural resources and the selection of irrigation system, irrigation methods, design, construction and maintenance of irrigation systems, use of pesticides and herbicides. Facilities in the irrigation system.

Economics of drainage and irrigation: the profitability of investments in land improvements, financing methods. Land improvements and protection of the environment: space and nature conservation aspects of drainage and irrigation (vegetation zones). Integrated land reclamation: a comprehensive approach to regulating land and agricultural infrastructure, agricultural land planning. Protection of water resources.

Planning the use of water resources and their distribution.

Tutorials

Lab tutorials in computer classroom using software and different water balance models to calculate individual components of the drainage system and the necessary amount of water for irrigation in combination with basic GIS tools to determine the model inputs. Development of concepts for a drainage and irrigation project.

Site visits of irrigation and drainage systems.

Temeljna literatura in viri/Readings:

Šraj, Mojca. 2006. Navodila za uporabo programa CROPWAT: verzija 4.2 za windows: program za izračun evapotranspiracije, potreb rastlin po vodi in določitev urnika namakanja. Ljubljana, Univerza v Ljubljani, Fakulteta za gradbeništvo in geodezijo, 35 str.

Nijland, H.J., Croon, F.W., Ritzema, H.P. 2005. Subsurface drainage practices: Guidelines for the implemetation, operation and maintenance of subsurface pipe drainage systems. Wageningen, Alterra, ILRI publication 60, 608 str.

USDA, Soil Conservation Service. National Engineering Handbook - Part 652: Irrigation guide. 1997, 1262 str. (samo izbrana poglavja)

ARSO z bazami hidroloških in meteoroloških podatkov. Dostopno na: http://www.arso.gov.si/ .

Publikacije Organizacije Združenih narodov za prehrano in Kmetijstvo.

Dostopno na: http://www.fao.org/home/en/ .

Učno gradivo v spletni učilnici UL FGG.

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Cilji in kompetence:

Objectives and competences:

Cilji:
- Študent se seznani z osnovami pedologije in principi agrohidrologije.
- Študent se seznani s podlagami za planiranje in projektiranje objektov za namakanje in drenažo.
- Spozna kriterije, nujne za izdelavo projekta, ekonomske osnove, vplive na varstvo okolja in tehnologijo agromelioracij.
Kompetence:
- Sposobnost izdelave projektov in izvajanja del pri osuševanju in namakanju.

Objectives:
- Student learns about the basics of soil science and principles of agro-hydrology.
- Student gets knowledge about the planning and design of facilities for irrigation and drainage systems.
- Student learns the criteria necessary for carrying out a project, economic bases, the impacts on environmental protection and technology for land improvements.
Competences:
- Ability to carry out a projects and works in drainage and irrigation.

Predvideni študijski rezultati:

Intended learning outcomes:

- Pridobljeno poglobljeno znanje s področja načrtovanja, projektiranja, izvajanja in vzdrževanja osuševalnih in namakalnih sistemov ter izkoriščanja vodnih virov.
- Doseženo znanje uporabljajo pri izdelavi diplomskega dela oz. v inženirski praksi.
- Dobro razumevanje značilnosti in pomena osuševalnih in namakalnih sistemov.
- Sposobnost abstraktne formulacije naravnih procesov.
- Sposobnost izdelati projektne zasnove in načrte osuševalnih in namakalnih sistemov.
- Sposobnost načrtovanja izkoriščanja in varovanja vodnih virov.

- Acquired detailed knowledge about planning, design, implementing and maintenance of drainage and irrigation systems and exploitation of water resources.
- Using knowledge for master degree preparation and/or in engineering practice.
- Good understanding of the nature and importance of drainage and irrigation systems.
- Ability of abstract formulation of natural processes.- Ability to create project concepts and plans for drainage and irrigation systems.
- Ability to plan exploitation and protection of water resources.

Metode poučevanja in učenja:

Learning and teaching methods:

Predavanja, laboratorijske vaje, terenske vaje, uporaba IKT, skupinsko in problemsko zasnovano projektno delo, interaktivno delo preko spletne učilnice (forumi, klepetalnice, kvizi, lekcije, dnevniki, individualno reševanje nalog, Wiki).

Lectures, lab tutorials, field work, using ICT, group and problem-based work, interactive work through e-classroom (forums, chats, quizzes, lessons, blogs, individual exercises, Wiki).

Načini ocenjevanja: **Delež/Weight   Assessment:**

Dva kolokvija ali izpit/ računski del	30,00 %	Mid-term exam practical part
Dva kolokvija ali izpit/ teoretični del	20,00 %	Mid-term exam theoretical part
Oddane vaje	50,00 %	Coursework/lab exercises

Reference nosilca/Lecturer's references:

ŠEBENIK, Urša, BRILLY, Mitja, ŠRAJ, Mojca. Drought Analysis Using the Standardized Precipitation Index (SPI) = Analiza sušnih razmer s pomočjo standardiziranega padavinskega indeksa (SPI). Acta geographica Slovenica, 2017, letn. 57, št. 1, str. 31-49.

ZABRET, Katarina, ŠRAJ, Mojca. Can urban trees reduce the impact of climate change on storm runoff? Urbani izziv, ISSN 0353-6483. [Tiskana izd.], 2015, vol. 26, special issue, suppl., str. S165-S178.

CESAR, Polona, ŠRAJ, Mojca. Evapotranspiracija: pregled vplivnih dejavnikov in metod izračuna.

Geogr. vestn. (Tisk. izd.). [Tiskana izd.], 2012, 84, [št.] 2, str. 73-87.

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UČNI NAČRT PREDMETA/COURSE SYLLABUS

Predmet:	
	ZAŠČITA VODA
Course title:	
	WATER PROTECTION

Študijski programi in stopnja	Študijska smer	Letnik	Semestri
Vodarstvo in okoljsko inženirstvo, druga stopnja, magistrski	Ni členitve (študijski program)	1. letnik	2. semester

Univerzitetna koda predmeta/University course code: 0035025

Koda učne enote na članici/UL Member course code: 1673

Predavanja	Seminar	Vaje	Klinične vaje	Druge oblike študija	Samostojno delo	ECTS
30	15	10	5	0	60	4

Nosilec predmeta/Lecturer: Mario Krzyk, Nataša Atanasova

Vrsta predmeta/Course type: Obvezni strokovni /Obligatory professional

Jeziki/Languages:	Predavanja/Lectures:	Slovenščina
	Vaje/Tutorial:	Slovenščina

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:

Prerequisites:

Opravljeni izpiti iz predmetov Hidravlika, Hidrologija in Osnove zdravstvene hidrotehnike ali ustrezne primerljive vsebine.

Passed exams in Hydraulics, Hydrology and Introduction to Sanitary Engineering or comparable adequate knowledge.

Vsebina:

Vrste in viri (izvori) onesnaževanja in onesnažila. Fizikalni, kemijski in biološki kazaniki kakovosi voda. Monitoring površinskih vodotokov. Osnovni biološki krogi (hidrološki, kisikov, ogljikov, dušikov, žveplov, kovin) s sončno energijo za kroženje vode in hranil. Osnovni pojmi kinetike in modeliranja naravnih procesov. Uporaba modeliranja teh procesov v naravnem okolju (reke, jezera, podtalnica, morja) in v umetnih čistilnih napravah. Inženirske metode

Content (Syllabus outline):

Types and sources of pollution and pollutants. Physical, chemical and biological indicators of water quality. Monitoring of surface waters. Basic biological cycles (hydrological, oxygen, carbon, nitrogen, sulfur, metals) with solar power necessary for the circulation of water and nutrients. Basic concepts of kinetics and modeling of natural processes. Usage of modeling these processes in a natural environment (rivers, lakes, groundwater,

povezovanja naravnih procesov (samočistilne sposobnosti narave) z umetno vodenimi procesi v čistilnih napravah in drugih umetno ustvarjenih sistemih. Osnove matematičnega modeliranja kakovosti tekočih in mirujočih voda. Problematika hidrodinamične disperzije polutantov v tekočih in mirujočih vodah. Osnove aplikativne limnologije. Optimalizacija ukrepov za zaščito voda. Pomen vključevanja naravnih samočistilnih sposobnosti voda pri načrtovanju vodovarstvenih del. Metode zaščite in umetnega bogatenja potalnice. Izpusti v morje in zaščita kopalnih voda.	sea) and in the artificial wastewater treatment plants. Engineering methods of integration of natural processes (auto-purification ability of nature) with artificially controlled processes in waste water treatment plants and other manmade systems. Basics of mathematical modeling and the quality of the dormant water. The problem of hydrodynamic dispersion of pollutants in liquid and dormant water. Fundamentals of Applied limnology. Optimization of measures to protect the water. The importance of inclusion of natural auto-purification ability of water in planning of water protection. Methods of protection and artificial enrichment of groundwater. Discharges into the sea and swimming water protection.

Temeljna literatura in viri/Readings:

Krzyk, Mario. Zaščita voda : študijsko gradivo. Ljubljana: Fakulteta za gradbeništvo in geodezijo, 2017., optični disk
Panjan, J. 2014. Zaščita voda (skripta), 128 strani.
Panjan, J. 2013. Količinske in kakovostne lastnosti voda, skripta 95 strani.
Panjan, J. 2005. Osnove zdravstveno hidrotehnične infrastrukture, Ljubljana, 289 strani.
Imhoff K., Imhoff K. R. 2009. Taschenbuch der Stadentwaesserung, 31. Auflage, Oldenbourg Verlag, Muenchen , Wien, 548 strani.
Droste, L. R. 1997. Theory and Practice of Water and Wastewater Treatment, John Wiley Sonns, Inc. New York, 800 strani.
Degremont, I. 1991. Water Tretment Handbook, Lavoisier Publishing, Paris, 1459 strani.
Gerald, T.O. 1983. Mathematical Modelling of Water Quality, John Wiley & Sons, 518 strani.
Kolar J., in sod. 1987. Kako deluje človekovo okolje, Ljubljana, DZS, 606 strani.
Učno gradivo v spletni učilnici UL FGG.

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

Cilji	Objectives
Namen predmeta je:	The purpose of the course is:
- osvojiti osnovna teoretična in praktična znanja, ki so potrebna za zaščito naravnih površinskih in podzemnih voda vključno z osnovno obravnavo ravnotežja vodnih ekosistemov,	- to master the basic theoretical and practical knowledge necessary for the protection of natural surface and underground water including basic treatment of aquatic ecosystems balance;
- podati pregled osnovnih inženirskih ukrepov za izboljšanje samočistilne sposobnosti vodnega okolja.	- to give an overview of basic engineering measures to improve auto-purification ability of the aquatic environment.
Kompetence	Competencies

- sposobnost prepoznavanja različnih pojavov onesnaževanja in obremenjevanja vodnega okolja,	- Ability to recognize various phenomena of pollution and burden of aquatic environment;
- sposobnost izdelave načrtov preprečevanja evtrofnosti oz. izboljšanja samočistilne sposobnosti vodnega okolja.	- Ability to plan or to prevent the eutrophication or to improve auto-purification ability of the aquatic environment.

Predvideni študijski rezultati: **Intended learning outcomes:**

- Pridobljeno poglobljeno znanje iz zaščite in varovanja vodnega okolja.	- In-depth knowledge of security and protection of the aquatic environment.
- Razumevanje procesov samočiščenja in evtrofikacije vodnega okolja.	- Understanding the processes of self-purification and eutrophication of the aquatic environment.
- Osvojene računske spretnosti za načrtovanje ureditvenih ukrepov zaščite vodnega okolja.	- Acquire numeracy planning regulatory measures to protect the aquatic environment.
- Sposobnost formulacije naravnih procesov.	- The ability of abstract formulations of natural processes.
- Sposobnost kritične presoje vhodnih podatkov in dobljenih računskih rezultatov pri načrtovanjuukrepov.	- The ability for critical analysis of the input data and the computational results obtained in planning interventions.
- Sposobnost upoštevanja dinamike naravnih procesov pri načrtovanju človekove dejavnosti v prostoru.	- Ability to take into account the dynamics of natural processes in the planning of human activities in a landscape.
- Sposobnost uporabe računalniškega programa za analizo vodotokov.	- Ability to use a computer program to analyze quality of water streams.

Metode poučevanja in učenja: **Learning and teaching methods:**

Predavanja, seminarske in laboratorijske vaje, strokovna ekskurzija.	Lectures, seminars and laboratory exercises, technical excursion.

Načini ocenjevanja: **Delež/Weight**   **Assessment:**

Načini ocenjevanja:	Delež/Weight	Assessment:
Seminarske in laboratorijske vaje	20,00 %	Ongoing work - exercises
Seminar	30,00 %	Seminar
Pisni izpit	50,00 %	Lectures

Reference nosilca/Lecturer's references:

VANRYKEL, Anouck, KRZYK, Mario. Plastic marine pollution = Onesnaženje morja s plastiko. Acta hydrotechnica, ISSN 1581-0267. [Spletna izd.], 2017, letn. 30, št. 53, str. 73-80, ilustr. ftp://ksh.fgg.uni-lj.si/acta/a30av.pdf. [COBISS.SI-ID 8268897]

KRZYK, Mario, DREV, Darko, KOLBL, Sabina, PANJAN, Jože. Self-purification processes of Lake Cerknica as a combination of wetland and SBR reactor. Environmental science and pollution research international, ISSN 0944-1344. [Print ed.], dec. 2015, letn. 22, št. 24, str. 20177-20185, ilustr., doi: 10.1007/s11356-015-5088-0. [COBISS.SI-ID 7133793].

Krzyk, M., Četina, M. 2013. Dvodimenzijski matematični model transporta lebdečih plavin = A two-dimensional mathematical model of suspended sediment transport. Strojniški vestnik.

Krivograd-Klemenčič, A., Krzyk, M., Drev, D., Balabanič, D., Kompare, B. (2012). Recikliranje tekstilnih odpadnih voda očiščenih z različnimi kombinacijami naprednih oksidacijskih postopkov. Acta hydrotechnica.

Rajar, R., Širca, A., Krzyk, M., Vidmar, A., Četina, M. (2012). Modeliranje 3D toka Save ob vtoku v kanal nuklearne elektrarne Krško ter primerjava z meritvami = Modelling the 3D flow in the Sava river at the entrance to the inflow channel of nuclear power plant Krško and comparison with measurements. Acta hydrotechnica.

RADINJA, Matej, ŠKERJANEC, Mateja, DŽEROSKI, Sašo, TODOROVSKI, Ljupčo, ATANASOVA, Nataša. Design and simulation of stormwater control measures using automated modeling. Water. 2021, vol. 13, no. 16, [26] str., graf. prikazi, tabele. ISSN 2073-4441. https://repozitorij.uni-lj.si/IzpisGradiva.php?id=131838, https://www.mdpi.com/2073-4441/13/16/2268/htm, DOI: 10.3390/w13162268. [COBISS.SI-ID 73739779].

VOLF, Goran, ATANASOVA, Nataša, ŠKERJANEC, Mateja, OŽANIĆ, Nevenka. Hybrid modeling approach for the northern Adriatic watershed management. Science of the total environment. sept. 2018, letn. 635, str. 353-363, ilustr. ISSN 0048-9697. https://doi.org/10.1016/j.scitotenv.2018.04.094, DOI: 10.1016/j.scitotenv.2018.04.094. [COBISS.SI-ID 8411233].

GIDEON, Gal, ŠKERJANEC, Mateja, ATANASOVA, Nataša. Fluctuations in water level and the dynamics of zooplankton : a data-driven modelling approach. Freshwater Biology. apr. 2013, letn. 58, št. 4, str. 800-816, ilustr. ISSN 0046-5070. DOI: 10.1111/fwb.12087. [COBISS.SI-ID 6213729].

UČNI NAČRT PREDMETA/COURSE SYLLABUS

Predmet:	
	MORJE IN OBALNI PAS
Course title:	
	OPEN SEA AND COASTAL AREA

Študijski programi in stopnja	Študijska smer	Letnik	Semestri
Vodarstvo in okoljsko inženirstvo, druga stopnja, magistrski	Ni členitve (študijski program)	1. letnik	2. semester

Univerzitetna koda predmeta/University course code:	0035026
Koda učne enote na članici/UL Member course code:	1595

Predavanja	Seminar	Vaje	Klinične vaje	Druge oblike študija	Samostojno delo	ECTS
30	0	20	0	10	60	4

Nosilec predmeta/Lecturer:	Dušan Žagar

Vrsta predmeta/Course type:	Obvezni strokovni /Obligatory professional

Jeziki/Languages:	Predavanja/Lectures:	Slovenščina
	Vaje/Tutorial:	Slovenščina

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:	Prerequisites:
Opravljen izpit iz predmetov Hidromehanika in Hidravlika oz. osvojena ustrezna primerljiva znanja	Passed exams in Fluid mechanics and Hydraulics or adequate attained skills.

Vsebina:	Content (Syllabus outline):
Predavanja	Lectures
Zakonodaja na področju morja, Morska direktiva.	Marine environmental policy and legislation including EU Marine strategy framework directive.
Osnovni pojmi oceanografije, razlike med odprtim morjem in priobalnimi območji.	Basic terminology of oceanography, differences
Masna in toplotna bilanca ter bilanca slanosti.	between open and coastal seas. Mass, heat and salinity balance. Equations of motion and forcing factors in marine environment; barotropic and baroclinic flows, Coriolis force, Ekman transport and

Enačbe gibanja in vrste vsiljevanj v morskem okolju, barotropni in baroklini tokovi, Coriolisova sila, Ekmanov transport in Ekmanova črpalka.

Vetrni valovi, plimovanje in druge vrste valov na morju.

Uporaba poenostavljenih numeričnih modelov pri simulacijah dinamike morja.

Robni pogoji in izvorno ponorni členi v kontinuitetni, dinamični in advekcijsko- disperzijski enačbi.

Sile in napetosti ter masni in toplotni tokovi na meji med morjem in drugimi okoljskimi segmenti.

Priobalni procesi, ki jih povzročajo valovi, plimovanje in rečni vtoki.

Dimenzioniranje osnovnih inženirskih ukrepov in konstrukcij za zaščito priobalnega pasu na morju in kopnem.

Vaje

Uporaba pridobljenega znanja pri računskih nalogah, ki obsegajo uporabo obstoječih numeričnih modelov ali izdelavo enostavnih modelov za račun gibanja, sil in napetosti v priobalnem morju. Kritično tolmačenje rezultatov. Dimenzioniranje skalometov in valobranov po različnih uveljavljenih metodah v obalnem inženirstvu.

Terensko delo

Praktično spoznavanje s procesi v obalnem pasu; meritve in opazovanje vetrnih valov in valov zaradi plovbe, fizikalnih parametrov kvalitete morja ter vplivov morja na grajeno in naravno obalo. Izdelava poročila.

Ekman pumping. Wind waves, tides and other sea-waves. Use of simplified numerical models in simulations of sea dynamics. Boundary conditions and source/sink terms in mass conservation, momentum and advection- dispersion equations. Forces and stress, mass and heat fluxes at boundaries with other environmental compartments. Near-shore processes due to waves, tides and river inflows.

Designing of basic measures and coastal engineering structures for the protection of coastal regions (off- and on-shore)

Tutorial

Application of obtained knowledge for solving practical problems in the coastal sea by using

existing numerical models or assembling a simple model for computation of dynamics, forces and stresses in coastal seas. Critical interpretation of modelling results. Designing of rubble mound and breakwaters following various coastal engineering methods.

Field work

Practical learning of the processes in the coastal area; measurements and observation of wind waves and navigation-induced waves, physical parameters of seawater quality, and the impact of sea on built and natural coastline. Writing a report.

Temeljna literatura in viri/Readings:

Zakon o vodah (Ur.l. RS, št. 67/2002, 110/2002-ZGO-1, 2/2004-ZZdrI-A, 41/2004-ZVO-1, 57/2008 in 57/2012) in Uredba o podrobnejši vsebini načrta upravljanja z morskim okoljem (Ur.l. RS, št. 92/2012 in 20/2013).

Morska direktiva: DIRECTIVE 2008/56/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL (2008); Uradni list C 242 E , 16/10/2007 str. 0011 – 00.

Knaus, J. A. 1997. Introduction to Physical Oceanography (2nd ed). Prentice Hall. 309 str. Martinez, PA., Harbaugh JW. 1993. Simulating Nearshore Environments. Pergamon Press Inc. 280 str.

Hearn, C.J. 2008. The dynamics of coastal models. Cambridge University Press, 488 str.

K. de Agremond, van Rode, FC, 2004. Breakwaters and closure dams. Taylor and Francis, 2004, 379 str.

Sorensen, R.M. 2006. Basic Coastal Engineering (Third Edition). Springer, 2006, 324 str.

Spletne strani projekta Copernicus – MyOcean: katalog modelov, modelnih napovedi, podatkov, člankov in orodij, ki se uporabljajo za napovedovanje stanja morja ter vrednotenje kvalitete merjenih in modelnih podatkov. Dostopno na https://www.copernicus.eu/en/myocean (20. 1. 2021)

NIB-MBP. Podatki, članki in aktualne napovedi oceanografskih, meteoroloških in okoljskih parametrov v Tržaškem zalivu. Dostopno na: https://www.nib.si/mbp/sl/oceanografski-podatki (20. 1. 2021)

Cilji in kompetence:	Objectives and competences:
Cilji:	Objectives:
Razumevanje pomena dobrega stanja morja in parametrov, ki na vplivajo na kvalitetno stanje morja.	Understanding the importance of good quality of seawater and parameters impacting the seawater quality.
Razširitev znanja in fizikalne predstave o gibanju vode:	To extend knowledge and physical understanding of fluid dynamics with:
- s specifičnimi pojmi iz oceanografije in dinamike priobalnih procesov,	- Specific terms in oceanography and dynamics of coastal processes;
- z medsebojnimi vplivi transportnih in gibalnih procesov v morju,	- Interactions between transport and motion processes in the sea;
- s silami in napetostmi, ki jih povzroča morje na trdne stene ter prenosom mase, gibalne količine in toplote prek odprtih robov.	- Forces and stresses of sea at solid boundaries, and mass, momentum and heat fluxes at open boundaries.
Razumevanje pomena in znanje dimenzioniranja osnovnih konstrukcij za zaščito obale.	Understanding the function of and knowledge on designing basic coastal engineering structures.
Kompetence:	Competences:
- Sposobnost pravilne določitve najpomembnejših procesov in ustreznih enačb za določanje gibanja morja.	- Ability to identify the most significant processes and appropriate equations for describing the sea motion.
- Sposobnost posploševanja in razumevanja sorodnih pojavov pri toku s prosto gladino v različnih tipih vodnih teles (reke, jezera, priobalno in odprto morje).	- Ability to generalise and comprehend the similarity of phenomena in various free-surface flows (rivers, lakes, coastal and open sea).
- Sposobnost izdelave in uporabe preprostih modelov obalnega morja ter kritične presoje in nadaljnje uporabe modelnih rezultatov.	- Ability to build and apply simple coastal models and to critically interpret and use the modelling results.
- Sposobnost dimenzioniranja skalometov in valobranov po različnih uveljavljenih metodah v obalnem inženirstvu.	- Ability to design rubble mound and concrete breakwaters following various widely accepted coastal engineering methods.

Predvideni študijski rezultati:	Intended learning outcomes:
Sposobnost abstraktne formulacije naravnih procesov.	Ability of abstract formulation of natural processes.
Pridobljeno osnovno znanje iz fizikalne oceanografije.	Obtained basic knowledge in physical oceanography.
	Obtained advanced knowledge in fluid dynamics and transport processes

Pridobljeno poglobljeno znanje s področja dinamike tekočin in transportnih procesov. Dobro razumevanje in matematično fizikalna obravnava različnih tipov valovanja ter dinamičnih obremenitev valov na grajeno in naravno obalo. Sposobnost izdelave in uporabe preprostih numeričnih modelov stanja morja ter kritično presojanje modelnih rezultatov. Sposobnost povezovanja specifičnih procesov v morju z znanji o materialih, obtežbah in kontrukcijah ter dimenzioniranje specifičnih obalnih konstrukcij. Sposobnost načrtovanja dejavnosti, zaščitnih konstrukcij in ukrepov na morju in obali. Uporaba pridobljenega znanja pri izdelavi magistrske naloge in/ali v inženirski praksi.	Good understanding and ability of mathematical and physical assessment of various wave types, and the dynamic loading of waves on natural and built coastline. Ability of builing and application of simple numerical models, and critical interpretation of results. Ability of connecting specific processes in coastal sea with knowledge on materials, loadings and structures, and of designing specific coastal structures, Ability of planning the activities, and structures and measures for on-shore and off-shore protection. Applying the obtained knowledge for preparation of master's thesis and/or in engineering practice.

Metode poučevanja in učenja: **Learning and teaching methods:**

Predavanja in uporaba pridobljenih znanj pri terenskem delu in računskih primerih v okviru seminarskih vaj.	Lectures and application of the obtained knowledge in field work and solving of practical problems in the framework of tutorial.

Načini ocenjevanja: **Delež/Weight**   **Assessment:**

Načini ocenjevanja	Delež/Weight	Assessment
Izdelane seminarske vaje	30,00 %	Course work
Pisni in/ali ustni izpit	50,00 %	Written and/or oral examination
Poročilo terenskega dela	20,00 %	Field work report

Reference nosilca/Lecturer's references:

BERTONCELJ, Vesna, LIČER, Matjaž, ŽAGAR, Dušan, BONALDO, Davide. Characterisation of low-frequency sea level oscillations in the Mediterranean Sea = Določanje nizkofrekvenčnega nihanja morske gladine v Sredozemskem morju. *Acta hydrotechnica*, ISSN 1581-0267. [Spletna izd.], 2019, letn. 32, št. 57, str. 121-133.

 ŽAGAR, Dušan, RAMŠAK, Vanja, PETELIN, Boris, MALAČIČ, Vlado. Sediment transport modelling in the Koper bay - Northern Adriatic Slovenia. V: IAHR 2nd European Congress Munich, 27.- 29.6.2012. Munich: IAHR, 2012, str. 1-6.

ČEHOVIN, Jerneja, ŽAGAR, Dušan. Določanje stabilnosti skalometov, obremenjenih z valovanjem = Determining rock armour stability under the stress of wave loading. *Acta hydrotechnica*, ISSN 1581-0267. [Spletna izd.], 2019, letn. 32, št. 56, str. 21-33.

UČNI NAČRT PREDMETA/COURSE SYLLABUS

Predmet:	
	GEOTEHNIKA OKOLJA
Course title:	
	ENVIRONMENTAL GEOTECHNICS

Študijski programi in stopnja	Študijska smer	Letnik	Semestri
Vodarstvo in okoljsko inženirstvo, druga stopnja, magistrski	Ni členitve (študijski program)	1. letnik	2. semester

Univerzitetna koda predmeta/University course code: 0035027

Koda učne enote na članici/UL Member course code: 1329

Predavanja	Seminar	Vaje	Klinične vaje	Druge oblike študija	Samostojno delo	ECTS
30	0	0	30	15	75	5

Nosilec predmeta/Lecturer: Matej Maček

Vrsta predmeta/Course type: Obvezni strokovni /Obligatory professional

Jeziki/Languages:	Predavanja/Lectures:	Slovenščina
	Vaje/Tutorial:	Slovenščina

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:

Prerequisites:

Opravljen izpit iz predmetov Mehanika tal in inženirska geologija ter Geotehnika ali osvojena primerljiva znanja.

Passed exams in Soil Mechanics and Engineering Geology, Geotechnics or comparable knowledge.

Vsebina:

Content (Syllabus outline):

Predavanja

Uvod v geotehniko okolja: zgodovina geotehnike okolja, razlike v pristopih obravnave geoloških tal v klasični geotehniki in v geotehniki okolja. Zemljina kot prevodnik, izolator ali akumulator onesnaževal. Uvod v nesaturirano zemljino, karakteristična krivulja zemljina - voda. Viri radona v naravnem okolju. Hidrogeologija in transport kontaminantov v

Lectures

Introduction to environmental geotechnics: history, differences in approaches used in classical and environmental geotechnics. Soil as conductor, barrier or accumulator of pollutants. Introduction to unsaturated soils, soil-water characteristic curve. Sources of radon in nature. Hydrogeology and transport of pollutants in ground. Alternative

tleh. Alternativni materiali v gradbeništvu in geotehnika okolja. Raba alternativnih materialov-sekundarnih surovin kot zemljinam nadomestnih materialov in njihovi potencialni vplivi na okolje. Izluževalni in perkolacijski testi. Raba geosintetikov za zaščito okolja.

materials in civil and environmental engineering. Use of alternative materials – secondary raw materials instead of natural soils and their potential environmental impact. Leaching and percolation test. Use of geosynthetics for environmental protection.

Odlagališča odpadkov I: vrste odlagališč, izbor lokacije, konstrukcijska zasnova talnega ustroja, materiali za talni ustroj, stabilnost in deformabilnost odlagališča, zajem in odvajanje izcedne vode.

Landfills I: types of landfills, choice of location, design and materials for bottom liner system, stability and deformability of landfill, collection and drainage of seepage water.

Odlagališča odpadkov II: zapiranje odlagališč odpadkov, konstrukcijska zasnova pokrova, račun vodne bilance, lizimetri, kontrola odlagališča po zaprtju.

Landfills II: Closure of landfills, design of cover layer, calculation of water balance, lysimeters, control of abandoned landfills.

Remediacija onesnaženih tal: metode prepoznavanja, strategije remediacije, tehnologije remediacije. Vrste in izvedbene značilnosti objektov za monitoring podzemne vode. Osnove iz geotermalne energije. Zakonodaja na področju geotehnike okolja, podzakonski akti, standardi.

Remediation of polluted land: methods of recognition, strategies and technologies of remediation. Types and properties of structures and devices for groundwater monitoring. Fundamentals of geothermal energy. Regulation in the field of environmental geotecnics, implications of regulations on engineering design, standards.

Vaje in terensko delo

Laboratorijske preiskave zemljin in odpadkov: presoja adsorpcijskih lastnosti, kationske izmenjalne kapacitete, nabrekalnega potenciala, strukturnega kolapsa. Laboratorijske preiskave nesaturiranih zemljin, retencijska krivulja, povezava prepustnosti, retencijske krivulje in Proctorjeve krivulje. Računi stabilnosti deponij odpadkov in pokrovov ter toka vode skozi pokrove in umetne bariere. Anizotropija vodoprepustnosti v tleh.

Tutorials and field work

Laboratory tests on soils and wastes: adsorption capacity, cation exchange capacity, swelling potential, structural collapse. Laboratory tests of unsaturated soil samples, retention curve, interdependence of permeability, retention curve and Proctor curve. Stability analyses of landfills and cover layers. Calculation of water seepage through cover layers and artificial barriers. Anisotropy of ground permeability.

Temeljna literatura in viri/Readings:

Van Impe, W.F., Bouazza, A., 1996. Fundamentals of Environmental geotechnics. Ghent State University.

Evrokod 7-2: Preiskovanje in preskušanje tal.

Daniel E. D. 1993. Geotechnical Practice for Waste Disposal. Chapman&Hall.

Salomons, W. in Forstner, U. 1993. Environmental Management of Solid Waste. Dredged Material and Mine Tailings. Springer-Verlag.

Učno gradivo v spletni učilnici UL FGG.

Cilji in kompetence:	Objectives and competences:

Cilji

- Razumeti pomen razlik med klasičnimi geotehničnimi zgradbami in zgradbami v geotehniki okolja.

- Nadgraditi osnovno znanje o lastnostih zemljin in o umetnih materialih v geotehniki ter o gibanju vode skozi zemljino s posebnim poudarkom na adsorpciji, kationski izmenjavi in retencijskih sposobnostih.

- Spoznati lastnosti odpadkov in lastnosti odpadkov sekundarnih surovin kot alternativnih materialov v gradbeništvu ter postopkih njihovega raziskovanja in ocenjevanja primernosti za rabo.

- Nadgraditi osnovna znanja o gibanju vode v tleh z znanji o gibanju polutantov v tleh.

- Podati temeljna znanja o načrtovanju, gradnji ter zapiranju odlagališč odpadkov, o ščitenju tal na območju odlagališč in prometnic in o sanaciji in remediaciji rudniških in industrijskih jalovišč in kontaminiranih tal.

- Spoznati objekte za opazovanje podzemne vode in specifiko njihovega načrtovanja, izvedbe in vzdrževanja.

Pridobljene kompetence:

- Sposobnost projektiranja, nadzorovanja gradenj in zapiranja deponij odpadkov, jalovišč, sanacije onesnaženih tal in opazovanja,

- Sposobnost vodenja aktivnosti za raziskovanje na področju opuščenih, aktivnih ali novih objektov, ki imajo pomembne vplive na okolje,

- Sposobnost načrtovanja monitoringa kontaminacije,

- Sposobnost odločanja o tehnični in okoljski primernosti rabe alternativnih materialov v nizkih gradnjah.

Objectives:

- To understand the difference between classical geotechnical structures and structures in environmental engineering.

- To enhance knowledge on soil properties, groundwater movement and artificial materials in geotechnical engineering with emphasize on adsorption, cation exchange capacity and retention properties.

- To study properties of wastes and secondary raw materials as alternative materials in civil engineering and procedures for their testing and assessment of their suitability in engineering applications.

- To combine the knowledge on groundwater movement with fundamentals of transport of polutants .

- To study fundamental principles of design, construction and closure of landfills, ground protection in landfill areas and traffic routes, remediation of mining and industrial contaminated areas.

- To know the facilities for groundwater monitoring and specific aspects of their design, construction

and maintenance.

Competences:

- Capability to design and supervise construction and closure of landfills, remediation of contaminated land, environmental monitoring.

- To manage activities for the exploration of abandoned or active and new facilities with significant environmental impact.

- To prepare the programme of environmental monitoring.

- To take decisions on technical and environmental suitability of the use of alternative materials in civil engineering.

Predvideni študijski rezultati:	Intended learning outcomes:
- Razumevanje toka vode in polutantov v zemljini in skozi naravne in umetne bariere - Razumevanje razlik med zemljinami, "inertnimi" zemljinami in aktivnimi „odpadki" - Razumevanje razlik med naravnimi gradivi in gradivi iz alternativnih materialov - Razumevanje konceptualne zasnove aktivnih in pasivnih ukrepov za preprečevanje onesnaženja tal in podzemne vode. - Doseženo znanje uporabljajo pri izdelavi magistrske naloge in v inženirski praksi kot inženirji projektanti, soglasodajalci ali nadzorniki. - Dobro razumevanje zakonitosti interakcij tla/podzemna voda/človekova dejavnost/objekt/odpadek/polutant/širjenje polutanta. - Sposobnost prepoznavanja ranljivosti okolja za onesnaženje - Sposobnost prepoznavanja samozaščitnih lastnosti tal - Sposobnost načrtovanja, gradnje.	- Understanding of groundwater movement and pollutant transport through natural and artificial barriers - Understanding the difference between "inert" soils and active "wastes" - Understanding the difference between natural and artificial building materials - Understanding conceptual design of active and passive measures for the protection of ground and groundwater against pollution - Knowledge will be used during the preparation of Master thesis and in engineering practice as designers, supervising engineers, decision makers - Thorough understanding of the interaction between ground, groundwater, human activities, structures, wastes, pollutants and pollutant transport - Ability to recognize the vulnerability of the environment for contamination - Ability to recognize the self protecting properties of ground - Ability to design and construct

Metode poučevanja in učenja: **Learning and teaching methods:**

Predavanja, vaje ter terensko delo. Uporaba pridobljenih znanj pri izdelavi individualnih nalog.	Lectures, tutorials, field work. Individual project work.

Načini ocenjevanja:	Delež/Weight	Assessment:
Vaje in individualne naloge	30,00 %	Tutorials and individual work
Pisni izpit	70,00 %	Written exam

Reference nosilca/Lecturer's references:

MAČEK, Matej, SMOLAR, Jasna, PETKOVŠEK, Ana (2018) Settlement prediction of gypsum sludge based on different test methods. V: Jovanovski, M. (ur.). Proceedings of the 16th Danube - European Conference on Geotechnical Engineering. Ernst & Sohn.

SMOLAR, Jasna, MAČEK, Matej, PETKOVŠEK, Ana (2016) Geotechnical and environmental characterization of boiler slag as fill material. Journal of geotechnical and geoenvironmental engineering 42(8): 1-7.

MAČEK, Matej, SMOLAR, Jasna, PETKOVŠEK, Ana (2013) Extension of measurement range of dew-point potentiometer and evaporation method. V: Delage, P. (ur.) Proceedings of the 18th International Conference on Soil Mechanics and Geotechnical Engineering. Presses des Ponts: 1137-1142

MAČEK, Matej, MAUKO, Alenka, MLADENOVIČ, Ana, MAJES, Bojan, PETKOVŠEK, Ana. A comparison of methods used to characterize the soil specific surface area of clays. Appl. clay sci.. [Print ed.], oktober 2013, letn. 83-84, str. 144-152.

MAČEK, Matej, MAJES, Bojan, PETKOVŠEK, Ana. Influence of mould suction on the volume - change behaviour of compacted soils during inundation = Vpliv vrojene sukcije na volumensko obnašanje zgoščenih zemljin med vlaženjem. Acta geotech. Slov., 2011, vol. 8, [no]. 2, str. 67-79.

UČNI NAČRT PREDMETA/COURSE SYLLABUS

Predmet:	
	DALJINSKO ZAZNAVANJE V OKOLJSKEM GRADBENIŠTVU
Course title:	
	REMOTE SENSING IN ENVIRONMENTAL CIVIL ENGINEERING

Študijski programi in stopnja	Študijska smer	Letnik	Semestri
Vodarstvo in okoljsko inženirstvo, druga stopnja, magistrski	Ni členitve (študijski program)	1. letnik	2. semester

Univerzitetna koda predmeta/University course code: 0035028

Koda učne enote na članici/UL Member course code: 1323

Predavanja	Seminar	Vaje	Klinične vaje	Druge oblike študija	Samostojno delo	ECTS
30	0	0	30	0	60	4

Nosilec predmeta/Lecturer: Mojca Kosmatin Fras

Vrsta predmeta/Course type: Obvezni strokovni /Obligatory professional

Jeziki/Languages:	Predavanja/Lectures:	Slovenščina
	Vaje/Tutorial:	Slovenščina

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:

Prerequisites:

Vsebina:

Zgodovinski mejniki in razvoj daljinskega zaznavanja. Elektromagnetno valovanje.

Interakcija svetlobe z atmosfero in površjem. Delovanje slikovnih senzorjev. Letalski in satelitski snemalni sistemi Digitalna podoba, spektralni podpis Interpretacija podob. Osnove digitalne obdelave slik Predobdelava podob: georeferenciranje, prevzorčenje, popravki zaradi vpliva atmosfere in terena Transformacije podob

Content (Syllabus outline):

Historical milestones and development of remote sensing. Electromagnetic radiation. Interaction of light with the atmosphere and the Earth's surface.

Working principles of image sensors Aerial and satellite imaging systems Digital image, spectral response Image interpretation. The basics of digital image processing. Image pre-processing: geo-referencing, resampling, corrections due to the atmosphere and the terrain Image transformations.

Klasifikacija podob: pikselska, objektna. Osnove aerolaserskega skeniranja. Državni topografski viri Satelitski sistemi in naročanje podatkov.	Image classification: pixel based, object based Basics of aerial laser scanning. National topographic sources Satellite systems and data ordering.

Temeljna literatura in viri/Readings:

Oštir, K. 2006. Daljinsko zaznavanje. Ljubljana, Založba ZRC. Učno gradivo v spletni učilnici UL FGG.

Cilji in kompetence:	**Objectives and competences:**
- Študenti pridobijo osnovna znanja o tehnologijah daljinskega zaznavanja s poudarkom na aplikacijah v okoljskem inženirstvu. - Pridobijo naslednja znanja in kompetence: izbira, vsebinsko razumevanje in uporaba državnih topografskih izdelkov in baz, naročanje in uporaba satelitskih in letalskih podob ter lidarskih izdelkov.	- Students gain the basic knowledge on remote sensing technologies with the emphasis on applications in environmental engineering. - They get the following knowledge and competences: selection, understanding of contents and use of national topographic products and databases, ordering and use of satellite and aerial images as well as lidar products.

Predvideni študijski rezultati:	**Intended learning outcomes:**
- Razumevanje osnovnih terminov in procesov daljinskega zaznavanja (satelitske in letalske podobe, aerolasersko skeniranje). - Uporaba računalniških orodij za obdelavo in uporabo podob daljinskega zaznavanja. - Uporaba teorije v praksi, sposobnost izbire primernih virov za svoje delo. - Povezovanje znanja z interdisciplinarnim pristopom. Samostojno iskanje in uporaba različnih virov.	- Understanding of basic terms and processes of remote sensing (satellite and aerial images, aerial laser scanning). - Applying computer tools for processing and use of remote sensing images. - Application of the theory in practice, ability of selecting appropriate data sources for the particular tasks. - Combining knowledge with interdisciplinary approach. Student's own search and use of different professional literature.

Metode poučevanja in učenja:	**Learning and teaching methods:**
Predavanja: prosojnice, grafične ponazoritve, demonstracije, primeri iz prakse. Praktične vaje: računalniška učilnica, uporaba specializirane opreme za daljinsko zaznavanje.	Lectures: slides, graphical presentations, demonstrations, practical examples. Practical exercises: computer classroom, use of specialized remote sensing equipment.

Načini ocenjevanja:	**Delež/Weight**	**Assessment:**
Individualna naloga	10,00 %	Individual exercise
Naloge in sprotno delo	50,00 %	Exercises and on-going work

Pisni izpit (teoretičen del)	40,00 %	Written exam (theoretical part)

Reference nosilca/Lecturer's references:

GRIGILLO, Dejan, KOSMATIN FRAS, Mojca, PETROVIČ, Dušan. Automatic extraction and building change detection from digital surface model and multispectral orthophoto = Samodejen zajem in iskanje sprememb v topografskem sloju stavb iz digitalnega modela površja in multispektralnega ortofota. Geod. vestn. 2011, letn. 55, št. 1, str. 28-45.

TRIGLAV, Mihaela, CROSILLA, Fabio, KOSMATIN FRAS, Mojca. Theoretical lidar point density for topographic mapping in the largest scales = Teoretična gostota lidarskih točk za topografsko kartiranje v največjih merilih. Geod. vestn. [Tiskana izd.], 2010, letn. 54, št. 3, str. 403-416.

KOSMATIN FRAS, Mojca, ATTWENGER, Maria, BITENC, Maja. Land use classification based on the intensity value of the reflected laser beam = Klasifikacija rabe površin iz vrednosti intenzitete odbitega laserskega žarka. Geod. vestn. 2007, letn. 51, št. 3, str. 501-518.

UL FGG, Vodarstvo in okoljsko inženirstvo (MA), 2. stopnja | Water Science and Environmental Engineering (MA), 2nd Cycle

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UČNI NAČRT PREDMETA/COURSE SYLLABUS

Predmet:	
	MAGISTRSKO DELO
Course title:	
	MASTERS THESIS/WORK

Študijski programi in stopnja	Študijska smer	Letnik	Semestri
Vodarstvo in okoljsko inženirstvo, druga stopnja, magistrski	Ni členitve (študijski program)	2. letnik	2. semester

Univerzitetna koda predmeta/University course code:	0035030
Koda učne enote na članici/UL Member course code:	1654

Predavanja	Seminar	Vaje	Klinične vaje	Druge oblike študija	Samostojno delo	ECTS
0	0	0	0	450	450	30

Nosilec predmeta/Lecturer:	

Vrsta predmeta/Course type:	Obvezni strokovni /Obligatory professional

Jeziki/Languages:	Predavanja/Lectures:	Slovenščina
	Vaje/Tutorial:	Slovenščina

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:	Prerequisites:
Odobrena tema in mentor s strani Študijskega odbora Oddelka za okoljsko gradbeništvo skladno s Pravilnikom o študiju na I. in II. stopnji.	Approved topic and supervisor by the Study Board of the Department of Environmental Civil Engineering according to the Rules of 1st and 2nd cycle studies.

Vsebina:	Content (Syllabus outline):
Magistrsko delo se izdela pod mentorstvom izbranega učitelja. Delo se javno predstavi ob zaključku študija. Vsebovati mora: - Uvod - Delovno hipotezo - Pregled virov	Master thesis shall be made under the supervision of a selected teacher. The work is presented in public at the end of the study. It must include: - Introduction - The working hypothesis - Overview of sources

- Material in metode	- Material and methods
- Rezultate	- Results
- Razpravo	- Discussion
- Povzetek	- Summary
Praviloma se v magistrskem delu obravnavajo praktični strokovni problemi ali raziskovalne in razvojne teme s področja vodarstva, okoljskega inženirstva in okoljskega gradbeništva ter podajajo rešitve, do katerih pridejo s pomočjo študija in izsledkov lastnega raziskovalnega dela.	The thesis will ordinarily deal with practical professional problems or research and development themes from the area of water science, environmental engineering or environmental civil engineering that provide further solutions derived from the study and from the results of students' own work.

Temeljna literatura in viri/Readings:

Literatura s področja vsebine magistrskega dela. T. Koler-Povh, G. Turk: Navodila za oblikovanje visokošolskih del na FGG in navajanje virov, FGG UL, Ljubljana, 2011, 39 strani, priloge. Dostopno na: http://www3.fgg.uni-lj.si/fileadmin/user_upload/UL_FGG_-_Pr_10_Navodila_za_oblikovanje_visokosolskih_del_na_UL_FGG_2011_07.pdf Literature from the field of the contents of the thesis. Instructions for writing theses and citing references at the UL Faculty of Civil and Geodetic Engineering.

Cilji in kompetence:	**Objectives and competences:**
Cilji - uporabiti pridobljena znanja v poglobljenem študiju na temi magistrskega dela, - pod mentorstvom izdelati koncept dela, v katerem so opredeljeni namen, cilji, metode in viri za izdelavo tega dela, - razvijanje samostojnega, kritičnega in etičnega načina dela. Pridobljene kompetence: - z javno predstavitvijo magistrskega dela pridobiti komunikacijske spretnosti in sposobnosti.	Objectives - to use the knowledge gained by in-depth study on the thesis topic; - under supervisor's supervision student prepares a concept, where the purposes, goals, methods and references for the thesis are presented; - to develop independent, critical and ethical way of working. Acquired competences: - student obtains communication skills and abilities with public presentation.

Predvideni študijski rezultati:	**Intended learning outcomes:**
- Pridobi znanja na vseh fazah, ki so del samostojnega reševanja konkretnih problemov in nalog na področju vodarstva, okoljskega inženirstva in okoljskega gradbeništva, sodelovanja in tudi skupinskega dela v okviru različnih subjektov na	- Students acquire knowledge in all phases, which are part of a real problem and tasks in water science, environmental and environmental civil engineering, as well as cooperation and teamwork within various entities in these fields.

navedenih področjih. - razume vodarstvo, okoljsko inženirstvo in okoljsko gradbeništvo kot interdisciplinarne panoge, vezane na ostale naravoslovne in tehniške vede in na okolje. Uporaba - doseženo znanje uporabljajo v inženirski praksi. Refleksija - raba teoretičnih znanj v praksi, - povezovanje ter inovativna dejavnost pri delu. - načrtovanje, izvedba in kritično vrednotenje pri reševanju problemov ter prezentacija izsledkov strokovnih nalog in raziskav, - sodelovanje, vključevanje strokovnjakov in skupno reševanje problemov.	- They understand water science, environmental and environmental civil engineering as interdisciplinary fields, connected to other natural and technical sciences and the environment. Application - They learn how to use the theoretical knowledge in engineering practice. Reflection - Use of theoretical knowledge in practice Transferability - Planning, execution and critical evaluation in problem solving and presentation of results of technical tasks and research. - Including, participation, involvement of experts and joint problem solving.

Metode poučevanja in učenja: **Learning and teaching methods:**

Mentorsko vodeno samostojno delo.	Independent work under supervision.

Načini ocenjevanja: Delež/Weight   **Assessment:**

Načini ocenjevanja:	Delež/Weight	Assessment:
Magistrska naloga	50,00 %	Master thesis
Zagovor	50,00 %	Defence

Reference nosilca/Lecturer's references:

UČNI NAČRT PREDMETA/COURSE SYLLABUS

Predmet:	
	STABILNOST POBOČIJ
Course title:	
	SLOPE STABILISATION

Študijski programi in stopnja	Študijska smer	Letnik	Semestri
Vodarstvo in okoljsko inženirstvo, druga stopnja, magistrski	Ni členitve (študijski program)		1. semester

Univerzitetna koda predmeta/University course code:	0037810
Koda učne enote na članici/UL Member course code:	1752

Predavanja	Seminar	Vaje	Klinične vaje	Druge oblike študija	Samostojno delo	ECTS
35	0	15	0	10	60	4

Nosilec predmeta/Lecturer: Matej Maček, Matjaž Mikoš

Vrsta predmeta/Course type: Izbirni strokovni /Elective professional

Jeziki/Languages:	Predavanja/Lectures:	Slovenščina
	Vaje/Tutorial:	Slovenščina

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:

Prerequisites:

Opravljen izpit iz predmetov Geotehnika okolja in Hidrološko modeliranje.	Passed exams in Environmental geology and Hydrological modeling.

Vsebina:

Content (Syllabus outline):

Predavanja

Oblike pobočnih procesov, vzroki nastanka, sprožilni dejavniki, terenske raziskave. Hidrotehnični in geotehnični ukrepi za umirjanje in stabilizacijo zemeljskih plazov in kamninskih podorov. Osnove ravnanja z naravnimi tveganji: zakonodaja, ureditev, aktivni in pasivni ukrepi, dokumentiranje plazenja tal, kartiranje pojavov in nevarnosti.

Lectures

Forms of slope processes, causes of their formation, triggering factors, field research. Hydrotechnical and geotechnical measures for mitigation and stabilisation of landslides and rockfalls. Basics of handling natural risks: legislation, arrangements, active and passive measures, documentation of landsliding, mapping of phenomena and hazards.

Seminarske vaje	Tutorials
Sanacija zemeljskih plazov v Sloveniji kot študijski primeri izvedenih sanacijskih ukrepov.	Mitigation of landslides in Slovenia as case studies of executed mitigation measures.
Terensko delo	Field work
Prepoznavanje ogroženih pobočij, koncepti sanacije aktivnih zemeljskih plazov in podorov.	Recognition of risky slopes, mitigation concepts of active landslides and rockfalls.

Temeljna literatura in viri/Readings:

Brilly, M., Mikoš, M., Šraj, M. 1999. Vodne ujme: varstvo pred poplavami, erozijo in plazovi, 1. izdaja, UL FGG, univerzitetni učbenik, 186 p.

Ribičič, M. 2005. Metodologija ukrepanja ob ogrožujočih plazovih. UL NTF, 78 p.

Vidrih, R. 2008. Potresna dejavnost Zgornjega Posočja = Seismic activity of the Upper Posočje area. ARSO, MOP RS, 509 p.

Elektronski spletni učni pripomoček N.I.T. (Naravne nevarnosti In Tveganja) za področje obvladovanja tveganj spletne strani Katedre za mehaniko tal. Učno gradivo v spletni učilnici UL FGG.

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

Cilji	Objectives
- Nadgraditi osnovno znanje o mehaniki zemljin s posebnostmi masnih gibanj.	- Upgrade of basic knowledge of soil mechanics to particular characteristics of mass movements.
- Podati osnove preventivnega in interventnega inženirskega delovanja pred geološko pogojenimi dejavniki tveganja.	- Provide the basics for preventive and interventional engineering activities against geologically conditioned risk factors.
- Podati osnove načrtovanja raziskav in trajnih sanacijskih ukrepov na aktivnih zemeljskih plazovih.	- Provide the basics of planning research and sustainable mitigation measures on active landslides.
- Podati osnove modernega pristopa k obvladovanju geološko in hidrološko pogojenih naravnih tveganj.	- Provide the basics of the modern approach to mitigation of geological and water-related natural risks.
Pridobljene kompetence:	Competences:
- Sposobnost vodenja aktivnosti za raziskovanje in sanacijo plazov ter inženirskega ukrepanja ob naravnih nesrečah.	- Ability to manage activities for research and rehabilitation of landslides and of engineering measures in natural disasters.

Predvideni študijski rezultati: **Intended learning outcomes:**

- Poglobljeno razumevanje procesov v naravi.	- Acquired in-depth knowledge of processes in nature.
- Poglobljeno znanje iz dinamike masnih gibanj in njihove sanacije.	- Acquired in-depth knowledge of dynamics of mass movements and their mitigation.
- Razumevanje pomembnosti preventivnega obnašanja pri posegih v prostor.	

- Sposobnost prepoznavanja ranljivosti naravnih in umetnih pobočij za sprožitev masnih gibanj. - Sposobnost razumevanja prilagajanja inženirskih ukrepov terenskim razmeram in nujnosti postopne izvedbe načrtovanih ukrepov. - Sposobnost upoštevanja dinamike naravnih procesov pri načrtovanju človekove dejavnosti v prostoru.	- Understanding of the importance of preventive behavior in spatial interventions. - Ability to recognize the vulnerability of natural and man-made slopes for triggering mass movements. - Ability to understand adaptation of engineering measures to terrain conditions and the necessity of gradual implementation of the planned measures. - Ability to take into account the dynamics of natural processes in the spatial design of human activities.

Metode poučevanja in učenja: **Learning and teaching methods:**

Predavanja, seminarske vaje, terensko delo.	Lectures, seminar tutorials, field work.

Načini ocenjevanja: **Delež/Weight**   **Assessment:**

Načini ocenjevanja	Delež/Weight	Assessment
Seminarske vaje	20,00 %	Seminar tutorials
Terensko delo	20,00 %	Field work report
Pisni in/ali ustni izpit	60,00 %	Written and/or oral examination

Reference nosilca/Lecturer's references:

PERANIĆ, J., ARBANAS, Ž., CUOMO, S., MAČEK, M. (2018). Soil-water characteristic curve of residual soil from a flysch rock mass. Geofluids: 1-15.

MAČEK, M., SMOLAR, J., PETKOVŠEK, A. (2017). Influences of rheometer size and the grain size on rheological parameters of debris flow. V: Mikoš, M. (ur.), et al. Advancing culture of living with landslides. Vol. 2, Advances in landslide science. Cham: Springer: 399-406.

MAČEK, M., MAJES, B., PETKOVŠEK, A. (2016). Lessons learned from 6 years of suction monitoring of the Slano blato landslide. Rivista Italiana di Geotecnica 5: 21-33.

BEZAK, N., MIKOŠ, M., ŠRAJ, M. (2016). Copula-based IDF curves and empirical rainfall thresholds for flash floods and rainfall-induced landslides. Journal of Hydrology 541, 272-284.

HÜBL, J., MIKOŠ, M. (2014). Monitoring von Murgängen = Debris flow monitoring. Wildbach- und lawinenverbau 78(173), 50-66.

PULKO, B., MAJES, B., MIKOŠ, M. (2014). Reinforced concrete shafts for the structural mitigation of large deep-seated landslides: an experience from the Macesnik and the Slano blato landslides (Slovenia). Landslides 11(1), 81-91.

MIKOŠ, M., ČARMAN, M., PAPEŽ, J., JANŽ, M. (2014). Legislation and procedures for the assessment of landslide, rockfall and debris flow hazards and risks in Slovenia = Rechtsvorschriften und Verfahren für die Beurteilung der Rutschungs-, Steinschlags- und Murganggefährdungen und Risiken in Slowenien. Wildbach- und Lawinenverbau 78/174, 212-221.

UČNI NAČRT PREDMETA/COURSE SYLLABUS

Predmet:	
	HIDRAVLIČNI STROJI IN NAPRAVE
Course title:	
	HYDRAULIC MACHINES AND DEVICES

Študijski programi in stopnja	Študijska smer	Letnik	Semestri
Vodarstvo in okoljsko inženirstvo, druga stopnja, magistrski	Ni členitve (študijski program)		1. semester

Univerzitetna koda predmeta/University course code:	0037811
Koda učne enote na članici/UL Member course code:	1753

Predavanja	Seminar	Vaje	Klinične vaje	Druge oblike študija	Samostojno delo	ECTS
30	0	30	0	0	60	4

Nosilec predmeta/Lecturer:	Gašper Rak, Marko Hočevar

Vrsta predmeta/Course type:	Izbirni strokovni/Elective professional

Jeziki/Languages:	Predavanja/Lectures:	Slovenščina
	Vaje/Tutorial:	Slovenščina

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:	**Prerequisites:**
Opravljen izpit iz predmetov Hidromehanika in Hidravlika oz. osvojena ustrezna primerljiva znanja.	Passed exams in Fluid mechanics and Hydraulics or adequate attained skills.

Vsebina:	**Content (Syllabus outline):**
Predavanja - Teoretične podlage turbinskih strojev: Eulerjeva turbinska enačba, zakoni podobnosti, tok v turbinski kaskadi. - Teoretične podlage hidravličnih naprav na vodnih zgrabbah, zasnova postrojev in pogoji delovanja. - Eksperimentalno modeliranje in določanje integralnih karakteristik hidravličnih strojev in naprav v skladu s standardi in predpisi.	Lectures - Theoretic foundations of turbine machinery: Euler turbine equation, similarity laws, flow in turbine cascade. - Theoretic foundations of hydraulic machinery on Hydraulic structures, facility design and operating conditions. - Experimental modeling and determination of integral characteristics of hydraulic machines in accordance with standards and legislation.

Vaje	Tutorial
Izbor hidravličnega stroja in določitev osnovnih geometrijskih karakteristik rotorja hidravličnega stroja za poljubno izbrane integralne hidroenergetske pogoje, prenos modelnih rezultatov na izvedbo. Meritve integralnih karakteristik hidravličnega stroja (turbina) v laboratoriju KMTe. Teoretično-eksperimentalno delo na modelnih hidravličnih sistemih v laboratoriju KMTe s simuliranjem dejanskih razmer na prototipih v praksi.	Selection of a hydraulic machine and determination of basic geometrical characteristics of a hydraulic machine's rotor for arbitrary selected integral hydropower conditions, transfer of model results to a prototype. Measurements of integral characteristics of a hydraulic machine (turbine) in KMTe lab. Theoretical-experimental work on model hydraulic systems within KMTe laboratory with the simulation of real conditions found in practical prototype operations.

Temeljna literatura in viri/Readings:

P. Novak, A.I.B. Moffat and C. Nalluri. 2007. Hydraulic Structures, Fourth Edition. New York, Taylor & Francis Group,

Lakshminarayana, B. 1996. Fluid dynamics and heat transfer of turbomachinery. New York, J. Wiley & Sons.

Turton, R.K. 1984. Principles of turbomachinery. London, E. & F.N. Spon.

Učno gradivo v spletni učilnici UL FGG.

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

Cilji	Objectives
- Spoznati osnovne fizikalne zakonitosti energijskih pretvorb in specifičnosti ter hidrodinamske pojave v hidrotehničnih sistemih, opremljenih s hidravličnimi stroji in napravami. - Predstaviti področja uporabe hidravličnih strojev in naprav ter povezanost z okoljem preko hidravličnih robnih pogojev. - Spoznati eksperimentalne metode – modelna preizkušanja hidravličnih strojev. Kompetence - Razumevanje zakonitosti energijskih pretvorb v hidravličnih strojih in napravah ter sposobnost izbire hidromehanske opreme glede na tehnične zahteve in dane integralne pogoje. - Razumevanje principov meritev delovnih karakteristik hidravličnih strojev in naprav.	- Knowledge of basic physical laws of energy conversions and specifics. Knowledge of hydrodynamic phenomena in Water Management Systems, equipped with hydraulic machinery and devices. - Presentation of application of hydraulic machines and their connection with the environment through hydraulic boundary conditions. - Knowledge of experimental methods – model testing of hydraulic machinery. Competences - Understanding of energy conversion laws in hydraulic machinery and determination of required Water Management equipment in accordance with technical requirements and integral conditions. - Understanding of principles of operating characteristics measurements in hydraulic machinery.

Predvideni študijski rezultati: **Intended learning outcomes:**

- Pridobljeno poglobljeno znanje o energijskih pretvorbah v turbinskih strojih in na hidromehanski opremi.	- Gained broad knowledge about energy conversions in turbine machinery and in Water Management facilities.
- Pridobljeno znanje o eksperimentalnih metodah na mikro in makro nivoju na področju vodnogospodarskih sistemov.	- Gained knowledge about experimental methods on micro- and macro scales in the field of Water Management Systems.
- Sposobnost uporabe in kritične presoje hidravličnih postrojenj na širšem področju Vodnih gradenj.	- Ability of application and critical assessment of hydraulic machines and facilities in the broad field of Water structures.

Metode poučevanja in učenja: **Learning and teaching methods:**

Predavanja in uporaba pridobljenih znanj pri izdelavi seminarskih vaj.	Lectures and application of obtained knowledge in tutorials.

Načini ocenjevanja: **Delež/Weight**   **Assessment:**

Načini ocenjevanja	Delež/Weight	Assessment
Vaje	50,00 %	Coursework/exercises
Pisni in/ali ustni izpit	50,00 %	Written and/or oral examination

Reference nosilca/Lecturer's references:

Bajcar, Tom, Gosar, Leon, Širok, Brane, Steinman, Franci, Rak, Gašper. 2010. Influence of flow field on sedimentation efficiency in a circular settling tank with peripheral inflow and central effluent. Chemical engineering and processing, 49 (5): 514-522. DOI: 10.1016/j.cep.2010.03.019.

Jašarević, Ajdin, Hočevar, Marko, Rak, Gašper. 2021. Turbulent flow height measurement with stereo vision. Defense and security studies, 2: 96111. DOI: 10.37868/dss.v2.id175.

Müller, Matej, Novak, Gorazd, Steinman, Franci, Rak, Gašper, Bajcar, Tom. 2015. Influence of the operating and geometric characteristics of a bottom-hinged flap gate. Strojniški vestnik, 61 (9): 498-506. DOI: 10.5545/sv-jme.2015.2453.

Novak, Gorazd, Rak, Gašper, Prešeren, Tanja, Bajcar, Tom. 2017. Non-intrusive measurements of shallow water discharge. Flow measurement and instrumentation, 56: 14-17. DOI: 10.1016/j.flowmeasinst.2017.05.007.

Pavlovčič, Urban, Rak, Gašper, Hočevar, Marko, Jezeršek, Matija. 2020. Ranging of turbulent water surfaces using a laser triangulation principle in a laboratory environment. Journal of hydraulic engineering, 146 (8): 1-10. DOI: 10.1061/%28ASCE%29HY.1943-7900.0001777.

Rak, Gašper, Hočevar, Marko, Steinman, Franci. 2017. Measuring water surface topography using laser scanning. Flow measurement and instrumentation, 56: 35-44. DOI: 10.1016/j.flowmeasinst.2017.07.004.

Rak, Gašper, Hočevar, Marko, Steinman, Franci. 2018. Construction of water surface topography using LIDAR data. Strojniški vestnik, 64 (9): 555-565. DOI: 10.5545/sv-jme.2017.4619.

Rak, Gašper, Hočevar, Marko, Steinman, Franci. 2019. Water surface topology of supercritical junction flow. Journal of Hydrology and Hydromechanics, 67, (2): 163-170. DOI: 10.2478/johh-2018-0042 .

Rak, Gašper, Hočevar, Marko, Steinman, Franci. 2020. Non-intrusive measurements of free-water-surface profiles and fluctuations of turbulent, two-phase flow using 2-D laser scanner. Measurement science & technology: 1-14. DOI: 10.1088/1361-6501/ab727f.

Rak, Gašper, Steinman, Franci, Hočevar, Marko, Dular, Matevž, Jezeršek, Matija, Pavlovčič, Urban. 2020. Laser ranging measurements of turbulent water surfaces. European journal of mechanics. B, Fluids, 81: 165-172. DOI: 10.1016/j.euromechflu.2020.02.001.

Škerjanec, Mateja, Kregar, Klemen, Štebe, Gašper, Rak, Gašper. 2022. Analysis of floating objects based on non-intrusive measuring methods and machine learning. Geomorphology: an international journal of pure and applied geomorphology, 408. DOI: 10.1016/j.geomorph.2022.108254.

UČNI NAČRT PREDMETA/COURSE SYLLABUS

Predmet:	
	VODARSTVO
Course title:	
	WATER POLICY

Študijski programi in stopnja	Študijska smer	Letnik	Semestri
Vodarstvo in okoljsko inženirstvo, druga stopnja, magistrski	Ni členitve (študijski program)		1. semester

Univerzitetna koda predmeta/University course code:	0035034
Koda učne enote na članici/UL Member course code:	1334

Predavanja	Seminar	Vaje	Klinične vaje	Druge oblike študija	Samostojno delo	ECTS
30	0	30	0	0	60	4

Nosilec predmeta/Lecturer:	Andrej Kryžanowski

Vrsta predmeta/Course type:	Izbirni strokovni/Elective professional

Jeziki/Languages:	Predavanja/Lectures:	Slovenščina
	Vaje/Tutorial:	Slovenščina

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:	**Prerequisites:**

Vsebina:	**Content (Syllabus outline):**
Predavanja	Lectures
Izhodišča vodarstva in varovanja okolja Kulturne osnove in običaji pri urejanju voda Pravne osnove, principi in doktrine vodnega prava. Značilnosti in interesi posameznih vrst dejavnost. Poplave in suše	Baseline water management and environmental protection. Culture and tradition in water management Legal basics, principles and doctrines of water law. Characteristics and interests of different activities. Floods and droughts
Informacijski sistemi v vodarstvu. Geografski informacijski sistemi, značilnosti, standardi	Information systems in water policy Geographic information systems, characteristics, standards
Ugotavljanje vodne bilance. Ugotavljanje vplivov na okolje in njihovo vrednotenje. Vrednotenje in	

primerjanje posegov v vodni režim s pomočjo SWOT. Ekonomske osnove vodarske politike Metode določanja optimalnih rešitev. Vodarska politika in sodelovanje javnosti. Politika več prostora za vode. Vpliv podnebnih sprememb na vodarstvo. Seminarske vaje Pridobijo osnove uporabe GIS sistemov. Študentje delajo skupaj na načrtih regije ali mesta z upoštevanjem razvoja in varovanja vodarstva. Analizirajo posamezne praktične primere.	Determination of water balance Determination of the impact on the environment and their evaluation Evaluating and comparing interventions in the water regime with the help of SWOT. Economic base of water policy. Methods for the determination of optimal solutions. Water policy and public participation. Policy of more space for water. Impact of Climate Change on Water Policy. Tutorial Acquire the basics of GIS systems. Students working together on plans for regions or cities with regard to the development of water policy. Analysis of specific practical examples.

Temeljna literatura in viri/Readings:

Grigg N. 1996. Water Resources Management.

Brilly, M., Mikoš, M., Šraj, M. 1999. Vodne ujme: varstvo pred poplavami, erozijo in plazovi,

1.izdaja, univerzitetni učbenik. Ljubljana, UL FGG, 186 str.

Cech T. 2003. Principles of water resources.

EU flood research reports, AWARE, URBEM.

Dostopno na: http://councilforeuropeanstudies.org/

Učno gradivo v spletni učilnici UL FGG.

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

Cilji - Pridobljeno poglobljeno teoretično znanje potrebno za načrtovanje in izvajanje vodasrke politike. - Razumevanje socialnih in ekonomslih problemov in kako jih reševati. - Uporaba GIS orodij pri izdelavi vodarskih načrtov. Kompetence - Sposobnost abstraktne formulacije vodarskih problemov. - Sposobnost kritične presoje interesov strank v procesu odločanja.	Objectives - Acquired in-depth theoretical knowledge necessary to design and implement water policy. - Understanding of the social and economical problems and how to resolve them. - The use of GIS tools in the development of water plans. Competencies - Ability to formulate water problems. - Critical assessment of interests of the parties in the decision-making process. - Ability to take into account the dynamics of the implementation of procedures for planning human activities in water policy. - Ability to use information technology

- Sposobnost upoštevanja dinamike izvajanja postopkov pri načrtovanju človekove dejavnosti v vodarstvu.
- Sposobnost uporabe informacijske tehnologije.

Predvideni študijski rezultati:

Intended learning outcomes:

Predvideni študijski rezultati	Intended learning outcomes
- osnovni termini in principi v vodarstvu,	- Basic terms and principles in water policy.
- socioloških in ekonomskih osnov,	- Sociological and economic bases.
- uporaba GIS orodij in informacijskih sistemov,	- The use of GIS tools and information systems.
- kritično presojanje socioloških, ekonomskih in psiholoških problemov v vodarstvu.	- Critical assessment of social, economic and psychological problems in water policy.

Metode poučevanja in učenja:

Learning and teaching methods:

Metode poučevanja in učenja	Learning and teaching methods
Predavanja in uporaba pridobljenih znanj pri izdelavi individualne naloge.	Lectures and application of the acquired knowledge in the development of individual coursework.

Načini ocenjevanja: **Delež/Weight**   **Assessment:**

Načini ocenjevanja	Delež/Weight	Assessment
Pisni in/ali ustni izpit	50,00 %	Written and / or oral examination
Seminarske vaje	50,00 %	Tutorial

Reference nosilca/Lecturer's references:

BRILLY, Mitja, ŠRAJ, Mojca, KRYŽANOWSKI, Andrej. Hydro-meteorological risk reduction and climate change adaptation in the Sava river basin. V: *European Geosciences Union, General Assembly 2017, Vienna, Austria, 23-28 April 2017*, (Geophysical research abstracts, ISSN 1607-7962, vol. 19). München: European Geosciences Union, 2017, 1 str.

JAVORNIK, Luka, KRYŽANOWSKI, Andrej, MIKOŠ, Matjaž. HPP Vrhovo operation under reservoir sediment management. V: WIEPRECHT, Silke (ur.). *River sedimentation : proceedings of the 13th International Symposium on River Sedimentation, ISRS 2016, Stuttgart, Germany, 19-22 September 2016*. London: Taylor & Francis Group; Balkem: CRC Press, 2017, str. 1127-1131, ilustr.

KRYŽANOWSKI, Andrej, BRILLY, Mitja, RUSJAN, Simon, SCHNABL, Simon. Structural flood-protection measures referring to several European case studies : review article. *Natural hazards and earth system sciences*, ISSN 1561-8633, jan. 2014, letn. 14, str. 135-142

HUMAR, Nina, ŽVANUT, Pavel, DETELA, Igor, ŠIRCA, Andrej, POLIČ, Marko, RAVNIKAR TURK, Mojca, KRYŽANOWSKI, Andrej. VODPREG - stanje slovenskih vodnogospodarskih pregrad = VODPREG - state of dams for water management purpose in Slovenia. *Ujma*, ISSN 0353-085X, 2013, št. 27, str. 208-221, ilustr.

UČNI NAČRT PREDMETA/COURSE SYLLABUS

Predmet:	
	ORODJA ZA PODPORO ODLOČANJU
Course title:	
	DECISION SUPPORT SYSTEMS IN WATER MANAGEMENT

Študijski programi in stopnja	Študijska smer	Letnik	Semestri
Vodarstvo in okoljsko inženirstvo, druga stopnja, magistrski	Ni členitve (študijski program)		1. semester

Univerzitetna koda predmeta/University course code:	0037812
Koda učne enote na članici/UL Member course code:	1754

Predavanja	Seminar	Vaje	Klinične vaje	Druge oblike študija	Samostojno delo	ECTS
45	15	0	15	0	75	5

Nosilec predmeta/Lecturer:	Primož Banovec

Vrsta predmeta/Course type:	Izbirni strokovni/Elective professional

Jeziki/Languages:	Predavanja/Lectures:	Slovenščina
	Vaje/Tutorial:	Slovenščina

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:	**Prerequisites:**

Vsebina:	Content (Syllabus outline):
Predavanja Teorija odločanja in orodja za simulacijo procesov odločanja; odločanje v več-ciljnem okolju, pareto-optimalna meja; identifikacija stanja in odločitvene spremenljivke, orodja za identifikacijo stanja; problem resolucije – agregacija disagregacija; problemi validacije v kompleksnem sistemu, redundančnost podatkov; mehanizmi zavarovanja pred napačnimi odločitvami; izkušnja uporabnika, integracija uporabnosti, povratne zanke (back-loop	Lectures Theory of decision making process and tools for the simulation of the decision making process; decision making process in multi-objective environment, pareto-optimal frontier, scenario identification; status identification and decision-making variables, tools for the status identification; resolution problem in decision-making process, aggregation, dis-aggregation; validation in complex system modelling, data and information redundancy; mechanisms and tools for the prevention of

pri uporabi in razvoju sistmov), definicija projekta, scrum pristop, omejenost scrum pristopa; OLAP (Online Analytical Processing) in različni koncepti, ki izhajajo iz njega, spremljanje stanja – razumevanje transakcijskega koncepta glede na nadgradnjo relacijskega koncepta upravljanja s podatki in informacijami; klasifikacija sistemov za podporo odločanju (single use, multiple use; data driven, model driven …); področja uporabe sistemov za podporo odločanju (inženirske rešitve, upravljanje s kompleksnimi organizacijami, komunikacija, integracija, identifikacija, napovedovanje, optimizacija …); klasifikacijski sistemi, pomen klasifikacij in vzdrževanje klasifikacij, homogenizacija prostora odločanja; izzivi sistemov za podporo odločanju in prihodnji razvoj (mednarodno okolje, avtomatski sistemi …); pomen identifikacije namena orodja za podporo odločanju (vezano na parametre, stanje, alternative, negotovosti) …

Seminar in vaje

Uporaba pridobljenega znanja pri analizi sistema za podporo odločanju. Uporaba sistema za podporo odločanju na področju upravljanja z vodami in okoljskega inženirstva. Konceptualni razvoj različnih modulov pri razvoju orodij za podporo odločanju na področju upravljanja z vodami in okoljskega inženirstva.

wrong/sub-optimal decisions; role of the DSS scope identification; managing uncertainties and risks in the DS process; end user experience, integration of user experience, back-loop approach in use and development of DSS, project definition, SCRUM approach, limits of SCRUM; OLAP (Online Analytical Processing) and concepts derived from it, dynamic status follow- up, concept of transactional understanding of the system and transactional modelling; classification of the decision support systems (single use, multiple use, data driven, model driven, etc.); uses of decision support systems in environmental engineering (engineering, economics, institutional; nowcasting, optimization; classification systems as backbone to large decision support systems, role of classifications; challenges of the future DSS developments (international environment, automatic systems, learning systems).

Seminar and tutorial

Application of the acquired knowledge in the analysis of the decision support system. Hands- on experience using different decision support systems in the field of water management and environmental engineering. Conceptual development of different modules for the DSS in the field of water management and environmental engineering.

Temeljna literatura in viri/Readings:

Haimes Y. 1998. Risk modelling, assessment and management; John Wiley & Sons; 726 str.

D. J. Power. 2002. Decision Support Systems: Concepts and Resources for managers, Greenwood Publishing Group.

M.E. Pate-Cornell M. E. 1993. Subjective De-Biasing of Data Sets: A Bayesian Approach, Risk-Based Decision Making in Water Resources VI, New York.

P.M. Lee. 1997. Bayesian statistics: an introduction. New York, Toronto, London, Wie Wiley.

M. Volk, S. Lautenbach, H. van Delden,L.T. Newham and R. Seppelt R. 2010. How Can We Make Progress with Decision Support Systems in Landscape and River Basin Management? Lessons Learned from a comparative Analysis of Four Different Decision Support Systems, Environmental Management, 46,834-849.

R. Slowinski. 1992. Intelligent Decision Support: Handbook of Applications and Advances in Rough Sets Theory, Business & Economics, Springer.

Spletne strani: IJSVO, Katmesina, RRS-POTROG, Razlitje, EVON.

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

Cilji	Objectives

- Razširitev znanja na področju procesov odločanja. - Seznanitev s koncepti, terminologijo in klasifikacijskimi opredelitvami na področju teorije odločanja. - Povezovanje procesov odločanja na področju upravljanja voda in okoljskega inženirstva. - Analiza praktičnih primerov orodij za podporo odločanju. Kompetence Sposobnost prepoznave potrebe po orodju za podporo odločanju - Sposobnost identifikacije primernih orodij in njihovih modulov za podporo odločanju. - Sposobnost razumevanja procesa odločanja v večinstitucionalnem, večciljnem in dinamičnem okolju ob upoštevanju negotovosti. - Sposobnost kritične presoje na področju uporabe in razvoja orodij za podporo odločanju.	- Improved knowledge in the field of decision making process; - Getting familiar with the concepts, terminology and classifications in the field of decision making; - Understanding close relationships between the environmental engineering process and decision making process using the results of environmental engineering; - Analysis of practical examples addressing the decision making process in the field of environmental engineering. Competences - Identification of the necessity for structured decision making process. - Capacity for the identification of adequate tools and modules for the decision making process. - Capacity of understanding the decision making process in multi-institutional, multi-objective and dynamic environment, taking uncertainty concept under consideration. - Capacity of critical analysis in the field of use and development of decision support tools.

Predvideni študijski rezultati: | **Intended learning outcomes:**

- Razumevanje načinov odločanja in teorije odločanja - Razumevanje sistemov za obvladovanje velikih količin podatkov - Razumevanje koncepta negotovosti v procesih odločanja. - Znanje o aktualnih orodjih za podporo odločanju na področju upravljanja voda. - Integracija procesa odločanja v ostala znanja, ki jih slušatelji osvojijo na študiju vodarstva in okoljskega inženirstva, - kritično presojanje obstoječih procesov odločanja in orodij, ki se pri tem uporabljajo za njihovo podporo, - uporaba modelov za podporo odločanju v različnih nivojih v inženirski praksi, - uporaba pridobljenega znanja pri predmetih, kjer je potrebno integrirati proces odločanja.	- Understanding the decision making process and its theoretical background - Understanding the systems for large dataset management - Understanding the concept of uncertainty in the decision making process - Knowledge on state-of-the-art tools and applications for the decision support in the field of water management and environmental engineering. - Integration of the decision making process in other fields of knowledge which the attendees obtain in other classes in the syllabus of water science and environmental engineering; - Critical analysis of existing decision making processes and tools used for their support; - Use of the models for the decision making process on different levels in engineering practice; application of the knowledge in the classes where decision making process shall be integrated.

Metode poučevanja in učenja: **Learning and teaching methods:**

Predavanja in uporaba pridobljenih znanj pri izdelavi individualne seminarske naloge.	Lectures and use of the acquired knowledge and competences in the development of seminar work.

Načini ocenjevanja: | **Delež/Weight** | **Assessment:**

Načini ocenjevanja	Delež/Weight	Assessment
Seminarska naloga	50,00 %	Seminar work
Pisni in/ali ustni izpit	50,00 %	Written and/or oral examination

Reference nosilca/Lecturer's references:

KANAKOUDIS, V., TSITSIFLI, P., SAMARAS, Paraskeuas M., ZOUBOULIS, A., BANOVEC, Primož. A new set of water losses-related performance indicators focused on area facing water scarcivity conditions. Desalination water treat. (Print). [Print ed.], mar. 2013, letn. 51, št. 13-15, str. 2994- 3010, doi: 10.1080/19443994.2012.748448.

HOLTEN LÜTZHOFT, Hans-Christian, DONNER, Erica, WICKMAN, Tonie, ERIKSSON, Eva, BANOVEC, Primož, MIKKELSEN, Peter Steen, LEDIN, Anna. A source classification framework supporting pollutant source mapping, pollutant release prediction, transport and load forecasting, and source control planning for urban environments. Environ. sci. pollut. res. int. [Print ed.], maj 2012, letn. 19, št. 4, str. 1119-1130,

BANOVEC, Primož, CERK, Matej. Oil spill management rapid response system: the developed project was structured in a way to provide operational assistance in intelligence to the intervention commander in the case of oil spills to rivers in Slovenia. Savski Vjesnik, maj 2013, št. 11, str. 14.

UČNI NAČRT PREDMETA/COURSE SYLLABUS

Predmet:	
	UREJANJE KRAJINE
Course title:	
	LANDSCAPE MANAGEMENT

Študijski programi in stopnja	Študijska smer	Letnik	Semestri
Vodarstvo in okoljsko inženirstvo, druga stopnja, magistrski	Ni členitve (študijski program)		1. semester

Univerzitetna koda predmeta/University course code:	0035012
Koda učne enote na članici/UL Member course code:	1333

Predavanja	Seminar	Vaje	Klinične vaje	Druge oblike študija	Samostojno delo	ECTS
30	0	0	30	0	60	4

Nosilec predmeta/Lecturer:	Mojca Golobič

Vrsta predmeta/Course type:	Izbirni strokovni /Elective professional

Jeziki/Languages:	Predavanja/Lectures:	Slovenščina
	Vaje/Tutorial:	Slovenščina

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:	**Prerequisites:**

Vsebina:	Content (Syllabus outline):
Predavanja: Pojem krajine ter osnove in izhodišča za urejanje krajine. Krajinska analiza in vrednotenje. Varstvo, upravljanje in načrtovanje krajine. Vplivi infrastrukturnih posegov na krajino in ukrepi za njihovo zmanjševanje. Sanacije krajine. Krajinske tehnike: oblikovanje reliefa, ravnanje s tlemi, zasaditve (izbor rastlin, oblike zasaditve, zasaditveni načrt, izvajalski postopki), prenova	Lectures: The term landscape and basis for landscape planning and management. Landscape analysis and evaluation. Landscape conservation, management and planning. The impact of infrastructural developments on landscape and mitigation measures. Landscape reclamation. Landscape techniques: terrain remodelling, planting, substitute biotopes.

biotopov in ureditev nadomestnih biotopov, vzdrževanje nasadov. Vaje: Študentje na izbranem primeru izvedenega ali načrtovanega posega v prostor izvedejo krajinsko analizo in vrednotenje ter oblikujejo smernice za urejanje krajine z namenom preprečevanja (ali sanacije) negativnih vplivov na krajino.	Tutorial: Students prepare landscape analysis, evaluation and guidelines for landscape management on a selected case of planned or already implemented development. The basic purpose is to prevent negative impacts on landscape.

Temeljna literatura in viri/Readings:

MOP-UPP. 1998. Načrtovanje in krajinsko oblikovanje koridorjev daljnovodov in cevnih vodov,

MOP-UPP, Ljubljana.

MOP-UPP. 1997. Urejanje obcestne krajine, MOP-UPP, Ljubljana.

MOP-UPP. 1998. Metodološke osnove, Regionalna razdelitev krajinskih tipov v Sloveniji, MOP- UPP, Ljubljana.

Turner, T. 1998. Landscape Planning and Environmental Impact Design, UCL Press

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

Cilji - Spoznati koncept krajine ter izhodišča za prepoznavanje kakovosti in razvrednotenja krajine. - Spoznati osnovne pristopov urejanja krajine: varstva, upravljanja in načrtovanja krajine. - Predstaviti načrtovanje izbranih tehnik za urejanje in sanacijo krajin ob posegih v prostor. Kompetence - Poznavanje in razumevanje vloge krajine pri poseganju v prostor. - Sposobnost razumevanja posledic poseganja v prostor za krajino in poznavanje možnosti za zmanjševanje negativnih vplivov. - Poznavanje pristopov in tehnik urejanja in sanacije krajine pri posegih v prostor ter sposobnost prepoznave potrebe za njihovo uporabo in izbire med njimi.	Objectives - To get acquainted with the concept of landscape and basis for recognizing landscape qualities and degradations. - To learn about landscape planning, management and conservation. - To introduce techniques for landscape design and rehabilitation of degraded landscapes. Competences - Understanding the role of landscape. - Understanding the consequences of development on landscape, understanding the possibilities for mitigation measures. - Knowledge of techniques for landscape rehabilitation.

Predvideni študijski rezultati: **Intended learning outcomes:**

- Poznavanje in razumevanje vloge krajine pri poseganju v prostor.	- Understanding the role of landscape.

- Sposobnost razumevanja posledic poseganja v prostor za krajino in poznavanje možnosti za zmanjševanje negativnih vplivov.	- Understanding the consequences of development on landscape, understanding the possibilities for mitigation measures.
- Poznavanje pristopov in tehnik urejanja in sanacije krajine pri posegih v prostor.	- Knowledge of techniques for landscape rehabilitation.
- Učinkovito sodelovanje v interdisciplinarnih skupinah pri načrtovanju posegov v prostor in pri sanacijah.	- Efficient work in interdisciplinary groups (planning and rehabilitation of landscape).
- Prepoznavanje potrebe in možnosti uporabe tehnik za sanacijo in urejanje krajine pri posegih v prostor, zlasti pri vodnogosppodarskih ureditvah in ureditvah komunalne infrastrukture.	- Knowledge of techniques for landscape rehabilitation, especially at water management plans and municipal infrastructure.
- Sposobnost vrednotenja kakovosti v prostoru glede na izbrane cilje in vrednostni sistem.	- Ability to evaluate spatial qualities according to selected goals and value system.
- Sposobnost kritičega vrednotenja obstoječih in načrtovanih posegov v prostor z vidika vplivov na krajino ter kakovosti krajinske ureditve in sanacije.	- Ability to critically evaluate implemented and planned development according to its impact on the landscape.
- Razumevanje kompleksnih in dinamičnih sistemov.	- Understanding of complex and dynamic systems.
- Sposobnost dela v interdisciplinarni skupini.	- Ability to work within interdisciplinary team.
- Sposobnost komunikacije s strokovnjaki drugih področij.	- Ability to communicate with experts from other fields.
- Praktična uporaba znanja.	- Practical use of knowledge.
- Zmožnost ustvarjanja novih idej (kreativnost).	- Creativity.
- Sposobnost predstavljanja idej v grafični obliki.	- Ability to present ideas.

Metode poučevanja in učenja: **Learning and teaching methods:**

Predavanja, samostojno delo – izdelava naloge ter predstavitve nalog z razpravo	Lectures, individual work – course work with presentation, discussion.

Načini ocenjevanja: **Delež/Weight**   **Assessment:**

Pisni izpit	50,00 %	Written exam.
Individualna naloga z zagovorom/predstavitvijo	50,00 %	Individual course work with oral presentation

Reference nosilca/Lecturer's references:

LESTAN, Katarina Ana, GOLIČNIK, Barbara, ERŽEN, Ivan, GOLOBIČ, Mojca. Odprti prostor stanovanjskih naselij povečuje kakovost grajenega. IB rev. (Ljubl., Tisk. izd.), 2013, letn. 47, št. 1, str. 41-55.

GOLOBIČ, Mojca, MAROT, Naja. Territorial impact assessment: integrating territorial aspects in sectoral policies. Eval. program plann. [Print ed.], 2011, letn. 34, št. 3, str. 163-173.

GOLOBIČ, Mojca. Transformation processes of Alpine landscapes and policy responses: top-down and bottom-up views. Soc. nat. resour., 2010, letn. 23, št. 3, str. 269-280.

UČNI NAČRT PREDMETA/COURSE SYLLABUS

Predmet:	
	UVOD V RAZISKOVALNO DELO
Course title:	
	INTRODUCTION TO RESEARCH WORK

Študijski programi in stopnja	Študijska smer	Letnik	Semestri
Vodarstvo in okoljsko inženirstvo, druga stopnja, magistrski	Ni členitve (študijski program)		1. semester

Univerzitetna koda predmeta/University course code:	0037813
Koda učne enote na članici/UL Member course code:	1755

Predavanja	Seminar	Vaje	Klinične vaje	Druge oblike študija	Samostojno delo	ECTS
30	15	0	15	0	60	4

Nosilec predmeta/Lecturer:	Matjaž Mikoš

Vrsta predmeta/Course type:	Izbirni strokovni/Elective professional

Jeziki/Languages:	Predavanja/Lectures:	Slovenščina
	Vaje/Tutorial:	Slovenščina

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:	**Prerequisites:**

Vsebina:	**Content (Syllabus outline):**
Predavanja	Lectures
Osnove komunikacije v raziskovanju in znanstvenem delu. Pisanje grobega osnutka. Iskanje in pregledovanje znanstvene literature. Priprava predlogov. Zaključna dela in disertacije.	Basic of scientific communication in research work.
	Writing a rough draft. Searching and reviewing of scientific literature. Preparation of proposals. Graduate theses and dissertations. Publishing in scientific journals. Forming the final draft.
Objavljanje v znanstvenih časopisih. Oblikovanje besedila. Recenziranje in popravki. Objavljanje podatkov. Profesionalnost, etika in pravni vidiki objavljanja rezultatov raziskovalnega dela. Znanstvene predstavitve (znanstveni in strokovni	Reviewing and revising. Publishing data. Professionalism, ethics, and legal issues when publishing results of research work. Scientific

seminarji, razgovori za delo). Besedilna sporočilnost in vizualizacija predstavitev. Ustne predstavitve. Predstavitve posterjev. Okrogle mize in razprave. Komuniciranje z laiki. Seminar Priprava osnutka raziskovalne magistrske naloge. Priprava predstavitve osnutka magistrske naloge in predstavitev pred študenti. Laboratorijske vaje Uvod v delo z bazami bibliografskih podatkovnih baz (COBISS, SICRIS, Web of Knowledge, SCOPUS, Google Scholar, Publish or Perish) in programi (Latex, MyEndNote, TurnItIn). Uporaba Navodil za oblikovanje zaključnih izdelkov na UL FGG.	presentations (scientific and professional seminars, job interviews). Communication without words and visualisation of presentations. Oral presentations. Poster presentations. Group communications. Communicating with the non-scientists. Seminar work Preparation of a draft of research master thesis. Preparation of the presentation of a draft of master thesis and its oral presentation in front of the fellow students. Laboratory tutorials Introduction to work with bibliographic databases (COBISS, SICRIS, Web of Science, SCOPUS, Google Scholar, Publish or Perish) and programs (Latex, MyEndNote, TurnItIn). The use of the faculty's internal instructions for preparing graduation theses at the UL FGG.

Temeljna literatura in viri/Readings:

Koler Povh, T., Turk, G. 2011. Navodila za oblikovanje visokošolskih del na Fakulteti za gradbeništvo in geodezijo in navajanje virov. Ljubljana, UL FGG, 60 str.

Carter, M. 2013. Designing Science Presentations - A Visual Guide to Figures, Papers, Slides, Posters, and More. Academic Press, 384 str. – odloženo v elektronski obliki (pdf) v spletni učilnici Davis, M., Davis, K.J., Dunagan, M.M. 2012. Scientific Papers and Presentations. 3rd Ed., Academic Press, 368 str.

Narodne univerzitetne knjižnice (NUK).

Dostopno na: http://www.nuk.uni-lj.si/

Spletne strani Centralne tehniške knjižnice (CTK).

Dostopno na: http://www.ctk.uni-lj.si/ .

Učno gradivo v spletni učilnici UL FGG.

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

Cilji - Študent spozna različne oblike komunikacije v raziskovanju ter posebnosti predstavitev rezultatov znanstvenega dela. - Študent spozna pravila oblikovanje zaključnih del na UL FGG in se nauči korektno navajati različne vire v lastnih izdelkih. Kompetence - Sposobnost uporabe bibliografskih informacijskih sistemov na spletu na področju tehniških znanosti in tehnologije.	Objectives - Students get acquainted with forms of scientific communication in research and specifics of presenting results of scientific work. - Students get acquainted with rules how to write graduation theses at the UL FGG, and learn to correctly quote different sources in their own works. Competences - Capability to use bibliographic information systems on the web in the field of technical sciences and technology.

- Sposobnost uporabe knjižničnega sistema UL FGG, UL, NUK in CTK. - Za izbrano temo magistrske naloge izdelati njen osnutek in ga znati napolniti z ustrezno vsebino.	- Capability to use the library system at the UL FGG, UL, NUK and CTK. - For a chosen theme of a master thesis competence to work out its draft and ability to fill it with adequate content.

Predvideni študijski rezultati: **Intended learning outcomes:**

- osnovnih pojmov komunikacije v raziskovanju, - posebnosti različnih oblik komunikacije s poudarkom na magistrski nalogi. - uporaba pridobljenih znanj pri izdelavi raziskovalne magistrske naloge, - kritično presojanje rezultatov dela drugih strokovnjakov in raziskovalcev.	- Basic terms of communication in research. - Specifics of different forms of communication with the accent on master thesis. - Use of acquired knowledge for working out a research master thesis. - Critical judgment of other professionals' and researchers' results.

Metode poučevanja in učenja: **Learning and teaching methods:**

Predavanja: potekajo v predavalnici z aktivnim sodelovanjem študentov na osnovi njihovega poznavanja študijskega gradiva iz spletne učilnice. Seminar: uporaba pridobljenih znanj pri izdelavi individualne seminarske naloge (osnutka magistrske naloge). Laboratorijske vaje: praktični primeri dela z bibliografskimi podatkovnimi bazami in računalniškimi programi v računalniški učilnici.	Lectures: in the lecture hall with active students' involvement based on their knowledge of the study materials available in the web classroom. Seminar coursework: use of acquired knowledge for the preparation of an individual seminar work (draft of the master thesis). Laboratory tutorials: practical use of bibliographic databases and bibliographic computer applications in the computer room.

Načini ocenjevanja: **Delež/Weight** **Assessment:**

Načini ocenjevanja	Delež/Weight	Assessment
Seminarska naloga	50,00 %	Seminar coursework
Pisni in/ali ustni izpit	50,00 %	Written and/or oral exam

Reference nosilca/Lecturer's references:

Cerovšek, T., Mikoš, M. 2013. A comparative study of cross-domain research output and citations: Research impact cubes and binary citation frequencies. Journal of Informetrics, (under review).

Koler-Povh, T., Turk, G., Mikoš, M. 2012. Repozitorij kot pridobitev za uporabnike in izziv za knjižničarje. V: Kavčič-Čolić, A., Vodopivec, I. (ur.). Izzivi sodobnih tehnologij: konkurenčna prednost knjižničnih storitev: zbornik referatov. Ljubljana: Zveza bibliotekarskih društev Slovenije, 2012, str. 217-234.

Lah, M., Cerovšek, T., Mikoš, M. 2010. Razvoj spletnega učnega pripomočka NIT na področju varstva pred naravnimi nesrečami. V: Zorn, M., Komac, B., Pavšek, M., Pagon, P. (ur.). Od razumevanja do upravljanja, (Naravne nesreče, knj. 1). Ljubljana: Založba ZRC, str. 245-253. Dostopno na: http://giam.zrc-sazu.si/sites/default/files/Naravne-nesrece-01.pdf.

UČNI NAČRT PREDMETA/COURSE SYLLABUS

Predmet:	
	PROJEKT IZ INFRASTRUKTURNIH SISTEMOV
Course title:	
	PROJECT IN INFRASTRUCTURAL SYSTEMS

Študijski programi in stopnja	Študijska smer	Letnik	Semestri
Vodarstvo in okoljsko inženirstvo, druga stopnja, magistrski	Ni členitve (študijski program)		1. semester

Univerzitetna koda predmeta/University course code:	0035013
Koda učne enote na članici/UL Member course code:	1605

Predavanja	Seminar	Vaje	Klinične vaje	Druge oblike študija	Samostojno delo	ECTS
30	30	0	0	0	60	4

Nosilec predmeta/Lecturer:	Maruška Šubic-Kovač

Vrsta predmeta/Course type:	Izbirni strokovni/Elective professional

Jeziki/Languages:	Predavanja/Lectures:	Slovenščina
	Vaje/Tutorial:	Slovenščina

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:	Prerequisites:

Vsebina:	Content (Syllabus outline):
Predavanja	Lectures
Pojem infrastrukturni sistemi in značilnosti	Concept of infrastructure systems and infrastructure characteristics; infrastructure development and its impact on space, urban and regional development; the legal basis of infrastructure placement and infrastructure development; infrastructure as operational instrument of spatial planning documents; technical infrastructure financing; public infrastructure planning; management and disposal of
Infrastrukture; razvoj infrastrukture in njen vpliv na prostor, urbani oziroma regionalni razvoj.	
Pravne podlage za umeščanje in razvoj	
Infrastrukture; infrastruktura kot operativni instrument prostorskih aktov; financiranje tehnične infrastrukture; planiranje javne infrastrukture; upravljanje in razpolaganje z infrastrukturnimi	

sistemi, javne evidence o infrastrukturi, infrastruktura za izvajanje GJS kot grajeno javno dobro; razmerja med lastnikom in izvajalcem GJS; obračunavanje in uporaba sredstev amortizacije infrastrukture; nadomestilo za uporabo infrastrukture.	infrastructure systems, public infrastructure records, infrastructure as built public good; relationship between owner and public service contractor; accounting for asset depreciation and use of infrastructure; compensation for the use of infrastructure.
Seminar	Seminar
Umeščanje vodnogospodarskih infrastrukturnih sistemov v prostor v različnih fazah in z različnih vidikov.	Seminar project dealing with spatial placement of water infrastructure systems in different phases and from different aspects.

Temeljna literatura in viri/Readings:

Rakar A., Šubic Kovač, M. 2012. Infrastrukturni sistemi, študijsko gradivo. Ljubljana, UL FGG, 81 str.
Žegarac, Z., Arsić, V. 1999. Programi unapređivanja javne infrastrukture, Urbanistički zavod Beograda Jp, 161 strani, izbrana poglavja.
Aktualni predpisi: http://www.gov.si.

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

Cilj predmeta je seznanitev študentov z značilnostmi infrastrukturnih sistemov predvsem na regionalni oziroma državni ravni.	The objective of the course is to familiarize students with characteristics of infrastructural systems, especially on regional and state level.

Predvideni študijski rezultati: **Intended learning outcomes:**

- Študent razume delovanje infrastrukturnih sistemov kot nenadomestljiv pogoj za zagotavljanje temeljnih materialnih dobrin za življenje in delo v urbani sredini.	- Understanding the role of public service infrastructure (technical infrastructure) as an irreplaceable condition for the provision of basic material goods to live and work in urban environment.
- Pridobljeno znanje bo študent uporabil pri izdelavi idejnih zasnov in idejnih projektov s področja infrastrukture. Znanja bo uporabil pri izdelavi prostorskih aktov.	- Acquired knowledge can be used when making a design concept in the field of public service infrastructure or energy infrastructure or in preparation of spatial planning documents.
Povezava z drugimi področji, povezanimi z infrastrukturnimi sistemi. Uporaba domače in tuje strokovne	Connection with other areas in the field of infrastructural systems.
literatura s področja infrastrukturnih sistemov.	Use of national and international professional literature in the field of infrastructural systems.

Metode poučevanja in učenja: **Learning and teaching methods:**

Nosilec predmeta razpiše teme projektov in prijavljene kandidate pri izdelavi elaborata usmerja in vodi. Študentje (posamično ali v skupini) izdelajo	The lecturer prepares various project tasks in advance and then guides students in the process of making the project. Students (individually or divided

elaborat s predpisano obliko in vsebino ter ga javno predstavijo in zagovarjajo.	in several groups) make project in prescribed written form and present the project in public.

Načini ocenjevanja: **Delež/Weight**   **Assessment:**

Projekt - pisni izdelek	70,00 %	Project - written document
Ustna predstavitev projekta	30,00 %	Project - presented in public

Reference nosilca/Lecturer's references:

RAKAR, Albin, MESNER, Andrej, MLINAR, Jurij, ŠARLAH, Nikolaj, ŠUBIC KOVAČ, Maruška. Zaščita in ohranjanje vrednosti gospodarske javne infrastrukture. Geod. vestn. [Tiskana izd.], 2010, letn. 54, št. 2, str. 242-252, ilustr.

ŠUBIC KOVAČ, Maruška, RAKAR, Albin. Model vrednotenja zemljišč kategoriziranih cest za namene pravnega prometa. Geod. vestn. [Tiskana izd.], 2010, letn. 54, št. 2, str. 253-266, ilustr.

RAKAR, Albin, ČERNE, Tomaž, ŠUBIC KOVAČ, Maruška. Fiskalna in usmerjevalna vloga javnih dajatev pri izvajanju aktivne zemljiške politike = Fiscal and guiding role of public duties in land policy implementation. Geod. vestn. [Tiskana izd.], 2008, letn. 52, št. 4, str. 743-757, ilustr.

UČNI NAČRT PREDMETA/COURSE SYLLABUS

Predmet:	
	IZBRANA POGLAVJA IZ MATEMATIKE III
Course title:	
	SELECTED TOPICS FROM MATHEMATICS III

Študijski programi in stopnja	Študijska smer	Letnik	Semestri
Vodarstvo in okoljsko inženirstvo, druga stopnja, magistrski	Ni členitve (študijski program)		1. semester

Univerzitetna koda predmeta/University course code: 0035014

Koda učne enote na članici/UL Member course code: 1768

Predavanja	Seminar	Vaje	Klinične vaje	Druge oblike študija	Samostojno delo	ECTS
30	0	30	0	0	60	4

Nosilec predmeta/Lecturer: Marjeta Kramar Fijavž

Vrsta predmeta/Course type: Izbirni splošni /Elective general

Jeziki/Languages:	Predavanja/Lectures:	Slovenščina
	Vaje/Tutorial:	Slovenščina

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:	Prerequisites:
Opravljena izpita iz predmetov Matematika I in Matematika II oz. drugih predmetov s primerljivo vsebino	Passed exams in Mathematics I and Mathematics II or other courses with comparable content

Vsebina:	Content (Syllabus outline):
Predavanja:	Lectures:
Navadne diferencialne enačbe: linearna diferencialna enačba n-tega reda, linearna diferencialna enačba s konstantnimi koeficienti, linearni sistemi diferencialnih enačb 1. reda, matrična rešitev začetnega problema, fazni diagrami v dveh dimenzijah, robni problem.	Ordinary differential equations: linear differential equations of order n, linear differential equations with constant coefficients, linear systems of differential equations of first order, matrix solution of initial problem, phase diagrams in two dimensions, boundary value problem.

Parcialne diferencialne enačbe: enačbe matematične fizike, nihanje strune, dAlembertova rešitev, toplotna enačba, Fourierove vrste, začetni in robni problem.	Partial differential equations: equations of mathematical physics, vibrating string, d'Alembert solutions, heat equation, Fourier series, initial and boundary value problem.
Primeri matematičnega modeliranja: prevajanje toplote, numerično računanje, končne diference.	Examples of mathematical modelling: heat transfer, numerical computation, finite differences.
Vaje:	Tutorial:
Reševanje nalog in praktičnih problemov iz vsebin predavanj	Exercises – solving practical problems learnt inthe framework of lectures.

Temeljna literatura in viri/Readings:

Gerald, C.F., Wheatley, P.O. 1993. Applied Numerical Analysis, Addison-Wesley Publishing Company.

Mizori-Oblak, P. 1987. Matematika za študente tehnike in naravoslovja II, III. Ljubljana, UL, Fakulteta za strojništvo.

I. Vidav. 1976. Višja matematika III. Ljubljana, DMFA.

Cilji in kompetence:	**Objectives and competences:**
Cilji:	Objectives:
- nadgraditi pridobljeno matematično znanje,	- to upgrade the acquired mathematical knowledge,
- omogočiti razumevanje matematičnega aparata, ki ga uporabljajo strokovni predmeti,	- to enable understanding of mathematical tools used by engineering courses,
- usposobiti za pravilno postavitev in numerično reševanje konkretnih problemov.	- to train for correct posing and numerical solving of given practical problems.
Pridobljene kompetence:	Gained competences:
- sposobnost kritične presoje podatkov in dobljenih računskih rezultatov,	- capability of critical judgement of data and obtained numerical results,
- sposobnost uporabe matematičnega znanja v inženirski praksi	- ability to use mathematical knowledge in engineering problems.

Predvideni študijski rezultati:	**Intended learning outcomes:**
- reševanje navadnih in parcialnih diferencialnih enačb	- solving ordinary and partial differential equations
- formulacija konkretnih problemov v matematičnem jeziku	- formulation of practical problems in mathematical language
- identifikacija ustreznega matematičnega modela	- identification of appropriate mathematical model
- poznavanje teoretičnih osnov za praktično iskanje rešitev	- basic theoretical knowledge to be used in practical problems

- spretnost uporabe literature in modernih tehnologij - poznavanje računalniških orodij (Mathematica, Matlab).	- skills in using literature and modern technologies - ability to use computational tools (Mathematica, Matlab).

Metode poučevanja in učenja: **Learning and teaching methods:**

Predavanja, seminarske vaje, domače naloge, konzultacije.	Lectures, tutorials, consultations.

Načini ocenjevanja: **Delež/Weight**   **Assessment:**

Načini ocenjevanja	Delež/Weight	Assessment
Računske naloge in sprotno delo	70,00 %	Exercises and homework
Izpit (teoretičen del)	30,00 %	Exam (theoretical part)

Reference nosilca/Lecturer's references:

KRAMAR FIJAVŽ, Marjeta, LAKNER, Mitja, ŠKAPIN-RUGELJ, Marjeta. An equal-area method for scalar conservation laws. The Anziam journal, 2012, vol. 53, iss. 2, str. 156-170. http://dx.doi.org/10.1017/S1446181112000065.

ENGEL, Klaus, KRAMAR FIJAVŽ, Marjeta, KLÖSS, Bernd, NAGEL, Rainer, SIKOLYA, Eszter. Maximal controllability for boundary control problems. Appl. math. optim., 2010, vol. 62, no. 2, str. 205-227.

KRAMAR FIJAVŽ, Marjeta, MUGNOLO, Delio, SIKOLYA, Eszter. Variational and semigroup methods for waves and diffusion in networks. Appl. math. optim., 2007, vol. 55, no. 2, str. 219-240.

KRAMAR FIJAVŽ, Marjeta, SIKOLYA, Eszter. Spectral properties and asymptotic periodicity of flows and networks. *Math. Z.*, 2005, vol. 249, no. 1, str. 139-162.

UČNI NAČRT PREDMETA/COURSE SYLLABUS

Predmet:	
	EKOHIDROLOGIJA
Course title:	
	ECOHYDROLOGY

Študijski programi in stopnja	Študijska smer	Letnik	Semestri
Vodarstvo in okoljsko inženirstvo, druga stopnja, magistrski	Ni členitve (študijski program)		1. semester

Univerzitetna koda predmeta/University course code: 0035015

Koda učne enote na članici/UL Member course code: 1730

Predavanja	Seminar	Vaje	Klinične vaje	Druge oblike študija	Samostojno delo	ECTS
30	10	15	0	5	60	4

Nosilec predmeta/Lecturer: Matjaž Mikoš, Simon Rusjan

Vrsta predmeta/Course type: Izbirni strokovni /Elective professional

Jeziki/Languages:	Predavanja/Lectures:	Slovenščina
	Vaje/Tutorial:	Slovenščina

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:

Prerequisites:

Opravljeni izpiti iz predmetov Geologija, Hidrologija in Hidravlika na 1. stopnji študijskega programa in iz predmeta Modeliranje v hidrologiji oz. osvojena ustrezna primerljiva znanja.

Basic courses on Geology, Hydrology and Hydraulics (BA level) and on Hydrologic Modelling (MA level) or adequate attained skills.

Vsebina:

Content (Syllabus outline):

Predavanja:

Ekohidrologija kot medsebojna soodvisnost hidroloških, biogeokemijskih in bioloških procesov.

Kroženje vode, snovi in energije v hidrosferi in geosferi.

Ecohydrology as interconnection between hydrological, biogeochemical and biological processes.

Cycling of water, matter, energy in hydrosphere and geosphere.

Prostorska in časovna spremenljivost mehanizmov oblikovanja padavinskega odtoka.	Spatial and temporal changeability of rainfall runoff formation.
Procesi spiranja in raztapljanja snovi: erozijski procesi, vnos raztopljenih snovi v vodna telesa, dinamično ravnotežje vodnih ekosistemov.	Processes of flushing and dissolving of matter: erosion processes, inflow of dissolved matter in water bodies, dynamical equilibrium of ecosystems.
Sezonski režimi: sezonska spremenljivost hidroloških razmer in procesov, sezonska spremenljivost biogeokemijskih razmer in procesov.	Seasonal regimes: seasonal variability of hydrological conditions and processes; seasonal variability of biogeochemical conditions and processes.
Antropogeni vplivi na hidrološke in biogeokemijske razmere v vodnih telesih (kmetijstvo, industrija, urbanizacija, rečne regulacije).	Anthropogenic impacts on hydrological and biogeochemical conditions in water bodies (agriculture, industry, urbanisation, river regulations).
Monitoring ekohidroloških procesov: hidrološki monitoring, monitoring fizikalnih in kemijskih parametrov vode.	Monitoring of ecohydrological processes: hydrological monitoring, monitoring of physical and chemical water parameters.
Modeliranje: hidroloških procesov, procesov spiranja snovi, biogeokemijskih procesov (modeli ANSWERS, AGNPS, SWAT, TOPCAT-N).	Modelling: modelling of hydrological processes, modelling flushing of matter, modelling of biogeochemical processes (models: ANSWERS, AGNPS, SWAT, TOPCAT-N).
Vaje:	**Tutorials:**
Seminarske vaje (računske vaje iz hidrologije povirij in modeliranja spiranja snovi).	Seminar tutorials (computational excercises from catchment hydrology and modelling of flushing of matter).
Laboratorijske vaje (uporaba matematičnih modelov za modeliranje hidroloških in biogeokemijskih procesov, uporaba modernih statističnih orodij pri obdelavi ekohidroloških podatkov).	Laboratory tutorials (use of mathematical models for modelling of hydrological and biogeochemical processes, use of modern statistical tools for analysis of ecohydrological data).
Terensko delo:	**Field work:**
Terenske meritve na različnih lokacijah: hidrološke meritve, meritve osnovnih fizikalnih in kemijskih parametrov vode.	Field measurements at different locations: hydrological measurements, measurements of basic physical and chemical water parameters.

Temeljna literatura in viri/Readings:

Knjižni viri (izbrana poglavja) / Books (selected chapters):

Bonacci, O. (2003). Ekohidrologija vodnih resursa i otvorenih vodotoka, Građevinsko-arhitektonski fakultet Sveučilišta u Splitu, 487 str.

Eagleson, P.S. (2002). Ecohydrology – Darwinian Expression of Vegetation Form and Function, Cambridge University Press, 443 str.

Moldan, B., Černý, J. (1994). Biogeochemistry of small catchments: a tool for environmental research, J. Wiley & Sons, 419 str.

Schlesinger, W.H. (Ed.) (2005). Biogeochemistry, Elsevier, 702 str.

Wood, P.J. (Ed.) (2008). Hydroecology and ecohydrology: past, present and future, J. Wiley & Sons, 436 str.

Elektronski viri / Other sources:

paket / package R, WEKA.

Revije / journals: Ecohydrology, Biogeochemistry, Ecosystems, International Journal of Ecohydrology & Hydrobiology, Journal of Hydrology, Science of the Total Environment, Hydrology and Earth System Sciences.

Spletna učilnica UL FGG / Web classroom UL FGG: http://ucilnica1516.fgg.uni-lj.si/

Cilji in kompetence:

Objectives and competences:

Cilji:

- Poglobiti osnovna hidrološka znanja o medsebojnem vplivu pri kroženju vode, snovi in energije.

- Razumevanje biogeokemijskega kroženja kot del hidrološkega kroga.

- Razumevanje ekohidrologije kot veznega člena med hidrologijo in ekologijo.

- Podati teoretične osnove za prepoznavanje, opazovanje, meritve in modeliranje ekohidroloških pojavov.

Kompetence:

Sposobnost prepoznavanja povezav med hidrološkimi in biogeokemijskimi procesi, kvantifikacija ekološkega stanja vodnih teles, sposobnost izbire, zasnove in izvedbe terenskega monitoringa ekohidroloških procesov.

Objectives:

- To extend basic hydrological knowledge on mutual influences in water, matter and energy cycles.

- Understanding of the biogeochemical cycling as a part of the hydrological cycle.

- Understanding ecohydrology as a link between hydrology and ecology.

- Give theoretical basis for identification, observation, measurements and modelling of ecohydrological phenomena.

Competences:

Ability to identify links between hydrological and biogeochemical processes, quantification of ecological states of water bodies, competence to choose, design and implement field monitoring of ecohydrological processes.

Predvideni študijski rezultati:

Intended learning outcomes:

Znanje in razumevanje:

- Pridobljeno poglobljeno znanje iz prepletanja hidrologije in ekologije.

- Pridobljeni znanje o medsebojni soodvisnosti hidroloških, biogeokemijskih in bioloških procesov v tekočih vodah.

- Osvojene računske spretnosti za modeliranje ekohidroloških procesov.

Uporaba:

- Doseženo znanje uporabljajo pri izdelavi magistrskega dela oz. v praksi.

Refleksija:

- Dobro razumevanje ekohidroloških procesov in možnosti modeliranja so dobra osnova za terenske meritve in raziskovanje kakovosti tekočih voda.

Prenosljive spretnosti:

Knowledge and understanding:

- Deepened knowledge on interactions between hydrology and ecology.

- Knowledge on mutual interdependence between hydrological, biogeochemical and biological processes in running waters.

- Obtaining computational skills for modelling of ecohydrological processes.

Use:

- Use of the obtained knowledge for master work and in practical/professional applications

Reflection:

- Understanding of ecohydrological processes and possibilities to model them is a foundation for field monitoring system designing and research on water quality of running waters.

- Sposobnost abstraktne formulacije (konceptualizacije) naravnih procesov. - Sposobnost kritične presoje vhodnih podatkov in dobljenih računskih rezultatov pri modeliranju pojavov. - Sposobnost upoštevanja dinamike naravnih procesov pri načrtovanju dejavnosti v prostoru. - Spretnost uporabe literature.	**Skills:** - Ability of abstract formulation (conceptualisation) of natural processes. - Critical assessment of input data and obtained computational results in modelling of the processes. - Ability to consider natural processes dynamics in designing spatial planning activities Ability of the use of literature.

Metode poučevanja in učenja: | **Learning and teaching methods:**

Predavanja (30 ur), seminar (10 ur), seminarske vaje (15 ur), terensko delo (5 ur).	Lectures (30 hours), seminar (10 hours), lab tutorials (15 hours), and field work (5 hours).

Načini ocenjevanja: | **Delež/Weight** | **Assessment:**

Načini ocenjevanja:	Delež/Weight	Assessment:
Pisni izpit	30,00 %	Written examination
Udeležba in poročilo s terenskega dela	10,00 %	Presence & Individual field work report
Laboratorijske in seminarske vaje	40,00 %	Lab and class tutorials
Seminarska naloga	20,00 %	Seminar coursework

Reference nosilca/Lecturer's references:

PETKOVSKA, Vesna, URBANIČ, Gorazd, MIKOŠ, Matjaž. Variety of the guiding image of rivers - defined for ecologically relevant habitat features at the meeting of the alpine, mediterranean, lowland and karst regions. Ecological engineering, ISSN 0925-8574. [Print ed.], 2015, letn. 81, str. 373-386, ilustr., doi: 10.1016/j.ecoleng.2015.04.043. [COBISS.SI-ID 7024481]

OJSTERŠEK ZORČIČ, Polona, MIKOŠ, Matjaž, KOŠMELJ, Katarina, PINTAR, Marina. Nitrate concentration changes in a river and its reservoir within an agriculturally influenced watershed: the river Ledava (SE Austria and NE Slovenia) case study. Fresenius environmental bulletin, ISSN 1018-4619. [Print ed.], 2015, vol. 24, no. 4b, str. 1537-1548. [COBISS.SI-ID 8140665]

RUSJAN, Simon, MIKOŠ, Matjaž. A catchment as a simple dynamical system: characterization by streamflow component approach. Journal of Hydrology, ISSN 0022-1694. [Print ed.], avg. 2015, letn. 527, št., str. 794-808, ilustr., doi: 10.1016/j.jhydrol.2015.05.050. [COBISS.SI-ID 7072353]

RUSJAN, Simon, MIKOŠ, Matjaž. Seasonal variability of diurnal in-stream nitrate concentration oscillations under hydrologically stable conditions. Biogeochemistry, ISSN 0168-2563, marec 2010, letn. 97, št. 2-3, str. 123-140, ilustr., doi: 10.1007/s10533-009-9361-5. [COBISS.SI-ID 4707425]

BRILLY, Mitja, RUSJAN, Simon, VIDMAR, Andrej. Monitoring the impact of urbanisation on the Glinscica stream. V: FOHRER, N. (ur.). Assessing water quality on catchment scale, (Journal of the European ceramic society, ISSN 1474-7065, vol. 31, no. 17, 2006). Kidlington: Elsevier, 2006, issue 17, str. 1089-1096, graf. prikazi. [COBISS.SI-ID 3366753]

UL FGG, Vodarstvo in okoljsko inženirstvo (MA), 2. stopnja | Water Science and Environmental Engineering (MA), 2nd Cycle

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UČNI NAČRT PREDMETA/COURSE SYLLABUS

Predmet:	
	GEOTEHNIKA NIZKIH GRADENJ
Course title:	
	GEOTECHNICS OF INFRASTRUCTURAL FACILITIES

Študijski programi in stopnja	Študijska smer	Letnik	Semestri
Vodarstvo in okoljsko inženirstvo, druga stopnja, magistrski	Ni členitve (študijski program)		1. semester

Univerzitetna koda predmeta/University course code:	0035016
Koda učne enote na članici/UL Member course code:	1731

Predavanja	Seminar	Vaje	Klinične vaje	Druge oblike študija	Samostojno delo	ECTS
45	0	45	0	0	90	6

Nosilec predmeta/Lecturer:	Janko Logar

Vrsta predmeta/Course type:	Izbirni strokovni/Elective professional

Jeziki/Languages:	Predavanja/Lectures:	Slovenščina
	Vaje/Tutorial:	Slovenščina

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:

Prerequisites:

Opravljen izpit iz predmetov Mehanika tal in inženirska geologija ter Geotehnika (1. stopnja) oz. osvojena ustrezna primerljiva znanja.	Passed exams in Soil mechanics and engineering geology, Geotechnics (1st cycle) or adequate comparable knowledge.

Vsebina:

Content (Syllabus outline):

Predavanja: - metode izboljšanja tal (preobremenitev, radialna konsolidacija, dinamična komprimacija, gruščnati koli, injektiranje, jet grouting, metode površinskega in globinskega mešanja z anorganskimi in organskimi vezivi) - strujanje podzemne vode skozi zasičena izotropna in anizotropna tla, vzgon, kritični hidravlični gradient,	Lectures: - Methods of soil improvement (pre-loading, radial consolidation, dynamic compaction, stone columns, grouting, jet grouting, methods of surface and deep mixing with inorganic and organic binders) - Groundwater flow through saturated isotropic and anisotropic soil (buoyancy, critical hydraulic gradient, hydraulic fracture (hydraulic failure, internal erosion,

hidravlične porušitve (hidravlični lom tal, notranja erozija, piping)

- zemeljske pregrade: strujanje vode skozi pregrado, ukrepi za zmanjšanje neugodnih posledic, načrtovanje filtrov, stabilnost zemeljskih pregrad v statičnih pogojih in v

slučaju potresne obtežbe

- likvifakcija tal

- raba geosintetikov za tesnenje, filtriranje, ločevanje in armiranje

- analiza in upravljanje z geotehnično pogojenimi tveganji

- osnove mehanike kamnin (klasifikacije kamnin, mehanske lastnosti kamnin, Hoekov in Brownov porušni kriterij, analiza stabilnosti blokov in klinov

- Schmidtova projekcija, Marklandov test, analitične in numerične metode)

- osnove načrtovanja in gradnje predorov (tehnologije gradnje, mehanizacija, podporni ukrepi, primarna in sekundarna napetostna stanja, principi in metode za projektiranje, geotehnični monitoring)

- osnove numerične geotehnike (nelinearni elastoplastični modeli za zemljine, principi nelinearnih numeričnih analiz)

Vaje:

- račun učinka izboljšave tal z vertikalnimi drenažami, gruščnatimi koli, preobtežbo (peš in z uporabo računalniških orodij)

- analiza strujanja vode skozi in pod zemeljsko pregrado

- stabilnostna analiza prečnega prereza zemeljske pregrade v statičnih pogojih in pogojih delovanja seizmičnih vplivov

- analiza likvifakcije tal na osnovi rezultatov terenskih in laboratorijskih preiskav tal

- dimenzioniranje mineralnih filtrov v pregradi

- dimenzioniranje in izbira geosintetikov za namen ločevanja, filtracije, tesnenja

- analiza in načrt armirane brežine

- izdelava kataloga tveganj in analize tveganja za izbran geotehnični projekt

piping)
- Earth dams: flow of water through the dam, measures to reduce the adverse consequences, filter design, stability of earth dams under static and dynamic (seismic) conditions

- Liquefaction of soil
- Use of geosynthetics: sealing, filtration, separation and reinforcement
- Analysis and management of geotechnical risks

- Fundamentals of rock mechanics (classification of rock, mechanical properties of rock, Hoek&Brown failure criterion, Structurally controlled instability of blocks and wedges

- Schmidt's projection, Markland test, analytical and numerical methods)
- Basics of design and construction of tunnels (technology, machinery, support measures, primary and secondary stress states, the principles and methods for the design, geotechnical monitoring)
- Fundamentals of numerical methods in geotechnics (nonlinear elasto-plastic models for soils, principles of non-linear numerical analysis)

Exercises:
- Ground improvement with vertical drains, stone columns, pre-loading (analytical methods and by using computer tools)
- Analysis of the groundwater flow through the dam and subsoil

- Stability analysis of the earth dam under static and seismic conditions, seismic impact

- Analysis of soil liquefaction based on the results of field and laboratory tests of soils
- Sizing of mineral filters in earth dam
- The design and choice of geosynthetics for separation, filtration and sealing
- Analysis and design of reinforced earth
- Risk analysis for a selected geotechnical project

- Classification of rocks and evaluation of mechanical parameters using Hoek&Brown's failure criteria
- Structural analysis of the stability of rock blocks and wedges
- Design of the tunnel cross section
- Numerical analysis of a tunnel and selected earth structure (an embankment, retaining structure, an earth-cut with retaining structure, ...)

- klasifikacija kamnin in ocena mehanskih parametrov s pomočjo Hoekovega in Brownovega porušnega kriterija - strukturna analiza stabilnosti kamninskih blokov in klinov - načrt podpiranja prečnega prereza predora - numerična analiza predora in izbranega zemeljskega objekta (nasip, podporna konstrukcija, vkop z oporno konstrukcijo,…)	

Temeljna literatura in viri/Readings:

Knjižni viri:

- SIST EN1997-1:2005 Evrokod 7-1: Geotehnično projektiranje - 1. del Splošna pravila.

- SIST EN1997-2:2007 Evrokod 7-2: Geotehnično projektiranje - 2. del Preiskovanje in preskušanje tal.

- Vaniček I, Vaniček M. (2008) Earth Structures in Transport, Water and Environmental Engineering, Springer, 637 str.

- Moseley, M.P., Kirsch, K. (2006), Ground improvement, Taylor & Francis, London, 432 p.

- Recommendations for Design and Analysis of Earth Structures using Geosynthetic Reinforcement - EBGEO, Ernst &

Sohn, DGGT, 2011.

- Nonveiller, E. (1983). Nasute brane, projektiranje i građenje, Školska knjiga Zagreb.

- Clayton, C.R.I. (2001). Managing geotechnical risk, Thomas Thelford.

- Chapman, D., Metje, N., Stärk, A. (2010). Introduction to tunnel construction, Spon press.

- Hoek, E.: (2007) Practical Rock Engineering, dosegljivo na http://www.rocscience.com/hoek/corner/Practical_Rock_Engineering.pdf

Elektronski viri:

- spletna učilnica predmeta na http://ucilnica.fgg.uni-lj.si/

Cilji in kompetence:

Cilji in kompetence:	Objectives and competences:
- spoznati metode izboljšanja tal, njihove dobre strani in omejitve v posameznih pogojih tal in predvidene vrste gradnje - spoznati zakonitosti strujanja podzemne vode in precejanje skozi zemeljske pregrade ter potencialne probleme, ki iz tega izhajajo ter možne rešitve - seznaniti študenta z vplivi potresa na tla in geotehnične objekte (vpliv na stabilnost in likvifakcijo) - predstaviti možnost uporabe geosintetičnih materialov v geotehničnem inženirstvu	- To learn about methods of soil-improvement, their benefits and restrictions based on specific ground conditions and type of construction - To learn about groundwater flow and percolation through earth dams (structures) and potential problems and possible solutions - To acquaint student with the effects of the earthquakes on the ground and geotechnical facilities (impact on stability and liquefaction) - To present the possibility of using geosynthetic materials in geotechnical engineering - To present the geotechnical risks and to perform simple risk management analysis

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- predstaviti geotehnično pogojena tveganja in preproste možnosti analize in upravljanja s tveganji - spoznati se z osnovami mehanike kamnin - spoznati osnovne principe načrtovanja in gradnje predorov - usposobiti študenta za osnovno razumevanje in uporabo nelinearnih numeričnih orodij za geotehnične analize	- To learn about the basics of rock mechanics - To recognize basic principles of planning and tunnel construction - To provide basic understanding and use of nonlinear numerical tools for geotechnical analysis

Predvideni študijski rezultati: **Intended learning outcomes:**

- študent pozna metode izboljšanja tal in se zna odločiti katera je primerna v določenih pogojih - razume in pozna metode za račun stacionarnega toka vode skozi zasičena izotropna in anizotropna tla ter skozi zemeljske pregrade - zna analizirati vpliv strujanja vode glede na možnost pojava hidravličnega lom tal in notranje erozije - razume vpliv potresne obtežbe na zemeljske pregrade in zna vpliv upoštevati v analizi stabilnosti - razume pojav likvifakcije tal in ga zna ovrednotiti - pozna možnosti uporabe geosintetikov glede filtracije, separacije, tesnenja in armiranja - razume geotehnično pogojena tveganja in jih zna analizirati. - pozna klasifikacijske sisteme kamnin (RQD, RMR, GSI, Q) - zna analizirati stabilnost blokov in klinov kamnine z uporabo ustreznih orodij - razume osnovne principe načrtovanja in gradnje predorov - študent je sposoben preprostih numeričnih geotehničnih analiz z uporabo nelinearnih numeričnih modelov	- Student knows the methods of soil improvement and is able to decide which is suitable under certain conditions - Understands and knows methods for stationary flow of water through saturated isotropic and anisotropic soil and through earth dams - Ability to analyze the impact of groundwater flow depending on the optional occurrence of a hydraulic failure and internal erosion - Understanding of the impact of seismic actions on earth dams and how to take them into account (stability analysis) - Understanding of the phenomena of liquefaction of soil and how to evaluate the associated risk - Knowledge of geosynthetics with respect to filtration, separation, sealing and reinforcement - Understanding of geotechnical risks and how to analyze them - Knowledge about rock classification systems (RQD, RMR, GSI, Q) - Ability to analyze the stability of rock blocks and wedges with using appropriate tools - Understanding of basic design principles and construction techniques of tunnels - Student is capable of performing basic numerical geotechnical analysis using non-linear numerical models.

Metode poučevanja in učenja: **Learning and teaching methods:**

Predavanja, vaje, računalniška učilnicam samostojno delo.	Lectures, tutorials, computer lab, individual work.

Načini ocenjevanja: **Delež/Weight**   **Assessment:**

Teoretični izpit	35,00 %	Theoretical exam

Računski izpit ali 2 kolokvija	50,00 %	Written exam or 2 midterm tests
Samostojno delo	15,00 %	Individual work

Reference nosilca/Lecturer's references:

PULKO, Boštjan, MAJES, Bojan, LOGAR, Janko. Geosynthetic-encased stone columns - analytical calculation model. Geotextiles and geomembranes, ISSN 0266-1144. [Print ed.], feb. 2011, letn. 29, št. 1, str. 29-39, ilustr., doi: 10.1016/j.geotexmem.2010.06.005. [COBISS.SI-ID 5133409]

KUDER, Sebastjan, LOGAR, Janko. Numerični model za analizo obnašanja tlačno obremenjenih, vtisnjenih jeklenih pilotov v Luki Koper = Numerical model for the prediction of behaviour of driven steel piles under axial compression loading in the Port of Koper. Gradbeni vestnik, ISSN 0017-2774, avgust 2008, letn. 57, št. 8, str. 207-214, ilustr. [COBISS.SIID 4231777]

ŠTRUKELJ, Andrej, ŠKRABL, Stanislav, ŠTERN, Ksenija, LOGAR, Janko. The assesment of pile shaft resistance based on axial strain measurements during the loading test. Acta geotechnica Slovenica, ISSN 1854-0171, 2005, letn. 2, št. 2, str. 12-23. [COBISS.SI-ID 10115350]

LOGAR, Janko, FIFER BIZJAK, Karmen, KOČEVAR, Marko, MIKOŠ, Matjaž, RIBIČIČ, Mihael, MAJES, Bojan. History and present state of the Slano Blato landslide. Natural hazards and earth system sciences, ISSN 1561-8633, 2005, 5, str. [447]-457. [COBISS.SI-ID 2752865]

LOGAR, Janko, PULKO, Boštjan. Evrokod 7: geotehnično projektiranje. V: BEG, Darko (ur.), POGAČNIK, Andrej (ur.). Priročnik za projektiranje gradbenih konstrukcij po evrokod standardih. Ljubljana: Inženirska zbornica Slovenije, 2009, str. 7.1-7.130, ilustr. [COBISS.SI-ID 4747361]

ŽITNIK, Davorin, LOGAR, Janko, SLAK, Tomaž, VRATUŠA, Srečko, et al., VRATUŠA, Srečko (urednik). Gradbeniški priročnik. 5., dopolnjena izd. Ljubljana: Tehniška založba Slovenije, 2012. XV, 843 str., ilustr. ISBN 978-961-251-286-6. [COBISS.SI-ID 262742272]

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UČNI NAČRT PREDMETA/COURSE SYLLABUS

Predmet:	
	PRAKTIČNO USPOSABLJANJE
Course title:	
	PRACTICAL TRAINING

Študijski programi in stopnja	Študijska smer	Letnik	Semestri
Vodarstvo in okoljsko inženirstvo, druga stopnja, magistrski	Ni členitve (študijski program)		1. semester

Univerzitetna koda predmeta/University course code:	0035036
Koda učne enote na članici/UL Member course code:	1653

Predavanja	Seminar	Vaje	Klinične vaje	Druge oblike študija	Samostojno delo	ECTS
6	0	0	0	120	54	6

Nosilec predmeta/Lecturer:	Andreja Istenič Starčič, Mario Krzyk

Vrsta predmeta/Course type:	Izbirni strokovni/Elective professional

Jeziki/Languages:	Predavanja/Lectures:	Slovenščina
	Vaje/Tutorial:	Slovenščina

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:	Prerequisites:

Vsebina:	Content (Syllabus outline):
Študent se seznani in opravlja delo, ki ga opravlja diplomant tega študija v praksi. Predvsem se seznani z organizacijsko strukturo podjetja; seznani se z aktualnim dogajanjem v podjetju; dela na terenu – aktualnem gradbišču, oziroma v pisarni; opravi manj zahtevna dela na aktualnem projektu.	Student is introduced to performance of work done by graduate in practice, especially: learning about the organizational structure of a company; getting familiar with current developments in a company; field work - the current site, or in the office - less demanding work on current project.

Temeljna literatura in viri/Readings:

Viri so izbrani v sodelovanju z mentorjem praktičnega usposabljanja glede na vsebine, ki so predpisane in z njimi razpolaga organizacija, ki izvaja praktično usposabljanje. /

Resources are selected in collaboration with the supervisor of practical training in relation to the contents prescribed and disposed of by the organization conducting the practical training.

Interna in druga gradiva v delovni organizaciji.

Smernice za praktično usposabljanje na Univerzi v Ljubljani, Ljubljana, september 2007, dostopno na spletu.

Govekar, Okoliš et.al. 2010. Praktično usposabljanje študentov v delovnih organizacijah in primeri dobrih praks. Ljubljana, UL FF, Center za pedagoško izobraževanje.

Učno gradivo v spletni učilnici UL FGG.

Cilji in kompetence:	Objectives and competences:
Osnovni cilj praktičnega usposabljanja je - motivacija, - spoznavanje dela inženirja v praksi ter - prenos in uporaba znanj v praksi. - Študent spozna delovno okolje, opremo in se aktivno vključi v posamezne delovne procese. - Študent spozna dejavnike kariernega načrtovanja in razvoja in procese povezane s kariernim razvojem. - Študentu se omogoči samoevalvacijo kompetenc in dejavnikov, ki podpirajo procese poklicne identifikacije v povezavi akademskega okolja in delovnih okolij. - Študent spozna značilnosti učenja na delovnem mestu in značilnosti delovnih okolij ter značilnosti opazovanja in registriranja delovnih procesov. Kompetence, ki si jih študent pridobi s strokovno prakso, so pogojene z delovnim okoljem in so lahko - s področja projektiranja vodogradbenih konstrukcij, - izvedbe gradbenih del, - kontrole kakovosti, - nadzora, - urejanja stavbnih zemljišč, - inženiringa idr	The primary objective of practical training is - motivation, - learning about the work of an engineer in practice and - transfer and application of knowledge in practice. - Students learn about the work environment, equipment and actively participate in certain working processes. - Student realizes factors of career planning and development and the processes related to career development. - Students are facilitated to do self-evaluation of competences and factors that support the processes of professional identification in relation to the academic and work environments. - Students learn about the characteristics of learning on the job site and the characteristics of working environments and features of observation and registration of workflows. Competences that students gain with professional practice depend on the working environment and may be in the areas of - design of building hydraulic structures, - construction, - part of quality control, - supervision, - regulation of building land, - engineering, etc.

Predvideni študijski rezultati:

Intended learning outcomes:

- Študent pridobi praktična znanja in izkušnje za področju nalog in storitev vodarske stroke.	- Students acquire practical knowledge and experience in the field of tasks and services of the profession.
- Prenos in uporaba znanj študijskih predmetov v delovnem okolju praktičnega usposabljanja.	- Transfer and application of knowledge from courses in the study programme to the workplace of practical training.
- Lažje in hitrejše uvajanja v delo po končanem študiju, razumevanje različnih vodarskih subjektov in njihove vloge v družbi.	- Efficient introduction after graduation, understanding of different entities in the field and their role in society.
- Sinteza pridobljenih znanj tekom študija z aktualnimi delovnimi nalogami oz. raba aktualnih znanj in pripomočkov pri izpolnjevanju nalog, ki jih opravlja organizacija, v kateri poteka praktično usposabljanje.	- Synthesis of knowledge acquired during the course of the current work tasks and application of current knowledge and tools in fulfilling the tasks carried out by the organization where training is being conducted.
- Pridobljena znanja mu koristijo tudi pri izdelavi zaključne naloge.	- Obtained knowledge is useful in the preparation of the final thesis.
- Pridobljena znanja in spretnosti je možno prenesti na kasnejše delo v teku študijskega procesa (izdelava zaključne naloge), kakor tudi kasneje ob uvajanju na delovnem mestu.	- Knowledge and skills can be transferred to subsequent work within the study process (final thesis), as well as later at the workplace.
- Praktično delo v izobraževalnem procesu je za ta poklic zelo potrebno.	- Practical work in the educational process for this profession is very necessary.
- Omogočena je sinteza znanj, razvijanje komunikacijskih spretnosti in timskega dela.	- It enables the synthesis of knowledge, communication skills and teamwork.
- Študent zna ovrednotiti svoje delo glede na zastavljene in dosežene cilje.	- Student is able to evaluate own work against the objectives and targets achieved.
- Strokovno delo reflektira na osnovi zbranih informacij.	- Professional work reflects on the basis of the information collected.
- Študent razvija kompetence za načrtovanje lastne kariere in samoevalvacijo znanja in kompetenc	- Student develops skills for planning his/her career and self-assessment of skills and competencies

Metode poučevanja in učenja:

Learning and teaching methods:

Terensko delo, mentorstvo, demonstracije, konzultacije, pisanje in vodenje dnevnika in portfolia prakse	Field work, mentoring, demonstrations, consultations, writing and managing diary and portfolio practices

Načini ocenjevanja:

Načini ocenjevanja:	Delež/Weight	Assessment:
Dnevnik prakse	40,00 %	Diary of practical work
Portfolio	30,00 %	Portfolio
Ustni zagovor	30,00 %	Oral presentation

Reference nosilca/Lecturer's references:

ISTENIČ STARČIČ, Andreja. Students' perception of field placement in professional competency and identity construction: transdisciplinary study in education, health and engineering. V: MILLWATER, Jan (ur.), EHRICH, Lisa Catherine (ur.), BEUTEL, Denise (ur.). Practical experiences in professional education: a transdisciplinary approach. Mt Gravatt: Post Pressed, 2011, str. 155-170, tabele.

ŠUBIC KOVAČ, Maruška, ISTENIČ STARČIČ, Andreja. Kompetence diplomantov gradbeništva - evropski raziskovalni projekt TUNING = Competences of graduates in civil engineering - the European Research Project TUNING. Gradb. vestn., julij 2006, letn. 55, str. 178-186, ilustr.

ISTENIČ STARČIČ, Andreja. Competence management system design in international multicultural environment: registration, transfer, recognition and transparency. Br. j. educ. technol. (Print), 2012, letn. 43, št. 4, str. 108-112.

UČNI NAČRT PREDMETA/COURSE SYLLABUS

Predmet:	
	PROGRAMSKO ORODJE R V VODARSTVU
Course title:	
	R SOFTWARE IN WATER MANAGEMENT

Študijski programi in stopnja	Študijska smer	Letnik	Semestri
Vodarstvo in okoljsko inženirstvo, druga stopnja, magistrski	Ni členitve (študijski program)		1. semester

Univerzitetna koda predmeta/University course code: 0643355

Koda učne enote na članici/UL Member course code:

Predavanja /Lectures	Seminar /Seminar	Vaje /Tutorials	Klinične vaje /Clinical tutorials	Druge oblike študija /Other forms of study	Samostojno delo /Individual student work	ECTS
15	45	0	30	0	90	6

Nosilec predmeta/Lecturer: Mojca Šraj, Nejc Bezak

Vrsta predmeta/Course type: Izbirni predmet/Elective course

Jeziki/Languages:	Predavanja/Lectures:	Slovenščina
	Vaje/Tutorial:	Slovenščina

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:	**Prerequisites:**
/	/

Vsebina:

Content (Syllabus outline):

Predavanja

Kaj je programski jezik R in kako ga lahko uporabimo, osnove R programskega jezika kot so različni objekti, uvoz/izvoz podatkov, uporaba podatkov, uporaba in pisanje funkcij, uporaba paketov, priprava interaktivnih spletnih strani z R Shiny, osnove uporabe prostorskih podatkov in statističnih analiz.

Lectures

What is R language and what can R software do, basics about data types, data structures, data import/export, data manipulation, writing functions, plotting, using packages, preparing interactive web pages using R Shiny, basics about spatial data and statistical analysis.

Seminar	Seminar
Samostojna uporaba programskega jezika R na izbranem praktičnem primeru s področja okoljskih znanosti in grajenega okolja ter izdelava seminarske naloge z uporabo R Markdown.	Independent preparation of seminar work using R in the field of environmental science and built environment and report preparation using R Markdown.
Vaje	Tutorials
Laboratorijske vaje v računalniški učilnici z uporabo programskega jezika R (grafični vmesnik R Studio) bodo pokrile vse vsebine, ki bodo predstavljene v okviru predavanj. Študentje bodo morali samostojno rešiti različne naloge s področja uporabe programskega jezika R v naravnem in grajenem okolju.	Lab tutorials in computer classroom using R (and R Studio interface) will focus on all topics covered during lectures where students will need to complete and solve multiple exercises in the field of natural and built environment.

Temeljna literatura in viri/Readings:

Alkarkhi, A.F.M., Alqaraghuli, W.A.A. 2020. Applied Statistics for Environmental Science with R. Elsevier.

Davies, M. T. 2016. The Book of R: A First Course in Programming and Statistics. No Starch Press.

Field, A. 2012. Discovering Statistics Using R. SAGE Publications.

Matloff, N. 2011. The Art of R Programming: A Tour of Statistical Software Design. No Starch Press.

Vries, A. 2015. R For Dummies, 2nd edition. John Wiley & Sons.

Wickham, H., Grolemund, G. 2016. R for Data Science. O'Reilly.

Gradivo dostopno na različnih spletnih straneh, npr.: https://www.guru99.com/r-tutorial.html, https://www.datacamp.com/, https://www.w3schools.com/r/.

Učno gradivo v spletni učilnici UL FGG.

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

Glavni cilj predmeta je zagotoviti osnovno znanje programskega jezika R in zagotoviti osnovne veščine uporabe R za pisanje in uporabo funkcij, izris grafov, itd. Predmet se bo osredotočil na programski jezik R z vidika uporabe v naravnem in grajenem okolju in bo pokril številna področja kot so obdelava podatkov, grafični prikaz podatkov, itd.	The objective of the course is to provide basic knowledge of the R language and provide the skills of writing R scripts for practical applications. The course will focus on the core of R programming language in the field of natural and built environment including, among others, data manipulation with R, graphical presentation, etc.
Kompetence	Competences
- Sposobnost samostojne uporabe programskega jezika R za različne praktične aplikacije na področju okoljskih znanosti in grajenega okolja.	- Ability of using R programming language independently for different practical applications in the field of environmental sciences and built environment.

Predvideni študijski rezultati: | **Intended learning outcomes:**

- Razumevanje osnovnih konceptov programskega jezika R in uporabe le-tega.	- Understand the structure of R and its basic programming principles.

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- Osvojiti pregled številnih zmožnosti programskega jezika R vključno z grafičnimi kapacitetami.	- Have an overview of supporting sources and R graphical capabilities.
- Sposobnost samostojne uporabe programskega jezika R za različne namene kot je uvoz/izvoz podatkov, analiza podatkov, priprava in uporaba funkcij, izris grafov, priprava R Shiny spletne strani, uporaba paketov, itd.	- Being able to carry data import/export, data analysis, create functions, graphs, prepare R Shiny web-page, use packages, etc. independently.
- Sposobnost samostojne izvedbe kompleksnejših medsebojno povezanih izračunov z uporabo programskega jezika R in priprava poročila na področju okoljskih znanosti in grajenega okolja.	- Being able to conduct complex inter-connected calculations using R language and preparation of report in the field of environmental sciences and built environment.

Metode poučevanja in učenja: **Learning and teaching methods:**

Predavanja, laboratorijske vaje v računalniški učilnici z uporabo IKT, skupinsko in problemsko zasnovano delo, interaktivno delo preko spletne učilnice.	Lectures, lab tutorials in computed classroom using ICT, group and problem-based work, interactive work through e-classroom.

Načini ocenjevanja: **Delež/Weight**   **Assessment:**

Načini ocenjevanja:	Delež/Weight	Assessment:
Seminarska naloga	50,00 %	Seminar work
Izpit (Računski del)	50,00 %	Exam (Practical part)

Reference nosilca/Lecturer's references:

BEZAK, N., BORRELLI, P., PANAGOS, P. 2022. Exploring the possible role of satellite-based rainfall data in estimating inter- and intra-annual global rainfall erosivity. Hydrology and earth system sciences. 2022, 26, 7, 1907-1924.

BEZAK, N., BORRELLI, P., PANAGOS, P. 2021. A first assessment of rainfall erosivity synchrony scale at pan-European scale. Catena: an interdisciplinary journal of soil science, hydrology- geomorphology focusing on geology and landscape evolution. 198, 105060.

BEZAK, N., MIKOŠ, M. 2021. Changes in the rainfall event characteristics above the empirical global rainfall thresholds for landslide initiation at the pan-European level. Landslides: Journal of the international consortium on landslides. 18, 1859-1873.

BEZAK, N., BALLABIO, C., MIKOŠ, M., PETAN, S., BORRELLI, P., PANAGOS, P. 2020. Reconstruction of past rainfall erosivity and trend detection based on the REDES database and reanalysis rainfall. Journal of Hydrology 590, 1-40.

ŠRAJ, M., BEZAK, N. 2020. Comparison of time trend- and precipitation-informed models for assessing design discharges in variable climate. Journal of Hydrology 589, 1-10.

SEZEN, C., BEZAK, N., BAI, Y., ŠRAJ, M. 2019. Hydrological modelling of karst catchment using lumped conceptual and data mining models. Journal of Hydrology 576, 98-110.

BEZAK, N., JEMEC AUFLIČ, M., MIKOŠ, M. 2019. Application of hydrological modelling for temporal prediction of rainfall-induced shallow landslides. Landslides 16(7), 1273-1283.

BEZAK, N., ZABRET, K., ŠRAJ, M. 2018. Application of copula functions for rainfall interception modelling. Water 10(8), 1-23.

UČNI NAČRT PREDMETA/COURSE SYLLABUS

Predmet:	
	HIDROTEHNIČNI OBJEKTI
Course title:	
	HYDRAULIC STRUCTURES

Študijski programi in stopnja	Študijska smer	Letnik	Semestri
Vodarstvo in okoljsko inženirstvo, druga stopnja, magistrski	Hidrotehnika (modul)	2. letnik	1. semester

Univerzitetna koda predmeta/University course code:	0038710
Koda učne enote na članici/UL Member course code:	1517

Predavanja	Seminar	Vaje	Klinične vaje	Druge oblike študija	Samostojno delo	ECTS
60	0	60	0	0	120	8

Nosilec predmeta/Lecturer:	Andrej Kryžanowski

Vrsta predmeta/Course type:	Obvezni strokovni /Obligatory professional

Jeziki/Languages:	Predavanja/Lectures:	Slovenščina
	Vaje/Tutorial:	Slovenščina

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:

Prerequisites:

Vsebina:

Predavanja

Zgodovinski pregled razvoja pregradnega inženirstva. Podlage za načrtovanje pregradnih objektov (planiranje, projektiranje, strokovne podlage za načrtovanje). Načrtovanje pregradnih objektov (betonske, nasute). Odvzem vode iz naravnih vodotokov (globinske in površinske odvzemne zgradbe) ter prelivanje vode prek jezovne zgradbe (prelivi, kaskade, vodni odskoki, prelivne drče, podslapja). Zapornice in zajezni objekti (različne vrste površinskih in globinskih zapornic). Zgradbe za

Content (Syllabus outline):

Lectures

Historical background of dam engineering. Bases for planning of dam structures (planning, design, expert groundwork for planning). Planning of dam structures (concrete, embankment dams). Abstraction of water from natural watercourses (withdrawal works, for surface water or groundwater), and water flow through weir structures (spillways, cascades, water jumps, slides, stilling basins). Gates and dam structures (various types of surface and submerged gates). Inlet and

dovod in odvod vode (zajetja, peskolovi, kanali, rovovske zgradbe, tlačni cevovodi, vodostani).	outlet works (reservoirs, desanding facilities, canals, pipes, pressure conduits, surge chambers).
Vaje	Tutorial
Zasnova in statično stabilitetni preračun težnostne pregrade s programom CADAM. Hidravlični dimenzioniranje evakuacijskih objektov - preliv, drča, podslapje, spajanje s spodnjo vodo. Statično dimenzioniranje zapornic (osnovni tipi zapornic). Statično-stabilitetni preračun različnih tipov regrad (težnostne, nasute, ločne) s programom DIANA.	Design, static and stability analysis of gravity dams using CADAM. Hydraulic dimensioning of evacuation structures. Spillway, slides, stilling basin, joining with tailwater. Static dimensioning of gates (basic types of gates). Static and stability calculation of various types of dams (gravity, embankment, arch dams) using DIANA.

Temeljna literatura in viri/Readings:

Pemič, A., Mikoš, M. 2008. Inženirska hidrotehnika – skripta verzija 2008, UL FGG, Katedra za splošno hidrotehniko, 400 str.

Strobl, T. Zunic, F. 2006. Wasserbau: Aktuelle Grundlagen – Neue Entwicklungen, Springer, 604 str.

Giesecke, J., Mosonyi. E. 1998. Wasserkraftanlagen, Springer, Berlin, str.101-396, str.591-657.

Blindt, H. 1987. Wasserbauten aus Beton, Ernst & Sohn, Berlin, 493 str.

Nonveiller, E. 1983. Nasute brane, Školska knjiga, Zagreb, 359 str.

Učno gradivo v spletni učilnici UL FGG.

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

Cilji	Objectives
- Uporabiti osnovno znanje hidravlike in urejanja vodotokov za hidravlični preračun objektov na pregradah.	- To use the basic knowledge in hydraulics and water management for hydraulic calculation of dam structures.
- Podati teoretične osnove za zasnovo in preračun pregradnih in hidrotehničnih objektov.	- To give theoretical bases for design and calculation of dams and hydraulic structures.
Kompetence	Competences
- Sposobnost zasnove pregrad in hidrotehničnih objektov na jezovnih zgradbah.	- Ability to design dam and hydraulic structures on weir structures.
- Sposobnost prepoznavanja, spremljave in načrtovanje procesa umeščanja pregrad v okolje in prostor.	- Ability to recognise, monitor and plan the process of site selection and placement.
- Sposobnost dimenzioniranja pregradnih in hidrotehničnih objektov.	- Ability of dimensioning dams and hydraulic structures.

Predvideni študijski rezultati: / **Intended learning outcomes:**

- Pridobljeno poglobljeno znanje za zasnovo in načrtovanje pregrad in hidrotehničnih objektov na vodnih zgradbah.	- In-depth knowledge for design and planning of dams and hydraulic structures in water works.

- Osvojene računske spretnosti za dimenzioniranje pregrad in hidrotehničnih objektov na jezovnih zgradbah.	- Acquisition of calculation skills for dimensioning of dams and hydraulic structures on weir structures.
- Pridobljeno poglobljeno znanje za prepoznavanje procesa umeščanja pregrad v okolje in prostor.	- Acquisition of in-depth knowledge for recognition of the site selection and placement process.
- Sposobnost kritične presoje vhodnih podatkov in dobljenih računskih rezultatov pri načrtovanju hidrotehničnih objektov.	- Ability of critical assessment of input data and obtained calculation results in design of hydraulic structures.
- Sposobnost izdelati projektne zasnove za pregrade in hidrotehnične objekte.	- Ability to elaborate design concepts for dams and hydraulic structures.
- Sposobnost načrtovanja procesa umeščanja posegov v okolje in prostor.	- Ability to plan the process of site selection and placement.

Metode poučevanja in učenja: **Learning and teaching methods:**

Predavanja in seminarske vaje.	Lectures and tutorial.

Načini ocenjevanja: **Delež/Weight**   **Assessment:**

Načini ocenjevanja	Delež/Weight	Assessment
Vaje	50,00 %	Course work/exercises
Pisni izpit	50,00 %	Written examination

Reference nosilca/Lecturer's references:

KRYŽANOWSKI, Andrej, MIKOŠ, Matjaž, ŠUŠTERŠIČ, Jakob, UKRAINCZYK, Velimir, PLANINC, Igor. Testing of concrete abrasion resistance in hydraulic structures on the lower Sava river. Stroj. vestn., apr. 2012, vol. 58, no. 4, str. 245-254.

KRYŽANOWSKI, Andrej, MIKOŠ, Matjaž, ŠUŠTERŠIČ, Jakob, PLANINC, Igor. Abrasion Resistance of Concrete in Hydraulic Structures. ACI mater. j., julij-avgust 2009, letn. 106, št. 4, str. 349-356.

MIKOŠ, Matjaž, KRYŽANOWSKI, Andrej. Debris-flow breakers as an unconventional dam type. V: Dams - recent experiences on research, design, construction and service: international symposium : proceedings, Skopje, 17th - 18th November, 2011. Skopje: Macedonian committee on large dams, 2011, str. 63-70.

UČNI NAČRT PREDMETA/COURSE SYLLABUS

Predmet:	
	VODNOGOSPODARSKI SISTEMI
Course title:	
	WATER MANAGEMENT SYSTEMS

Študijski programi in stopnja	Študijska smer	Letnik	Semestri
Vodarstvo in okoljsko inženirstvo, druga stopnja, magistrski	Hidrotehnika (modul)	2. letnik	1. semester

Univerzitetna koda predmeta/University course code:	0037809
Koda učne enote na članici/UL Member course code:	1337

Predavanja	Seminar	Vaje	Klinične vaje	Druge oblike študija	Samostojno delo	ECTS
10	15	30	0	5	60	4

Nosilec predmeta/Lecturer:	Mateja Škerjanec	Franci Steinman

Vrsta predmeta/Course type:	Obvezni strokovni /Obligatory professional

Jeziki/Languages:	Predavanja/Lectures:	Slovenščina
	Vaje/Tutorial:	Slovenščina

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:

Prerequisites:

Vsebina:

Predavanja

Umestitev vodnega gospodarstva (VG) v standardno klasifikacijo dejavnosti in objektov. Zasnova VG sistemov in ureditev, VG načela, cilji in naloge (v javnem interesu), pristopi k gospodarjenju z vodami. Institucionalni okvirji VG, organizacijska struktura subjektov, politika do voda in pravni status voda, primerjava s tujimi oblikami organiziranosti. Zasnova nadzora, monitoringa in podatkovnih virov ter skladnost z zadevnimi EU direktivami. Celostno gospodarjenje z vodami, razvojne poti VG sistemov

Content (Syllabus outline):

Lectures

Placement of water management (WM) in standard classification of activities and structures. Design of WM systems and regulations, WM principles, objectives and tasks (in the public interest), and approaches to water management. Institutional frameworks of WM, the organizational structure of stakeholders, water policy, the legal status of waters, and comparison with foreign forms of organization. Design of control, monitoring, and data resources and compliance with relevant EU

in ureditev, navezava z varovalnim, sektorskim in prostorskim načrtovanjem ter načrtovanjem finančnih virov.

Seminar

Analiza zasnove izbranega VG sistema, določanje relacij med primarno in podrejeno rabo, lastniška razmerja in upoštevanje območij s pravnimi režimi, SWOT analiza upoštevanja načel celostnega gospodarjenja z vodami.

Vaje

Zasnova izbranega VG sistema, ugotavljanje virov možne skladne in nasprotujoče primarne in podrejenih rab ter ocena iz tega izvirajočih nevarnosti, tehnična interpretacija vsebin obravnavanega pravnega režima, vrste monitoringov in možno spremljanje stanja – uporaba podatkovnih baz in GIS orodij.

Terensko delo

Terenska prepoznava zasnove in gradnikov VG sistema, zaznavanje skladne in nasprotujoče primarne in podrejenih rab, analiza vpliva hipotetične spremembe pravnega režima in analiza potrebnih vsebin obratovalnega monitoringa.

directives. Integrated water management, WM development, relations with protective, sectorial and spatial planning, and water funds planning.

Seminar

Analysis of the selected WM system design, primary and subordinate water use analysis, ownership relations and impact of areas under different legal regimes, and SWOT analysis considering the principles of integrated water management.

integrated water management.

Tutorials

Designing a selected WM system, assessment of potential sources of consistent and opposing primary and subordinate water uses and related risks, technical interpretation of the legal regimes, types of monitoring and surveillance – use of databases and GIS tools.

Field-work

Field recognition of the general design and elements of a WM system, recognizing consistent and opposing primary and subordinate water uses, impact assessment of hypothetical changes in legal regimes, and analysis of the required content of operational monitoring.

Temeljna literatura in viri/Readings:

Matičič, Brane, Steinman, Franci. 2006. Irrigation sector reform in Central and Eastern European Countries : Slovenian Report. V: DIRKSEN, Wolfram (ur.), HUPPERT, Walter (ur.). Irrigation sector reform in Central and Eastern European countries : with the contributions from the ICID national committees of Bulgaria, Czech Republic, Germany, Hungary, Macedonia, Poland, Romania, Russia, Slovenia and Ukraine. Eschborn: Deutsche Gesellschaft für Technische Zusammenarbeit (GTZ); New Delhi: International Commission on Irrigation and Drainage (ICID), str. 447-527, graf. prikazi.

Djordjević, B. 1990. Vodoprivredni sistemi, Naučna knjiga, 498 str. Journal of Water Resources Planning and Management (izbrani članki – 2013 in prej).

Water Management in the Czech Republic. 2012. Spletna stran: Ministry of Agriculture of the Czech Republic.

Učno gradivo v spletni učilnici UL FGG.

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

Cilji

- Spoznavanje organizacijske in institucionalne strukture gospodarjenja z vodami, nalog VG sistemov in ureditev ter njihove povezanosti z

Objectives

- Understanding the organizational and institutional structure of WM, WM systems and regulations' tasks, and functioning, and their connection with

rabami voda, rabo prostora in antropogenimi dejavnostmi.

- Razumeti umeščanje v prostor, poznati vplive vodne infrastrukture na delovanje infrastrukture drugih resorjev na vodah (plovba, kmetijstvo ipd.) in usklajevanje skupne in posebne rabe voda.

Kompetence

- Znati analizirati primarne in podrejene (sekundarne) cilje VG sistemov, določati interakcije z naravnim in grajenim okoljem ter drugimi infrastrukturami, določati obratovalne razmere ter

primernost in uspešnost VG sistemov v različnih fazah življenjskega cikla.

- Sposobnost presoje robnih pogojev, delovanja ter zanesljivosti VG sistemov in ureditev.

water use, spatial planning, and anthropogenic activities.

- To understand the placement of WM systems in the space, the influence of water infrastructure on the operation of infrastructure in other water-related sectors (e.g., navigation, agriculture), and harmonization of public and commercial water uses.

Competences:

- Ability to analyze primary and subordinate (secondary) objectives of WM systems, determine interaction with the natural and built environment and other infrastructure, the operating conditions, suitability, and usefulness of WM systems in the whole life cycle.

- Ability to assess the efficiency and reliability of the WM systems and regulations within boundary conditions.

Predvideni študijski rezultati:

- Razumeti pravno-ekonomsko-tehnične vidike v katerih delujejo VG sistemi, ter znati določiti robne pogoje, načine delovanja in stopnjo zanesljivosti VG sistemov in ureditev.

- Doseženo znanje uporabiti kot izhodišče za obravnavo na posameznih področjih hidrotehnike, ki se povezujejo v VG sisteme ali vključujejo v druge infrastrukturne sisteme.

- Dobro poznavanje pogojev gospodarjenja z vodami in institucionalnih okvirjev omogoča razumevanje obratovalnih razmer (običajne, izredne, ekstremne) VG sistemov.

- Sposobnost uporabe in kritične presoje zasnove, delovanja in robnih pogojev na drugih sistemih (komunala, promet, itd.).

Intended learning outcomes:

- Understanding of legal-economic-technical aspects of WM systems and defining their boundary conditions, mode of action, and level of reliability.

- To use the achieved knowledge as starting point for consideration in individual fields of Hydraulics, incorporated in WM systems or other infrastructure systems.

- Good knowledge of the Water Management Sector and institutional contexts enables understanding of operating conditions (normal, exceptional, extreme) of WM systems.

- Ability to apply and critically assess design, operation, and boundary conditions of other (e.g., public services) systems.

Metode poučevanja in učenja:

Predavanja, seminar, seminarske vaje in terensko delo.

Learning and teaching methods:

Lectures, seminar, seminar tutorials and field work.

Načini ocenjevanja:	Delež/Weight	Assessment:
Seminarske vaje	50,00 %	Seminar tutorials
Seminarska naloga	20,00 %	Individual seminar work (Project Report)
Pisni in/ali ustni izpit	30,00 %	Written and/or oral examination

Reference nosilca/Lecturer's references:

ŠKERJANEC, Mateja, ATANASOVA, Nataša, ČEREPNALKOSKI, Darko, DŽEROSKI, Sašo, KOMPARE, Boris. 2014. Development of a knowledge library for automated watershed modeling. Environmental Modelling & Software, 54: 60-72. DOI: 10.1016/j.envsoft.2013.12.017.

ŠKERJANEC, Mateja, STEINMAN, Franci, RAK, Gašper. 2021. Integrated flood management based on "hazard analysis critical control point" approach. Journal of flood risk management, e-12769. DOI: 10.1111/jfr3.12769.

VOLF, Goran, ATANASOVA, Nataša, ŠKERJANEC, Mateja, OŽANIĆ, Nevenka. 2018. Hybrid modeling approach for the northern Adriatic watershed management. Science of the total environment. 635: 353-363. DOI: 10.1016/j.scitotenv.2018.04.094.

UL FGG, Vodarstvo in okoljsko inženirstvo (MA), 2. stopnja | Water Science and Environmental Engineering (MA), 2nd Cycle

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UČNI NAČRT PREDMETA/COURSE SYLLABUS

Predmet:	
	VODNE MOČI
Course title:	
	HYDROELECTRIC POWER

Študijski programi in stopnja	Študijska smer	Letnik	Semestri
Vodarstvo in okoljsko inženirstvo, druga stopnja, magistrski	Hidrotehnika (modul)	2. letnik	1. semester

Univerzitetna koda predmeta/University course code:	0037815
Koda učne enote na članici/UL Member course code:	1550

Predavanja	Seminar	Vaje	Klinične vaje	Druge oblike študija	Samostojno delo	ECTS
30	0	30	0	0	60	4

Nosilec predmeta/Lecturer:	Andrej Kryžanowski

Vrsta predmeta/Course type:	Obvezni strokovni /Obligatory professional

Jeziki/Languages:	Predavanja/Lectures:	Slovenščina
	Vaje/Tutorial:	Slovenščina

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:	Prerequisites:

Vsebina:	Content (Syllabus outline):
Predavanja	Lectures
Proizvodnja električne energije v RS in vloga vodne energije. Osnove načrtovanja energetske rabe vodnih virov (dimenzioniranje akumulacij, ekonomske in finačne osnove vrednotenja, opredelitev specifičnih pokazateljev investicije, zakonska regulativa pri načrtovanju vodnih elektrarn in umeščanju v elektroenergetski sistem).	Electricity generation in the Republic of Slovenia and the role of hydro power. Fundamentals of energy use planning of water resources (dimensioning of reservoirs, economic and financial baselines of evaluation, definition of specific investment indicators, legislation governing HPP planning and placement in the electric power system).
Oprema vodnih elektrarn (turbine, generatorji, prenos energije). Tipi vodnih elektrarn (akumulacijske, pretočne, črpalne, elektrarne v nizu,	Equipment of HPPs (turbines, generators, energy transport). Types of hydropower plants (reservoir, run-of- river, pumped storage, series of HPPs, small

male HE). Optimizacijski hidravlični modeli obratovanja HE (akumulacijske elektrarne, pretočne elektrarne v nizu). Optimizacija obratovanja HE in vloga HE v elektroenergetskem sistemu. Okoljski vidiki načrtovanja in obratovanja vodnih elektrarn. Vaje Račun energetske proizvodnje za akumulacijsko elektrarno. Ekonomska optimizacija derivacijskih objektov. Preveritev izvedljivosti projekta vodne elektrarne.	HPPs). Optimising hydraulic models of HPP operation (reservoir HPPs, series of run-of-river HPPs). Optimisation of HPP operation and the role of HPPs in the electric power system. Environmental aspects of planning and operation of hydropower plants. Tutorials Calculation of power generation for a reservoir power station. Economic optimisation of derivation structures. Feasibility assessment of a HPP project.

Temeljna literatura in viri/Readings:

Pemič, A., Mikoš, M. 2008. Inženirska hidrotehnika – skripta. Ljubljana, UL FGG, Katedra za splošno hidrotehniko, 400 str. Giesecke, J., Mosonyi, E. 1998. Wasserkraftanlagen. Berlin, Springer, str.1-100 & str.397-590. ASME. 1996. Hydropower mechanical engineering, HCI publications, Kansas City, poglavja 2-7 in 10. Mosonyi, E. 1991. High-head power plants - Vol 2/A, Akademia Kiado, Budapest, 519 str. Učno gradivo v spletni učilnici UL FGG.

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

Cilji - Nadgraditi znanje s področja hidrotehničnih objektov v smeri izrabe vodnih moči. - Podati teoretične osnove za načrtovanje vodnih elektrarn. Kompetence - Sposobnost izdelave idejne zasnove vodne elektrarne. - Sposobnost ocene izvedljivosti vodne elektrarne.	Objectives - To upgrade the knowledge of hydraulic structures in the sense of water power exploitation. - To give theoretical bases of HPP planning. Competences - Ability to elaborate the preliminary concept design of a hydropower plant. - Ability to assess the feasibility of the hydropower plant.

Predvideni študijski rezultati: **Intended learning outcomes:**

- Pridobljeno poglobljeno znanje s področja hidro energetike. - Razumevanje procesa načrtovanja in umestitve vodne elektrarne v elektro energetski sistem. - Osvojene računske spretnosti za izdelavo idejne zasnove vodne elektrarne in izdelave študije izvedljivosti.	- Acquisition of in-depth knowledge of the hydropower sector. - Understanding of the planning process and placement of the hydropower plant in the electrical power system. - Acquisition of calculation skills for the preparation of the HPP preliminary concept design, and the feasibility study.

- Sposobnost kritične presoje vhodnih podatkov in dobljenih računskih rezultatov pri načrtovanju energetske rabe vodnih virov.		- Ability of critical assessment of input data and obtained calculation results in design of energy use of water resources.
- Sposobnost izdelati tehnično, finančno in ekonomsko presojo izvedljivosti energetske rabe vodnega vira.		- Ability to elaborate technical, financial and economic feasibility assessment of power exploitation of the water resource in question.

Metode poučevanja in učenja: **Learning and teaching methods:**

Predavanja in seminarske vaje.	Lectures and tutorial.

Načini ocenjevanja: **Delež/Weight**   **Assessment:**

Način	Delež/Weight	Assessment
Vaje	50,00 %	Coursework/exercises
Pisni izpit	50,00 %	Written examination

Reference nosilca/Lecturer's references:

KRYŽANOWSKI, Andrej, BRILLY, Mitja, PORENTA, Marijan, TOMŠIČ, Ladislav. Hydro potential and development opportunities in Slovenia. The international journal on hydropower & dams, 2008, letn. 15, št. 5, str. 41-46, ilustr.

KRYŽANOWSKI, Andrej. Possibilities of exploitation of hydroelectric power potential in Slovenia. 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. [1-7].

KRYŽANOWSKI, Andrej. Possibilities of exploitation of hydroelectric power potential in Slovenia. V: Dams - recent experiences on research, design, construction and service: international symposium: proceedings, Skopje, 17th - 18th November, 2011. Skopje: Macedonian committee on large dams, 2011, str. 1-8

UČNI NAČRT PREDMETA/COURSE SYLLABUS

Predmet:	
	KANALIZACIJA IN ČIŠČENJE ODPADNIH VODA
Course title:	
	URBAN DRAINAGE AND WASTEWATER TREATMENT

Študijski programi in stopnja	Študijska smer	Letnik	Semestri
Vodarstvo in okoljsko inženirstvo, druga stopnja, magistrski	Hidrotehnika (modul)	2. letnik	1. semester
Vodarstvo in okoljsko inženirstvo, druga stopnja, magistrski	Okoljsko inženirstvo (modul)	2. letnik	1. semester

Univerzitetna koda predmeta/University course code:	0037816
Koda učne enote na članici/UL Member course code:	1590

Predavanja	Seminar	Vaje	Klinične vaje	Druge oblike študija	Samostojno delo	ECTS
45	15		55	5	120	8

Nosilec predmeta/Lecturer:	Mario Krzyk, Nataša Atanasova

Vrsta predmeta/Course type:	Obvezni strokovni/Obligatory professional

Jeziki/Languages:	Predavanja/Lectures:	Slovenščina
	Vaje/Tutorial:	Slovenščina

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:	**Prerequisites:**

Vsebina:	Content (Syllabus outline):
Uvod in zgodovinski razvoj stroke. Poraba vode, odtok in sestava odpadne vode ter odtok padavinske vode. Splošna obravnava in načrtovanje kanalskih sistemov. Možnosti ponovne uporabe odpadnih voda in njihovo ponikanje.	Introduction and historical development of wastewater management. Water consumption, drainage and composition of waste water and storm water runoff. General treatment and planning of the canal systems. Wastewater reuse and sinking
Vrste sistemov za odvodnjavanje onesnaženih voda. Zasnova kanalizacijskih sistemov. Padavine, padavine v Sloveniji. Analiza nalivov. Hidravlično	Types of drainage systems for sewage water drainage. Design of sewerage systems. Precipitation, precipitation in Slovenia. Rainfall analysis. Hydraulic

UL FGG, Vodarstvo in okoljsko inženirstvo (MA), 2. stopnja | Water Science and Environmental Engineering (MA), 2nd Cycle

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dimenzioniranje kanalskih sistemov. Koincidenca pojavov visokih voda v recipientih in kanalskem omrežju. Zadrževanje in razbremenjevanje kanalskih voda. Metode za presojo kakovostnih vplivov razbremenjenih kanalskih voda na recipiente. Vpliv zalednih voda na poplavno varnost urbaniziranih površin. Presoja primerne (potrebne) poplavne varnosti urbaniziranih površin pred lastnimi in zalednimi padavinskimi vodami. Objekti na kanalizacijskih sistemih. Upravljanje in vzdrževanje kanalizacijskega sistema in naprav. Procesi čiščenja vode.

Predčiščenje odpadnih voda. Precejanje skozi mikro sita in filtriranje. Mehanska stopnja čiščenja odpadnih vod. Kemijsko čiščenje in obarjanje. Postopki biološkega čiščenja odpadnih voda: s poživljenim blatom, s precejalniki, eliminacija hranil. Adsorbcija. Dezinfekcija očiščenih odpadnih vod.

Napredno čiščenje odpadnih voda. Modeliranje procesov čiščenja voda. Osnove obdelave blata. Aerobna, anaerobna in kemična stabilizacija blata iz čistilnih naprav. Ekološka, ekonomska in higienska problematika dispozicije blata iz čistilnih naprav. Ponovna uporaba očiščene odpadne vode. Decentralizirani sistemi in male čistilne naprave.

Laboratorijske vaje in terenske vaje s praktičnim reševanjem problemov obravnavanih na predavanjih. Izdelava seminarske naloge z uporabo osvojenih računalniških orodij.

design of sewage systems. Coincidence of high water events in recipients and sewage network. Retention and overflowsin combined sewage system. Methods for assessing the qualitative effects of combined sewage overflows to recipients. Impact of extraneous water on flood safety of urban areas. Assessment of flood safety in urbanized areas from rainfall and extraneous water. Structures on sewage systems. Management and maintenance of sewerage system and devices.

Pre-treatment of waste water. Filtering through micro filters and filtration. Mechanical treatment of wastewater. Chemical purification and precipitation. Methods of biological wastewater treatment: the activated sludge, percolators, elimination of nutrients. Adsorption. Disinfection of treated waste water.

Advanced wastewater treatment. Modelling of wastewater treatment processes. Basics of sludge treatment. Aerobic, anaerobic and chemical stabilization of sewage sludge. Ecological, economic and hygiene problems disposition of sewage sludge. Water reuse. Decentralized systems and small wastewater treatment plants.

Laboratory and field work on practical problems learnt within the lectures. Seminar work using computer tools.

Temeljna literatura in viri/Readings:

Larsen, T. A., Kai M. Udert and Judit Lienert, Editors. Source Separation and Decentralization for Wastewater Management, 2013, IWA Publising.

Panjan, J. 2010. Odvodnjavanje onesnaženih voda, Skripta, 103 strani.

Metcalf & Eddy, Inc. Wastewater Engineering : Treatment and Reuse. Boston :McGraw-Hill, 2003.

Panjan, J. 2001. Čiščenje odpadnih voda (skripta), 169 strani.

Krzyk, M. 2022. Komunalne naprave. 2. del : študijsko gradivo za študente univerzitetnega študija "Vodarstvo in okoljsko inženirstvo". Ljubljana: Univerza v Ljubljani, Fakulteta za gradbeništvo in geodezijo.

Droste, L. R. 1997. Theory and Practice of Water and Waste-water Treatment, John Wiley Sonns, Inc. New York, 800 strani.

Kompare B. 1991. Modeliranje deževnega odtoka iz urbaniziranih povodij. Ljubljana, FAGG Inštitut za zdravstveno hidrotehniki, 509 strani.

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

Cilji	Objectives

Namen predmeta je osvojiti osnovna teoretična in praktična znanja, ki so potrebna za zasnovo, projektiranje, gradnjo in vzdrževanje objektov in naprav na najzahtevnejših sistemih za odvod onesnaženih voda in pri čiščenju odpadnih voda – čistilnih napravah.	The purpose of the course is to reach basic theoretical and practical knowledge necessary for designing, planning, constructing and maintaining the facilities and equipment of the most demanding sewage systems and purification of wastewater - sewage treatment plants.
Kompetence	Competences
Osvojena osnovna teoretična in praktična znanja za zasnovo, projektiranje, gradnjo, obratovanje in regulacijo sistemov ter vzdrževanje objektov in naprav na najzahtevnejših sistemih za odvod in čiščenje onesnaženih voda.	The acquired basic theoretical and practical knowledge for planning, designing, constructing, operation and regulation of systems and maintenance facilities in the most demanding waste water systems and waste water treatment plants.

Predvideni študijski rezultati:	**Intended learning outcomes:**
- Razumevanje funkcioniranja kanalizacijskih sistemov in zaključek s komunalno čistilno napravo. - Pridobljeno poglobljeno znanje za načrtovanje in hidravlično dimenzioniranje urbanih odvodnih sistemov in čistilnih naprav. - Snovanje in izgradnja kanalizacije v urbanem in ruralnem okolju. - Izdelava hidravličnih izračunov kanalizacije in ČN v hidrotehnični oz. komunalni praksi. - Razumevanje fizikalnih in tehničnih osnov kanalizacijskih sistemov, sposobnost analize variantnih rešitev in izbira optimalne. - Sposobnost upoštevanja hidravličnih lastnosti infrastrukturnih in drugih sistemov in naprav pri dimenzioniranju kanalizacijskih sistemov in objektov na njih vključno s KČN, ki jih bodo načrtovali v praksi. - Sposobnost umeščanja sistemov in naprav v urbanem okolju. - Sposobnost kritične presoje podatkov in dobljenih računskih rezultatov pri načrtovanju ukrepov.	- Understanding the functioning of sewage systems with the completion of a municipal sewage treatment plant. - Acquired in-depth knowledge of the design and dimensioning of urban drainage systems and water treatment plants. - Design and construction of sewage in urban and rural areas. - Hydraulic calculations of sewage systems and sewage treatment plant in hydraulic practice. - Understanding the physical and technical bases of sewage systems, ability to analyze alternative solutions and the optimal choice. - Ability to take into account the hydraulic characteristics of infrastructure and other systems and devices for the design of sewerage systems and facilities, including municipal wastewater treatment plant, which will be designed in practice. - Ability to position systems and devices in urban environment. - Ability of critical analysis of data and computational results obtained in planning interventions.

Metode poučevanja in učenja:	**Learning and teaching methods:**
Predavanja se pretežno izvajajo z računalniškimi (Power Point) in delno na tabli ter filmski prikazi. Seminar in vaje se izvajajo na tabli, z računalnikom, laboratorijskim delom, terenskim delom in projektno. Predvidena je ekskurzija na naprave in objekte v okolici Ljubljane in po Sloveniji.	Lectures are mainly carried out on computers (Power Point) and partly on blackboard and multimedia presentations. Seminar and tutorials are carried out on blackboard, computers, in laboratory and as field work. An excursion is planned to plants and buildings in the vicinity of Ljubljana and elsewhere in Slovenia.

Načini ocenjevanja:

Načini ocenjevanja:	Delež/Weight	Assessment:
Pisni izpit	50,00 %	Written exam
Seminar	25,00 %	Seminar
Laboratorijske vaje	25,00 %	Laboratory exercises

Reference nosilca/Lecturer's references:

ATANASOVA, Nataša, DALMAU, Montserrat, COMAS, Joaquim, POCH ESPALLARGAS, Manel, RODRIGUEZ-RODA, Ignasi, BUTTIGLIERI, Gianluiggi. Optimized MBR for greywater reuse systems in hotel facilities. Journal of environmental management, ISSN 0301-4797, 2017, letn. 193, št. maj, str. 503-511, ilustr., doi: 10.1016/j.jenvman.2017.02.041. [COBISS.SI-ID 8125793].

ŠIVIC, Ana, ATANASOVA, Nataša, PUIG, Sebastià, GRIESSLER BULC, Tjaša. Ammonium removal in landfill leachate using SBR technology - dispersed versus attached biomass. Water science and technology, ISSN 0273-1223, 2017, vol. 77, iss. 1, str. 27-38, ilustr., doi: 10.2166/wst.2017.519. [COBISS.SI-ID 8181089].

RADINJA, Matej, COMAS, Joaquim, COROMINAS, Lluis, ATANASOVA, Nataša. Assessing stormwater control measures using modelling and a multi-criteria approach. Journal of environmental management. 2019, letn. 243, št. avg., str. 257-268, ilustr. ISSN 0301-4797. DOI: 10.1016/j.jenvman.2019.04.102. [COBISS.SI-ID 8801889].

ŽITNIK, Miha, ŠUNTA, Urška, GODIČ TORKAR, Karmen, KRIVOGRAD-KLEMENČIČ, Aleksandra, ATANASOVA, Nataša, GRIESSLER BULC, Tjaša. The study of interactions and removal efficiency of Escherichia coli in raw blackwater treated by microalgae Chlorella vulgaris. Journal of cleaner production. [Print ed.]. 2019, letn. 238, št. nov., str. 1-9, ilustr. ISSN 0959-6526. DOI: 10.1016/j.jclepro.2019.117865. [COBISS.SI-ID 8866145].

KRZYK, Mario, DREV, Darko, KOLBL, Sabina, PANJAN, Jože. Self-purification processes of Lake Cerknica as a combination of wetland and SBR reactor. Environmental science and pollution research international, ISSN 0944-1344. [Print ed.], dec. 2015, letn. 22, št. 24, str. 20177-20185, ilustr., doi: 10.1007/s11356-015-5088-0. [COBISS.SI-ID 7133793].

DALMAU, Montserrat, ATANASOVA, Nataša, GABARRÓN, Sara, RODRIGUEZ-RODA, Ignasi, COMAS, Joaquim. Comparison of a deterministic and a data driven model to describe MBR fouling. The chemical engineering journal, ISSN 1385-8947. [Print ed.], jan. 2015, letn. 260, str. 300-308, ilustr., doi: 10.1016/j.cej.2014.09.003. [COBISS.SI-ID 6754401].

KRZYK, Mario, MALUS, Davor, PANJAN, Jože. Meritve kakovostnih parametrov za modeliranje prvega vala onesnaženih voda s cestnih površin = Measurements of quality parameters for the modeling of the first flush of polluted water from roads. Gradbeni vestnik, ISSN 0017-2774, jul. 2013, letn. 62, str. 159-164, ilustr. [COBISS.SI-ID 6310497].

KRZYK, Mario, PANJAN, Jože. Občutljivostna analiza parametrov modeliranja prvega vala onesnaženih voda s cestnih površin = A sensitivity analysis modeling parameters of the first wave of polluted waterfrom road surface. Gradbeni vestnik, ISSN 0017-2774, dec. 2012, letn. 61, str. 275-283, ilustr. [COBISS.SI-ID 6129505].

KRZYK, Mario, PANJAN, Jože. Samočistilni procesi v kanalskih sistemih : predavanje 3.4.2008 na gradbenem sejmu Megra v Gornji Radgoni, v okviru teme z naslovom: "Zakaj so betonske cevi in jaški pri gradnji kanalizacij v Nemčiji še vedno na prvem mestu?". Gornja Radgona, 2008. [COBISS.SI-ID 4047713].

KRZYK, Mario. Komunalne naprave. 2. del : študijsko gradivo za študente univerzitetnega študija "Vodarstvo in okoljsko inženirstvo". Ljubljana: Univerza v Ljubljani, Fakulteta za gradbeništvo in geodezijo, 2022. 54 f., ilustr.

UČNI NAČRT PREDMETA/COURSE SYLLABUS

Predmet:	
	VODNOGOSPODARSKI SISTEMI
Course title:	
	WATER MANAGEMENT SYSTEMS

Študijski programi in stopnja	Študijska smer	Letnik	Semestri
Vodarstvo in okoljsko inženirstvo, druga stopnja, magistrski	Hidrotehnika (modul)	2. letnik	1. semester

Univerzitetna koda predmeta/University course code:	0037809
Koda učne enote na članici/UL Member course code:	1337

Predavanja	Seminar	Vaje	Klinične vaje	Druge oblike študija	Samostojno delo	ECTS
10	15	30	0	5	60	4

Nosilec predmeta/Lecturer:	Mateja Škerjanec

Vrsta predmeta/Course type:	Obvezni strokovni /Obligatory professional

Jeziki/Languages:	Predavanja/Lectures:	Slovenščina
	Vaje/Tutorial:	Slovenščina

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:	Prerequisites:

Vsebina:

Predavanja

Umestitev vodnega gospodarstva (VG) v standardno klasifikacijo dejavnosti in objektov. Zasnova VG sistemov in ureditev, VG načela, cilji in naloge (v javnem interesu), pristopi k gospodarjenju z vodami. Institucionalni okvirji VG, organizacijska struktura subjektov, politika do voda in pravni status voda, primerjava s tujimi oblikami organiziranosti. Zasnova nadzora, monitoringa in podatkovnih virov ter skladnost z zadevnimi EU direktivami. Celostno gospodarjenje z vodami, razvojne poti VG sistemov

Content (Syllabus outline):

Lectures

Placement of water management (WM) in standard classification of activities and structures. Design of WM systems and regulations, WM principles, objectives and tasks (in the public interest), and approaches to water management. Institutional frameworks of WM, the organizational structure of stakeholders, water policy, the legal status of waters, and comparison with foreign forms of organization. Design of control, monitoring, and data resources and compliance with relevant EU

in ureditev, navezava z varovalnim, sektorskim in prostorskim načrtovanjem ter načrtovanjem finančnih virov.	directives. Integrated water management, WM development, relations with protective, sectorial and spatial planning, and water funds planning.
Seminar	Seminar
Analiza zasnove izbranega VG sistema, določanje relacij med primarno in podrejeno rabo, lastniška razmerja in upoštevanje območij s pravnimi režimi, SWOT analiza upoštevanja načel celostnega gospodarjenja z vodami.	Analysis of the selected WM system design, primary and subordinate water use analysis, ownership relations and impact of areas under different legal regimes, and SWOT analysis considering the principles of integrated water management.
Vaje	integrated water management.
Zasnova izbranega VG sistema, ugotavljanje virov možne skladne in nasprotujoče primarne in podrejenih rab ter ocena iz tega izvirajočih nevarnosti, tehnična interpretacija vsebin obravnavanega pravnega režima, vrste monitoringov in možno spremljanje stanja – uporaba podatkovnih baz in GIS orodij.	Tutorials
	Designing a selected WM system, assessment of potential sources of consistent and opposing primary and subordinate water uses and related risks, technical interpretation of the legal regimes, types of monitoring and surveillance – use of databases and GIS tools.
Terensko delo	Field-work
Terenska prepoznava zasnove in gradnikov VG sistema, zaznavanje skladne in nasprotujoče primarne in podrejenih rab, analiza vpliva hipotetične spremembe pravnega režima in analiza potrebnih vsebin obratovalnega monitoringa.	Field recognition of the general design and elements of a WM system, recognizing consistent and opposing primary and subordinate water uses, impact assessment of hypothetical changes in legal regimes, and analysis of the required content of operational monitoring.

Temeljna literatura in viri/Readings:

Matičič, Brane, Steinman, Franci. 2006. Irrigation sector reform in Central and Eastern European Countries : Slovenian Report. V: DIRKSEN, Wolfram (ur.), HUPPERT, Walter (ur.). Irrigation sector reform in Central and Eastern European countries : with the contributions from the ICID national committees of Bulgaria, Czech Republic, Germany, Hungary, Macedonia, Poland, Romania, Russia, Slovenia and Ukraine. Eschborn: Deutsche Gesellschaft für Technische Zusammenarbeit (GTZ); New Delhi: International Commission on Irrigation and Drainage (ICID), str. 447-527, graf. prikazi.
Djordjević, B. 1990. Vodoprivredni sistemi, Naučna knjiga, 498 str. Journal of Water Resources Planning and Management (izbrani članki – 2013 in prej).
Water Management in the Czech Republic. 2012. Spletna stran: Ministry of Agriculture of the Czech Republic.
Učno gradivo v spletni učilnici UL FGG.

Cilji in kompetence:	**Objectives and competences:**
Cilji	Objectives
- Spoznavanje organizacijske in institucionalne strukture gospodarjenja z vodami, nalog VG sistemov in ureditev ter njihove povezanosti z	- Understanding the organizational and institutional structure of WM, WM systems and regulations' tasks, and functioning, and their connection with

rabami voda, rabo prostora in antropogenimi dejavnostmi.

- Razumeti umeščanje v prostor, poznati vplive vodne infrastrukture na delovanje infrastrukture drugih resorjev na vodah (plovba, kmetijstvo ipd.) in usklajevanje skupne in posebne rabe voda.

Kompetence

- Znati analizirati primarne in podrejene (sekundarne) cilje VG sistemov, določati interakcije z naravnim in grajenim okoljem ter drugimi infrastrukturami, določati obratovalne razmere ter

primernost in uspešnost VG sistemov v različnih fazah življenjskega cikla.

- Sposobnost presoje robnih pogojev, delovanja ter zanesljivosti VG sistemov in ureditev.

water use, spatial planning, and anthropogenic activities.

- To understand the placement of WM systems in the space, the influence of water infrastructure on the operation of infrastructure in other water-related sectors (e.g., navigation, agriculture), and harmonization of public and commercial water uses.

Competences:

- Ability to analyze primary and subordinate (secondary) objectives of WM systems, determine interaction with the natural and built environment and other infrastructure, the operating conditions, suitability, and usefulness of WM systems in the whole life cycle.

- Ability to assess the efficiency and reliability of the WM systems and regulations within boundary conditions.

Predvideni študijski rezultati: | **Intended learning outcomes:**

- Razumeti pravno-ekonomsko-tehnične vidike v katerih delujejo VG sistemi, ter znati določiti robne pogoje, načine delovanja in stopnjo zanesljivosti VG sistemov in ureditev.

- Doseženo znanje uporabiti kot izhodišče za obravnavo na posameznih področjih hidrotehnike, ki se povezujejo v VG sisteme ali vključujejo v druge infrastrukturne sisteme.

- Dobro poznavanje pogojev gospodarjenja z vodami in institucionalnih okvirjev omogoča razumevanje obratovalnih razmer (običajne, izredne, ekstremne) VG sistemov.

- Sposobnost uporabe in kritične presoje zasnove, delovanja in robnih pogojev na drugih sistemih (komunala, promet, itd.).

- Understanding of legal-economic-technical aspects of WM systems and defining their boundary conditions, mode of action, and level of reliability.

- To use the achieved knowledge as starting point for consideration in individual fields of Hydraulics, incorporated in WM systems or other infrastructure systems.

- Good knowledge of the Water Management Sector and institutional contexts enables understanding of operating conditions (normal, exceptional, extreme) of WM systems.

- Ability to apply and critically assess design, operation, and boundary conditions of other (e.g., public services) systems.

Metode poučevanja in učenja: | **Learning and teaching methods:**

Predavanja, seminar, seminarske vaje in terensko delo. | Lectures, seminar, seminar tutorials and field work.

Načini ocenjevanja:	Delež/Weight	Assessment:
Seminarske vaje	50,00 %	Seminar tutorials
Seminarska naloga	20,00 %	Individual seminar work (Project Report)
Pisni in/ali ustni izpit	30,00 %	Written and/or oral examination

Reference nosilca/Lecturer's references:

ŠKERJANEC, Mateja, ATANASOVA, Nataša, ČEREPNALKOSKI, Darko, DŽEROSKI, Sašo, KOMPARE, Boris. 2014. Development of a knowledge library for automated watershed modeling. Environmental Modelling & Software, 54: 60-72. DOI: 10.1016/j.envsoft.2013.12.017.

ŠKERJANEC, Mateja, STEINMAN, Franci, RAK, Gašper. 2021. Integrated flood management based on "hazard analysis critical control point" approach. Journal of flood risk management, e-12769. DOI: 10.1111/jfr3.12769.

VOLF, Goran, ATANASOVA, Nataša, ŠKERJANEC, Mateja, OŽANIĆ, Nevenka. 2018. Hybrid modeling approach for the northern Adriatic watershed management. Science of the total environment. 635: 353-363. DOI: 10.1016/j.scitotenv.2018.04.094.

UČNI NAČRT PREDMETA/COURSE SYLLABUS

Predmet:	
	UREJANJE HUDOURNIKOV IN POVIRIJ
Course title:	
	TORRENT, EROSION, ROCKFALL AND AVALANCHE CONTROL

Študijski programi in stopnja	Študijska smer	Letnik	Semestri
Vodarstvo in okoljsko inženirstvo, druga stopnja, magistrski	Poplave in upravljanje z vodami (modul)	2. letnik	1. semester
Vodarstvo in okoljsko inženirstvo, druga stopnja, magistrski	Okoljsko inženirstvo (modul)	2. letnik	1. semester

Univerzitetna koda predmeta/University course code:	0037817
Koda učne enote na članici/UL Member course code:	1340

Predavanja	Seminar	Vaje	Klinične vaje	Druge oblike študija	Samostojno delo	ECTS
35	0	15	0	10	60	4

Nosilec predmeta/Lecturer:	Matjaž Mikoš

Vrsta predmeta/Course type:	Obvezni strokovni /Obligatory professional

Jeziki/Languages:	Predavanja/Lectures:	Slovenščina
	Vaje/Tutorial:	Slovenščina

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:	Prerequisites:
Opravljeni izpiti iz predmetov Urejanje vodotokov, Hidravlično modeliranje in Hidrološko modeliranje ali pridobljena primerljiva znanja.	Passed exams in River engineering, Hydraulic modeling and Hydrologic modeling or acquired comparable knowledge.

Vsebina:	Content (Syllabus outline):
Predavanja	Lectures
Uvod v urejanje hudournikov: zgodovinski pregled, problematika in koncept urejanja, zakonodaja in načrtovanje, standardizacija. Osnove urejanja hudournikov in povirij: hidrologija povirij, erozija tal, hudourniška hidravlika, nastanek in dinamika masnih	Introduction to torrent control: historical overview, problems and control concepts, legislation and planning, standardisation. Basics of torrent, erosion, rockfall and avalanche control: headwaters hydrology, soil erosion, torrent hydraulics, initiation

tokov (drobirski in blatni tokovi, padajoče kamenje in skalni podori), mehanika in dinamika snežne odeje in snežnih plazov, prodna bilanca.
Urejanje hudournikov in povirij: varstvo pred površinsko erozijo (protierozijske vegetativne zaščite), varstvo pred hudourniško erozijo (objekti v hudourniških strugah), varstvo pred delovanjem snežnih plazov (protilavinske zgradbe).

Seminarske vaje
Računske vaje iz hudourniške hidravlike in erozije tal ter dimenzioniranja izbranih vrst hudourniških objektov. Uporaba matematičnega modela za račun prodne bilance.

Terensko delo
Zasnova in izvedba tehničnih ureditev v hudourniških območjih in hudournikih.

and dynamics of mass movements (debris flows and mudflows, stone falls and rockfalls, mechanics and dynamics of snow cover and avalanches, sediment balance. Torrent, erosion, rockfall, and avalanche control: soil erosion control (soil bioengineering), torrent control (torrent control works), avalanche control (avalanche protection works).

Tutorials
Computational tutorials in torrent hydraulics and soil erosion, as well as in design of selected types of torrent control works. Using mathematical model for the computation of sediment balance.

Field work
Preliminary design and execution of technical torrent control works in headwaters.

Temeljna literatura in viri/Readings:

Mikoš M. 2008. Inženirska hidrotehnika – zbirka rešenih primerov, verzija 2008, UL FGG, Katedra za splošno hidrotehniko, 200 p.

Mikoš M. 2009. Osnove hudourništva – varstvo pred hudourniki in zemeljskimi plazovi, UL FGG, Katedra za splošno hidrotehniko, 217 p.

Spletne strani resornega ministrstva (MKO) s področja vodne infrastrukture (vodnih objektov).

Dostopno na: http://www.hec.usace.army.mil/software/hec-ras/.

Atlasa okolja in gospodarske javne infrastrukture (GJI) v Sloveniji.

Dostopno na: http://gis.arso.gov.si/atlasokolja/.

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

Cilji

- Nadgraditi znanje iz urejanja vodotokov z znanji o urejanju hudournikov in povirij (hudourniških območij).

- Podati teoretične osnove za načrtovanje in dimenzioniranje hudourniških objektov.

Kompetence

- Sposobnost izdelave celovitih ureditvenih načrtov urejanja voda na nivoju povodij.

- Sposobnost dimenzioniranja in projektiranja določenih vrst hudourniških objektov.

Objectives

- Upgrade of knowledge of river engineering with knowledge of torrent, erosion, rockfall, and avalanche control (in torrential watersheds).

- Giving theoretical basics for planning and design of torrent control works.

Competencies

- Ability to prepare integrated river basin management plans.

- Ability to design and plan selected types of torrent control works.

Predvideni študijski rezultati: | **Intended learning outcomes:**

- Poglobljeno znanje iz hudourniške hidravlike in mehanike/dinamike.	- Acquired in-depth knowledge of torrent hydraulics and mechanics/dynamics.
- Razumevanje procesov erozije tal v prostoru.	- Understanding spatial soil erosion processes.
- Osvojene računske spretnosti za načrtovanje ureditvenih ukrepov na hudournikih in v povirjih.	- Learned numerical skills for planning control works in torrents and in torrential headwaters.
- Doseženo znanje uporabljajo pri izdelavi magistrske naloge oz. v inženirski praksi.	- Achieved knowledge applied when writing a master thesis or in engineering practice.
- Sposobnost abstraktne formulacije naravnih procesov.	- Ability of abstract formulation of natural processes.
- Sposobnost kritične presoje vhodnih podatkov in dobljenih računskih rezultatov pri načrtovanju ukrepov.	- Ability for critical analysis of input data and calculation results when planning interventions.
- Sposobnost upoštevanja dinamike naravnih procesov pri načrtovanju človekove dejavnosti v prostoru.	- Ability to take into account natural process dynamics in spatial planning of human activities.

Metode poučevanja in učenja: **Learning and teaching methods:**

Predavanja, seminarske vaje, terensko delo.	Lectures, seminar tutorials, field work.

Načini ocenjevanja: | **Delež/Weight** | **Assessment:**

Pisni in/ali ustni izpit	50,00 %	Written and/or oral examination
Seminarske vaje	40,00 %	Seminar tutorials
Terensko delo	10,00 %	Field work report

Reference nosilca/Lecturer's references:

Fidej, G., Mikoš, M., Rugani, T., Jež, J., Kumelj, Š., Diaci, J. (2015). Assessment of the protective function of forests against debris flows in a gorge of the Slovenian Alps. IForest 8, 73-81.

Sodnik, J., Kogovšek, B., Mikoš, M. (2015). Vlaganja v vodno infrastrukturo v Sloveniji in Avstriji = Investments into water infrastructure in Slovenia and in Austria. Gradbeni vestnik 64(1), 3-12.

Sodnik, J., Martinčič, M., Kryžanowski, A., Mikoš, M. (2015). Are Torrent Check-Dams Potential Debris-Flow Sources? V: Lollino, G. (ur.), et al. *Engineering geology for society and territory. Vol. 2, Landslide processes*. Springer International Publishing Switzerland, 485-488.

Sodnik, J., Mikoš, M. (2013). Vodarstvo in vzdrževanje vodne infrastrukture v Sloveniji. Gradbeni vestnik 62(8), 166-173.

Mikoš, M. (2012). Prispevek k zgodovinskemu pregledu razvoja hudourništva in hudourničarstva v Sloveniji. Gozdarski vestnik 70(10), 429-439.

Sodnik, J., Mikoš, M. (2010). Modeling of a debris flow from the Hrenovec torrential watershed above the village of Kropa = Modeliranje drobirskega toka v hudourniškem območju Hrenovecnad Kropo. Acta geographica Slovenica 50(1), 59-84.

UČNI NAČRT PREDMETA/COURSE SYLLABUS

Predmet:	
	MATEMATIČNO MODELIRANJE OKOLJSKIH PROCESOV
Course title:	
	MATHEMATICAL MODELLING OF ENVIRONMENTAL PROCESSES

Študijski programi in stopnja	Študijska smer	Letnik	Semestri
Vodarstvo in okoljsko inženirstvo, druga stopnja, magistrski	Okoljsko inženirstvo (modul)	2. letnik	Zimski

Univerzitetna koda predmeta/University course code:	0037823
Koda učne enote na članici/UL Member course code:	1757

Predavanja	Seminar	Vaje	Klinične vaje	Druge oblike študija	Samostojno delo	ECTS
45	0	0	30	0	75	5

Nosilec predmeta/Lecturer:	Matjaž Četina

Vrsta predmeta/Course type:	Obvezni strokovni/Obligatory professional

Jeziki/Languages:	Predavanja/Lectures:	Slovenščina
	Vaje/Tutorial:	Slovenščina

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:	Prerequisites:
Opravljena izpita iz predmetov Hidravličnega modeliranja in Hidrološkega modeliranja ali druga ustrezna primerljiva znanja.	Passed exams in Hydraulic modelling and Hydrologic modelling or other adequate comparable knowledge.

Vsebina:	Content (Syllabus outline):
Predavanja	Lectures
Osnovni principi modeliranja naravnih procesov v vodi: hidrodinamična cirkulacija, transport in disperzija polutantov, biokemični procesi. Primerjava principov ter prednosti in slabosti fizičnih in matematičnih modelov. Osnovne naravne zakonitosti modeliranja procesov. Opis enačb: kontinuitetna, dinamična, konvekcijsko-difuzijska	Basic principles of modelling natural processes in water: hydrodynamic circulation, transport and dispersion of pollutants, biochemical processes. Comparison of principles, advantages and disadvantages of physical and mathematical models. Basic natural laws of modelling processes. Description of equations: continuity, momentum,

enačba za transport snovi, vpliv modelov turbulence ter toplotne in gostotne stratifikacije, enačbe za opis bio-kemičnih procesov. Princip povezave hidrodinamičnega, transportno-disperzijskega in bio-kemičnega modula v kompleksen ekološki model. Uporabnost 1D, 2D in 3D modelov in prikazi primerov iz prakse.

Vaje

Laboratorijske vaje (meritve parametrov kvalitete v bio-kemičnem laboratoriju IZH, delo v računalniški učilnici z računalniškimi programi PCFLOW2D, PCFLOW3D, QUAL2 in sorodnimi orodji za račun tokov, širjenja in koncentracije snovi in napovedovanje sprememb kvalitete vode). Izdelava naloge, ki obsega analitično in numerično reševanje 1D enačbe za transport snovi v vodotokih in uporabo 2D in 3D modelov za račun širjenja onesnaženja v vodnih telesih.

advection-diffusion equation for mass transfer, the impact of turbulence models and thermal / density stratification, equations for the description of biochemical processes. The principle of connecting hydrodynamic, transport-dispersion and biochemical module into a complex ecological model. The applicability of 1D, 2D and 3D models, presentation of case studies.

Tutorials

Laboratory tutorials (measurements of quality parameters in the IZH biochemical laboratory, work in the computer classroom with computer codes PCFLOW2D, PCFLOW3D, QUAL2 and similar tools for the computation of flow, pollutant spreading and concentration and prediction of water quality changes). Elaboration of individual work including analytical and numerical solutions of 1D equation for mass transport in streams and the use of 2D and 3D models to compute pollutant spreading in water bodies.

Temeljna literatura in viri/Readings:

Jørgensen, S.E. & Bendoricchio, G. 2001. Fundamentals of Ecological Modelling, 3rd Ed., Elsevier, Amsterdam, 530 str.

Orlob, G.T. 1983. Mathematical modelling of Water Quality: Streams, Lakes and Reservoirs, John Wiley & Sons, 509 str.

Spletne strani revije Ecological Modelling.

Dostopno na: http://www.journals.elsevier.com/ecological-modelling/ .

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

Cilji

- Razširiti znanje slušateljev tako, da dosežemo širino pristopa in povezavo inženirskih znanj z različnih področij oz. strok.

- Spoznati, kako vključevati pridobljena temeljna znanja s področij hidromehanike, hidravlike, inženirske in zdravstvene hidrotehnike, transporta polutantov, numeričnih metod ter vodne kemije in mikrobiologije v kompleksne ekološke modele.

- Teoretične vsebine podpreti s prikazom praktičnih primerov računalniške simulacije tokov in širjenja onesnaženja v vodi.

Kompetence

Objectives

- To deepen knowledge of students by giving them more general view in order to connect engineering skills from different professional fields.

- To find out how to include the acquired basic knowledge from the fields of hydrodynamic, hydraulics, sanitary engineering, transport of pollutants, numerical methods and water chemistry and microbiology into complex ecological models

- To support theoretical contents with practical applications of computer simulations of flow and pollutant spreading.

Competences

- Sposobnost pravilne določitve najpomembnejših procesov in ustreznih enačb ter posledično uporabe najustreznejših računalniških programov za določanje širjenja onesnaženj v površinskih in podzemnih vodah.	- Ability to choose the most important processes and equations and, as a consequence, use of appropriate computer codes to determine the spreading of pollutants in surface waters and groundwater.
- Sposobnost izdelave kvalitativnih in s pomočjo sodobnih računalniških simulacij tudi kvantitativnih inženirskih ocen vplivov na vodno okolje vsled posegov v naravne procese.	- Ability to produce qualitative and, with the use of up to date computer simulations, also quantitative engineering assessments of the influence of human interventions into natural processes in water environment.

Predvideni študijski rezultati:	**Intended learning outcomes:**
- Osvojeno interdisciplinarno znanje za povezavo hidrodinamičnih, transportno-disperzijskih in bio-kemičnih procesov v vodnem okolju.	- Acquired interdisciplinary knowledge to connect hydrodynamic, transport-dispersion and bio-chemical processes in water environment.
- Razumevanje procesov kakovostnih sprememb v vodnih telesih in sposobnost njihovih kvantitativnih napovedi.	- Understanding processes of quality changes in water bodies and ability to quantify them.
- Doseženo znanje uporabljajo pri izdelavi kvantitativnih sprememb napovedi kakovostnih v vodnih telesih zaradi človekovih vplivov.	- Acquired knowledge can be used for quantitative prediction of quality changes in water bodies due to human impacts.
- Dobro razumevanje osnovnih fizikalnih in bio-kemičnih procesov v vodnem okolju omogoča pravilno presojo različnih časovnih meril hidrodinamičnega in bio- kemičnega dogajanja.	- Good understanding of basic physical and bio-chemical processes in water environment provides correct assessment of different time scales of hydrodynamic and bio-chemical occurrences.
- Široko interdisciplinarno znanje omogoča pravilno povezovanje posameznih modulov v kompleksne ekološke modele za dolgoročne simulacije sprememb kakovosti vode.	- General interdisciplinary knowledge enables correct integration of individual modules into complex ecological models for long term simulations of water quality changes.
- Sposobnost načrtovanja meritev hitrosti, gladin in parametrov kvalitete vode v recipientih za potrebe umerjanja matematičnih modelov.	- Ability to plan measurements of velocity, water elevations and water quality parameters needed to calibrate mathematical models.
- Sposobnost uporabe kompleksnih ekoloških modelov za simulacijo kvalitete vode in usposobljenost za kritično presojo rezultatov.	- Ability to use complex ecological models for water quality simulations and qualification to assess the results critically.

Metode poučevanja in učenja:	**Learning and teaching methods:**
Predavanja in laboratorijske vaje.	Lectures and laboratory tutorials.

Načini ocenjevanja:	**Delež/Weight**	**Assessment:**
Domače naloge (pisno, oddaja več vaj)	50,00 %	Homework (written, several exercises)
Pisni izpit (izpit iz teorije)	50,00 %	Written exam (theory)

Reference nosilca/Lecturer's references:

ŽAGAR, Dušan, SIRNIK, Nataša, ČETINA, Matjaž, HORVAT, Milena, KOTNIK, Jože, OGRINC, Nives, HEDGECOCK, Ian M., CINNIRELLA, Sergio, DE SIMONE, Francesco, GENCARELLI, Christian N., PIRRONE, Nicola. Mercury in the Mediterranean. Part 2, Processes and mass balance. *Environ. sci. pollut. res. int*. [Print ed.], [in press] 2013, 10 str., doi: 10.1007/s11356-013-2055-5.

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. *Gradb. vestn.*, jun. 2013, letn. 62, str. 131-139.

ŽAGAR, Dušan, PETKOVŠEK, Gregor, RAJAR, Rudolf, SIRNIK, Nataša, HORVAT, Milena, VOUDOURI, Antigoni, KALLOS, George B., ČETINA, Matjaž. Modelling of mercury transport and transformation in the water compartment of the Mediterranean Sea. *Mar. Chem*. [Print ed.], 2007, issue 1, vol. 107, str. 64-88.

UČNI NAČRT PREDMETA/COURSE SYLLABUS

Predmet:	
	METEOROLOGIJA
Course title:	
	METEOROLOGY

Študijski programi in stopnja	Študijska smer	Letnik	Semestri
Vodarstvo in okoljsko inženirstvo, druga stopnja, magistrski	Okoljsko inženirstvo (modul)	2. letnik	1. semester

Univerzitetna koda predmeta/University course code:	0038711
Koda učne enote na članici/UL Member course code:	1593

Predavanja	Seminar	Vaje	Klinične vaje	Druge oblike študija	Samostojno delo	ECTS
30	0	15	0	0	45	3

Nosilec predmeta/Lecturer:	Gregor Skok

Vrsta predmeta/Course type:	Obvezni strokovni/Obligatory professional

Jeziki/Languages:	Predavanja/Lectures:	Slovenščina
	Vaje/Tutorial:	Slovenščina

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:	**Prerequisites:**

Vsebina:	**Content (Syllabus outline):**
Predavanja:	Lectures:
Sestava atmosfere, osnovne meteorološke količine, polje zračnega tlaka in njegove spremembe, kvazistacionarni vetrovi v višinah in pri tleh. Meritve zračnega tlaka in temperature, temperaturna polja. Diabatne in adiabatne spremembe, stabilnost, konvekcija, vlaga v zraku, fazne spremembe za vodo v ozračju, nastanek oblakov, megle in padavin. Energijska bilanca tal, ogrevanje tal in zraka. Sinoptični pojavi in tvorbe: cikloni, anticikloni,	Composition of the atmosphere, basic meteorological variables, air pressure field and its changes, quasi-stationary winds at upper levels and close to the ground. Air pressure and temperature measurement, temperature field. Diabatic and adiabatic changes, stability of the atmosphere, convection, moisture in the atmosphere, phase changes for water in the air, formation of clouds, fog and precipitation.

fronte. Makro in mezo meteorološki pojavi: planetarna mejna plast, nevihte. Osnove vremenske napovedi, numerična napoved vremena. Osnove klimatologije in razlaga vzrokov za klimo in klimatske spremembe. Povezava med meteorologijo in hidrologijo. Vaje: Računske naloge iz osvojenih znanj pridobljenih pri predavanjih.	Energy balance of ground surface, heating/cooling of the ground and air close to it. Synoptic processes and phenomena: cyclones, anticyclones, fronts. Macro- and meso-meteorological phenomena: planetary boundary layer, thunderstorms. Principles of weather forecasting, numerical weather prediction. Elements of climatology, physical bases of climate and climate change. Relation between meteorology and hydrology. Tutorial: Computational exercises using knowledge and skills acquired within lectures.

Temeljna literatura in viri/Readings:

J. Rakovec, T. Vrhovec. 2007. Osnove meteorologije za naravoslovce in tehnike. Ljubljana, DMFA. A. Hočevar, Z. Petkovšek. 1995. Meteorologija, osnove in nekatere aplikacije. Ljubljana, BTF. S. Gaberšek, G. Skok in R. Žabkar. 2013. Rešene naloge iz osnov meteorologije. Ljubljana, DMFA C. D. Ahrens. 2004. Essentials of Meteorology (with Meteorology Now and InfoTrac). R. A. Paul. 1996. Exercises in Meteorology. 2nd ed. Prentice Hall, Upper Saddle River.

Cilji in kompetence:	**Objectives and competences:**
- Pridobitev osnovnega znanja o vremenu in klimi na podlagi fizikalnega pristopa, - spoznavanje z osnovnimi količinami, meritvami, procesi in pojavi v atmosferi, predvsem s padavinami, - z metodami napovedovanja vremena in - vzroki za klimo in njene spremembe.	- To obtain basic knowledge on weather and climate, based on mathematical-physical approach, - to recognize basic variables and their measurements, atmospheric processes and phenomena, especially with precipitation, - with methods of weather forecasting and - with factors determining climate and its changes.

Predvideni študijski rezultati:	**Intended learning outcomes:**
- Osnovni meteorološki predmet, ki razloži glavna dogajanja v ozračju. Za njegovo razumevanje je nujno osnovno znanje fizike. - Pridobljeno znanje služi za razumevanje vremena in klime ter nastanka padavin. - Uporaba fizikalnega pristopa in matematičnih formalizmov na primerih iz dinamike in termodinamike ozračja. - Spoznavanje primerov obravnave dogajanj iz vsakodnevnih izkušenj v ozračju s fizikalnim pristopom: skladnost modelov dogajaj z opazovanim razvojem v naravi.	- The first of meteorological courses, explaining main processes in the atmosphere. Knowledge of basics of classical physics is a prerequisite. - A knowledge gained serves student to understand weather, climate and precipitation processes. - Use of mathematical-physical methods and formalisms on dynamic and thermodynamic processes in the atmosphere. - Understanding of cases from everyday life using the tools of physics: correspondence between concepts and development in nature.

Metode poučevanja in učenja:

Learning and teaching methods:

Predavanja, vaje, primeri dogajanj v ozračju s pomočjo satelitskih, radarskih in drugih metod merjenj in zaznavanja.	Lectures, tutorials, study of cases by satellite and radar images and other methods of sensing.

Načini ocenjevanja:	**Delež/Weight**	**Assessment:**
2 kolokvija namesto izpita iz vaj ali izpit iz vaj	50,00 %	2 written tests (mid-term and end-term) applied towards the problem-solving examination, problem-solving examination
Izpit iz teorije	50,00 %	Theoretical examination

Reference nosilca/Lecturer's references:

SKOK, Gregor, ROBERTS, Nigel. Analysis of Fractions Skill Score properties for random precipitation fields and ECMWF forecasts. Quarterly Journal of the Royal Meteorological Society, 2016, ISSN 0035-9009, 12 str.

SKOK, Gregor, ŽAGAR, Nedjeljka, HONZAK, Luka, ŽABKAR, Rahela, RAKOVEC, Jože, CEGLAR, Andrej. Precipitation intercomparison of a set of satellite- and raingauge-derived datasets, ERA Interim reanalysis, and a single WRF regional climate simulation over Europe and the North Atlantic. Theoretical and applied climatology, ISSN 0177-798X. [Tiskana izd.], 2016, vol. 123, iss. 1, str. 217-232.

RAKOVEC, Jože, SKOK, Gregor, ŽABKAR, Rahela, ŽAGAR, Nedjeljka. The influence of the depth of a very shallow cool-pool lake on nocturnal cooling. Agricultural and forest meteorology, ISSN 0168-1923. [Print ed.], 2015, vol. 203, str. 17-29.

SKOK, Gregor, BACMEISTER, Julio T., TRIBBIA, Joe. Analysis of tropical cyclone precipitation using an object-based algorithm. Journal of climate, ISSN 0894-8755, 2013, vol. 26, iss. 8, str. 2563-2579.

UČNI NAČRT PREDMETA/COURSE SYLLABUS

Predmet:	
	PROSTORSKO PLANIRANJE IN OGROŽENOST PRED POPLAVAMI
Course title:	
	SPATIAL PLANNING FOR FLOOD PROTECTION

Študijski programi in stopnja	Študijska smer	Letnik	Semestri
Vodarstvo in okoljsko inženirstvo, druga stopnja, magistrski	Poplave in upravljanje z vodami (modul)	2. letnik	1. semester

Univerzitetna koda predmeta/University course code:	0035017
Koda učne enote na članici/UL Member course code:	1548

Predavanja	Seminar	Vaje	Klinične vaje	Druge oblike študija	Samostojno delo	ECTS
45	10	20	0	0	75	5

Nosilec predmeta/Lecturer:	Alma Zavodnik Lamovšek, Andrej Kryžanowski, Simon Rusjan

Vrsta predmeta/Course type:	Obvezni strokovni /Obligatory professional

Jeziki/Languages:	Predavanja/Lectures:	Angleščina
	Vaje/Tutorial:	Angleščina

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:	Prerequisites:

Vsebina:

Content (Syllabus outline):

Predavanja

Uvod v prostorsko načrtovanje, temelje trajnostnega načrtovanja in pregled pravnih podlag urejanja prostora. Pregled sodobnega znanja v prostorskem načrtovanju v državah EU. Mednarodno načrtovanje. Načrtovanje na državni ravni. Regionalno načrtovanje. Urbano in krajinsko načrtovanje. Lokalno in podrobno načrtovanje. Varovanje pred poplavami na vseh ravneh urejanja prostora. Pravni vidiki prostorskega načrtovanja. Celovito in

Lectures

Introduction to spatial planning, foundations of sustainable planning and overview of legal foundations of spatial planning. Review of current knowledge in spatial planning in the EU countries. International design. Planning at the national level. Regional planning. Urban and landscape planning. Local and detailed planning. Flood protection at all levels of planning. Legal aspects of spatial planning.

sektorsko načrtovanje. Trajnostno načrtovanje. Primeri dobre prakse. Načrtovanje z upoštevanjem varovanja pred poplavami na državni, regionalni in lokalni ravni; lokalno in detajlno načrtovanje območij z upoštevanjem ukrepov nadzora in zaščite pred poplavami ter blaženja posledic poplav z ukrepi prostorskega načrtovanja. Metode in tehnike. Analiza praktičnih primerov. Zbiranje in obdelava prostorskih podatkov. Kartiranje ranljivosti, analiza vpliva poplav, presoja vplivov na okolje in prostorsko planiranje. Metode in tehnike urbanističnega načrtovanja v zvezi z nadzorom poplav. Načrtovanje in varstvo pred poplavami z gradbenimi in negradbenimi ukrepi.	Comprehensive and sectoral planning. Sustainable planning. Examples of good practice. Planning with respect to flood protection at state, regional and local levels. Local and site planning with respect to flood control and protection and flood mitigation by spatial planning. Methods and techniques. Analysis of practical examples. Collection and processing of spatial data. Vulnerability mapping, analysis of the impact of floods, environmental impact assessments and spatial planning. Methods and techniques of urban planning with regard to flood control. Planning and flood protection construction, without structural measures.
Seminar	Seminar
Študentje delajo skupaj na načrtih regije ali mesta z upoštevanjem razvoja in varovanja pred poplavami. Analizirajo posamezne praktične primere.	Students work together on plans for regions or cities with respect to development and flood protection. They analyze practical examples.

Temeljna literatura in viri/Readings:

Colley B.C. 2005. Practical manual of land development, Mc Graw Hill.
De Chiara 1984. Time saver standards for regional development, McGraw-Hill.
Fukuoka S. 1999. Floodplain riska management, Balkema AA, 1998EU commission: European spatial development and floods directives CESDP, POTSDAM FLOODS Directive 1999.
Stiftel B., Watson C. 2005. Dialogues in urban and regional planning. Routledge Espon Atlas selection topics.
Wegener M. Button K., Nijkamp P. 2007. Planning history and methodology, EE Pugusnik, UK selected topics.
The World Bank. 1991. Environmental assessment source book, Washington, Chapters 1-3.
EU flood research reports, AWARE, URBEM.
Dostopno na: http://councilforeuropeanstudies.org/
Učno gradivo v spletni učilnici UL FGG.

Cilji in kompetence:	**Objectives and competences:**
Cilji	Objectives
- Pridobljeno poglobljeno teoretično znanje o prostorskem planiranju in poplavah.	- Obtained in-depth theoretical knowledge of spatial planning and floods.
- Razumevanje prakse prostorskega planiranja in vpliva prisotnosti poplavne ogroženosti na prostorsko planiranje.	- Understanding the practice of spatial planning and the impact of flood risk on spatial planning.
- Uporaba metod prostorskega planiranja pri načrtovanju ukrepov varstva pred poplavami.	- Using the methods of spatial planning for planning flood protection measures.
	- Obtaining theoretical knowledge in the implementation of structural and non-structural flood protection measures in urban areas.

- Pridobljeno teoretično znanje pri izvajanju strukturnih in nestrukturnih ukrepov varstva pred poplavami na urbanih območjih.	Competences
Kompetence	- Ability to assess the role of spatial planning in planning flood protection measures.
- Sposobnost presoje možnosti upoštevanja prostorskega planiranja pri varovanju pred poplavami.	- Performing basic flood risk analysis for the needs of spatial planning.
- Izdelava osnovnih analiz poplavne ogroženosti za potrebe prostorskega planiranja.	- Ability to assess the adequacy of the implementation of flood protection measures in urban areas
- sposobnost presoje ustreznosti izvajanja ukrepov varstva pred poplavami na urbanih območjih	- Preparation of cost-benefit analyzes of flood consequences for the needs of flood protection planning.
- izdelava stroškovnih analiz posledic poplav za potrebe načrtovanja protipoplavnih ukrepov.	

Predvideni študijski rezultati: **Intended learning outcomes:**

- poznavanje osnovnih terminov prostorskega planiranja	- knowledge of basic terms of spatial planning.
- poznavanje osnov metod prostorskega planiranja	- knowledge of basic methods of spatial planning.
- poznavanje osnovih pristopov k oceni poplavne ogroženosti prostora	- knowledge on the basic approaches to assess the flood risk.
- uporaba prostorskega planiranja in GIS	- use of spatial planning and GIS
- kritično presojanje problemov pri planiranju	- critical assessment of problems in planning
- poznavanje osnov izvajanja ukrepov varstva pred poplavami	- knowledge of the basics of implementing flood protection measures
- poznavanje osnovnih pristopov k stroškovni oceni posledic poplav v prostoru	- knowledge of basic approaches to estimating the costs and benefits of flood protection measures

Metode poučevanja in učenja: **Learning and teaching methods:**

Predavanja in uporaba pridobljenih znanj pri izdelavi individualne seminarske naloge.	Lectures and application of acquired knowledge in the writing of individual seminars.

Načini ocenjevanja: **Delež/Weight**   **Assessment:**

Načini ocenjevanja	Delež/Weight	Assessment
Seminarska naloga	20,00 %	Seminar work
Pisni in/ali ustni izpit	50,00 %	Written and / or oral examination
Vaje	30,00 %	Course work

Reference nosilca/Lecturer's references:

KRYŽANOWSKI, Andrej, BRILLY, Mitja, RUSJAN, Simon, SCHNABL, Simon. Structural flood protection measures referring to several European case studies: review article. Natural hazards and earth system sciences, ISSN 1561-8633, jan. 2014, letn. 14, str. 135-142.

ZABRET, Katarina, HOZJAN, Urška, KRYŽANOWSKI, Andrej, BRILLY, Mitja, VIDMAR, Andrej. Development of model for the estimation of direct flood damage including the movable property. Journal of _flood risk management, ISSN 1753-318X, jan. 2018, letn. 11, št. S1, str. 527-540

VIDMAR, Andrej, ZABRET, Katarina, SAPAČ, Klaudija, PERGAR, Petra, KRYŽANOWSKI, Andrej. The two-step KRPAN application for calculating the benefits of flood protection measures. Hydraulic structures monitoring and safety. Warszawa 2019: Instytut Meteorologii i Gospodarki Wodnej Państwowy Instytut Badawczy. 2019, str. 277-289

HUMAR, Nina, ŠIMIC, Jure, KRYŽANOWSKI, Andrej. How dams can create an added environmental value in space. Hydraulic structures monitoring and safety. Warszawa 2019: Instytut Meteorologii i Gospodarki Wodnej Państwowy Instytut Badawczy. 2019, str. 383-397

BEZAK, Nejc, ŠRAJ, Mojca, RUSJAN, Simon, MIKOŠ, Matjaž. Impact of the rainfall duration and temporal rainfall distribution defined using the Huff curves on the hydraulic flood modelling results. Geosciences. feb. 2018, letn. 8, št. 2, str. 1-15, ilustr. ISSN 2076-3263. http://www.mdpi.com/2076-3263/8/2/69, DOI: 10.3390/geosciences8020069.

RUSJAN, Simon, KOBOLD, Mira, MIKOŠ, Matjaž. Characteristics of the extreme rainfall event and consequent flash floods in W Slovenia in September 2007. Natural hazards and earth system sciences. 2009, letn. 9, pos. št., str. 947-956, ilustr. ISSN 1561-8633. http://www.nat-hazards-earth-syst-sci.net/9/947/2009/nhess-9-947-2009.pdf.

FOŠKI, Mojca, ZAVODNIK LAMOVŠEK, Alma. Monitoring land-use change using selected indices. Acta geographica Slovenica, ISSN 1581-6613. [Tiskana izd.], 2019, 59, št. 2, str. 161-175, fotogr., zvd., tabele. https://ojs.zrc-sazu.si/ags/article/view/5276, https://repozitorij.uni-lj.si/IzpisGradiva.php?id=114117&lang=slv, doi: 10.3986/AGS.5276.

KONJAR, Miha, ZAVODNIK LAMOVŠEK, Alma, GRIGILLO, Dejan. Use of unsupervised classification for the determination of prevailing land use topology = Uporaba nenadzorovane klasifikacije za določanje tipologije pretežne rabe prostora. Geodetski vestnik : glasilo Zveze geodetov Slovenije, ISSN 0351-0271. [Tiskana izd.], 2017, letn. 61, št. 4, str. 541-581, ilustr. http://www.geodetski-vestnik.com/61/4/gv61-4_konjar.pdf, doi: 10.15292//geodetski-vestnik.2017.04.541-581.

ARTMANN, Martina, CHEN, Xianwen, IOJĂ, Cristian, HOF, Angela, ONOSE, Diana, PONIŻY, Lidia, ZAVODNIK LAMOVŠEK, Alma, BREUSTE, Jürgen. The role of urban green spaces in care facilities for elderly people across European cities. Urban Forestry and Urban Greening, ISSN 1618-8667, 2017, vol. 27, str. 203-213, ilustr., doi: 10.1016/j.ufug.2017.08.007.

UČNI NAČRT PREDMETA/COURSE SYLLABUS

Predmet:	
	SOCIOLOŠKO EKONOMSKA OCENA OGROŽENOSTI PRED POPLAVAMI
Course title:	
	SOCIO-ECONOMICAL ASSESSMENT OF FLOOD PROTECTION

Študijski programi in stopnja	Študijska smer	Letnik	Semestri
Vodarstvo in okoljsko inženirstvo, druga stopnja, magistrski	Poplave in upravljanje z vodami (modul)	2. letnik	1. semester

Univerzitetna koda predmeta/University course code: 0035018

Koda učne enote na članici/UL Member course code: 1547

Predavanja	Seminar	Vaje	Klinične vaje	Druge oblike študija	Samostojno delo	ECTS
37	38	0	0	0	75	5

Nosilec predmeta/Lecturer: Aleksander Kešeljević, Drago Kos, Matjaž Mikoš

Vrsta predmeta/Course type: Obvezni strokovni /Obligatory professional

Jeziki/Languages:	Predavanja/Lectures:	Angleščina
	Vaje/Tutorial:	Angleščina

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:

Prerequisites:

Vsebina:

Predavanja
Uvod v socialne in ekonomske poglede vodne politike in varovanje pred poplavami. Osnovna načela politike do voda. Socialni in ekonomski pogledi. Procesi odločanja. Različni kulturni in politični pogledi pri procesih odločanja (od zgoraj navzdol in od spodaj navzgor). Zgodovinski pregled.

Razumevanje socialnih problemov ocenjevanja ogroženosti pred poplavami. Komunikacija in

Content (Syllabus outline):

Lectures
Introduction to socioeconomics aspect of water policy and flood protection. Basic principles of water policy. Social and economic views. Decision-making processes. Various cultural and political perspectives in decision-making processes (top-down and bottom-up). Historical overview. Understanding of social problems caused by flood danger and flood protection. Communication and public participation

sodelovanje javnosti pri politiki do voda (Aarhuška konvencija). Sociološki vidiki razumevanja ogroženosti zaradi poplav. Legitimizacija in posredovanje informacij v sili. Javno mnenje nasproti strokovnemu znanju. Javna percepcija poplav in občutljivost informacij o nesrečah. Sposobnosti deležnikov pri komunikaciji zaradi opozorila pred poplavami. Ekonomika ogroženosti pred poplavami. Analiza stroškov in koristi ukrepov za varstvo pred poplavami in podpora odločanju. Ekonomske metode za ocenjevanje škode. Gospodarske spodbude za preprečevanje poplav in regulativa. Obvladovanje tveganj.

Seminar
Študentje delajo skupaj na načrtih regije ali mesta z upoštevanjem razvoja in varovanja pred poplavami. Analizirajo posamezne praktične primere.

of stakeholders in water management policies. Legitimization and information dissemination in emergency situations. Public perception of floods and sensibility of information on flood accidents. Problems caused by divergences of public and expert opinions. Competences of stakeholders in communication on floods emergencies. Economics threat from flooding. Cost-benefit analysis of measures for flood protection and support to decision-making. Economic methods to assess the damage. Economic incentives for flood prevention and regulation. Risk management.

Seminar
Students work together on regional plans or city plans with respect to development and flood protection. Analysis of specific practical examples.

Temeljna literatura in viri/Readings:

Colley B.C. 2005. Practical manual of land development, Mc Graw Hill.

De Chiara. 1984. Time saver standards for regional development, McGraw-Hill.

Fukuoka S. 1999. Floodplain riska management, Balkema AA, 1998EU commission: European spatial development and floods directives CESDP, POTSDAM FLOODS Directive 1999.

Stiftel B., Watson C. 2005. Dialogues in urban and regional planning. Routledge Espon Atlas selection topics.

Wegener M. Button K., Nijkamp P. 2007. Planning history and methodology, EE Pugusnik, UK selected topics.

The World Bank. 1991. Environmental assessment source book, Washington, Chapters 1-3.

EU flood research reports, AWARE, URBEM.

Dostopno na: http://councilforeuropeanstudies.org/

Učno gradivo v spletni učilnici UL FGG.

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

Cilji

- Pridobljeno poglobljeno teoretično znanje o socioloških, ekonomskih in psiholoških problemih pri poplavah.

- Razumevanje socialnih in ekonomskih problemov in kako jih reševati.

Kompetence

- Sposobnost upoštevanja socioloških in ekonomskih osnov pri varovanju pred poplavami.

Objectives

- Obtained in-depth theoretical knowledge of sociological, economic and psychological problems of floods.

- Understanding the social and economic problems and how to solve them.

Competences

- Ability to take into account sociological and economic aspects of protection against floods.

Predvideni študijski rezultati:	Intended learning outcomes:
- osnovnih terminov sociologije, ekonomije in psihologije, - socioloških in ekonomskih osnov, - razumevanje ekonomskih, socioloških in psiholoških analiz, - kritično presojanje socioloških, ekonomskih in psiholoških problemov pri poplavah.	- Basic terms of sociology, economics and psychology; - Sociological and economic bases; - Understanding of the economic, sociological and psychological analysis; - Critical assessment of sociological, economic and psychological problems of floods.

Metode poučevanja in učenja:	Learning and teaching methods:
Predavanja in uporaba pridobljenih znanj pri izdelavi individualne seminarske naloge.	Lectures and application of the acquired knowledge in the writing of individual seminars.

Načini ocenjevanja:	Delež/Weight	Assessment:
Seminarska naloga	50,00 %	Coursework
Pisni in/ali ustni izpit	50,00 %	Written and / or oral examination

Reference nosilca/Lecturer's references:

Mikoš, M. (2015). Od varstva pred naravnimi tveganji do kulture sobivanja z njimi. V: Zbornik referatov, 26. Mišičev vodarski dan 2015, Maribor, 09. 12.2015, 7-13.

Mikoš, M. (2014). O izrazih nezgoda, naravna nesreča, naravna katastrofa in naravna kataklizma = On Terms such as Accident, Natural Disaster, Natural Catastrophe and Natural Cataclysm. Ujma 28, 306-310. Bezak, N., Mikoš, M. (2014). Estimation of design floods using univariate and multivariate flood frequency approach with regard to one wet year = Ocena projektnih pretokov z uporabo univariatnih ter multivariatnih metod s poudarkom na vplivu nadpovprečno mokrega leta. Acta hydrotechnica 27(47), 103-117.

Mikoš, M. (2013). Upravljanje gorskih nevarnosti in tveganj v zavarovanih območjih: primer Triglavskega narodnega parka, Slovenija = Alpine hazard and risk management in protected areas: the case of the Triglav National Park, Slovenia. Geodetski vestnik 57(1), 112-124.

Kešeljević, A. (2007). Social capital as factor of evolutionary changes within the economic theory of organization. Ekon. čas., 55, 1, 79-93

Kešeljević, A. (2007). Understanding social capital within the framework of economic theory of organization: a theoretical approach. Management (Split), May, vol. 12/1, 1-24. Kešeljević, A. (2008). Going beyond the derogative attitude towards knowledge within particular scientific communities. E+M, Ekon. Manag., vol. 11, 3, 73-84

Kos, D. (2005). Participativna prenova mest = Participatory urban renewal. Urbani izziv, 2005, let. 16, št. 2, 16-23, 141-146. Kos, D. (2006). Urbanistični diskurzi med strokovnostjo in strokovnjaštvom. Urbani izziv, 2006, letn. 17, št. 1/2, 85-92.

Kos, D. (2004). Javno mnenje o okolju. V: Malnar, B. (ur.), BERNIK, Ivan (ur.). S Slovenkami in Slovenci na štiri oči: ob 70-letnici prof. Nika Toša, (Dokumenti SJM, 11). Ljubljana: Fakulteta za družbene vede, IDV, CJMMK, 307-320.

Malešič, M., Bašić-Hrvatin, S., Polič, M. (2006). Komuniciranje v krizi, (Knjižna zbirka Varnostne študije). Ljubljana: Fakulteta za družbene vede, 208 str.

Polič, M., Repovš, G., Natek, K., Klemenčič, M. M., Kos, D., Ule, M., Marušič, J., Kučan, A. (2005). A cognitive map of Slovenia: perceptions of the regions. Int. j. psychol., vol. 40, no. 1, 27-35.

Polič, M., Marušič, J., Kos, D., Natek, K. (2005). People-environment studies in Slovenia: past and prospects. V: Martens, B. (ur.), Keul, A. G. (ur.). Designing social innovation: planning, building, evaluating. Toronto: Hogrefe, 17-26.

UČNI NAČRT PREDMETA/COURSE SYLLABUS

Predmet:	
	UREJANJE HUDOURNIKOV IN POVIRIJ
Course title:	
	TORRENT, EROSION, ROCKFALL AND AVALANCHE CONTROL

Študijski programi in stopnja	Študijska smer	Letnik	Semestri
Vodarstvo in okoljsko inženirstvo, druga stopnja, magistrski	Poplave in upravljanje z vodami (modul)	2. letnik	1. semester
Vodarstvo in okoljsko inženirstvo, druga stopnja, magistrski	Okoljsko inženirstvo (modul)	2. letnik	1. semester

Univerzitetna koda predmeta/University course code:	0037817
Koda učne enote na članici/UL Member course code:	1340

Predavanja	Seminar	Vaje	Klinične vaje	Druge oblike študija	Samostojno delo	ECTS
35	0	15	0	10	60	4

Nosilec predmeta/Lecturer:	Matjaž Mikoš

Vrsta predmeta/Course type:	Obvezni strokovni /Obligatory professional

Jeziki/Languages:	Predavanja/Lectures:	Slovenščina
	Vaje/Tutorial:	Slovenščina

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:	Prerequisites:
Opravljeni izpiti iz predmetov Urejanje vodotokov, Hidravlično modeliranje in Hidrološko modeliranje ali pridobljena primerljiva znanja.	Passed exams in River engineering, Hydraulic modeling and Hydrologic modeling or acquired comparable knowledge.

Vsebina:	Content (Syllabus outline):
Predavanja Uvod v urejanje hudournikov: zgodovinski pregled, problematika in koncept urejanja, zakonodaja in načrtovanje, standardizacija. Osnove urejanja hudournikov in povirij: hidrologija povirij, erozija tal, hudourniška hidravlika, nastanek in dinamika masnih	Lectures Introduction to torrent control: historical overview, problems and control concepts, legislation and planning, standardisation. Basics of torrent, erosion, rockfall and avalanche control: headwaters hydrology, soil erosion, torrent hydraulics, initiation

tokov (drobirski in blatni tokovi, padajoče kamenje in skalni podori), mehanika in dinamika snežne odeje in snežnih plazov, prodna bilanca. Urejanje hudournikov in povirij: varstvo pred površinsko erozijo (protierozijske vegetativne zaščite), varstvo pred hudourniško erozijo (objekti v hudourniških strugah), varstvo pred delovanjem snežnih plazov (protilavinske zgradbe). Seminarske vaje Računske vaje iz hudourniške hidravlike in erozije tal ter dimenzioniranja izbranih vrst hudourniških objektov. Uporaba matematičnega modela za račun prodne bilance. Terensko delo Zasnova in izvedba tehničnih ureditev v hudourniških območjih in hudournikih.	and dynamics of mass movements (debris flows and mudflows, stone falls and rockfalls, mechanics and dynamics of snow cover and avalanches, sediment balance. Torrent, erosion, rockfall, and avalanche control: soil erosion control (soil bioengineering), torrent control (torrent control works), avalanche control (avalanche protection works). Tutorials Computational tutorials in torrent hydraulics and soil erosion, as well as in design of selected types of torrent control works. Using mathematical model for the computation of sediment balance. Field work Preliminary design and execution of technical torrent control works in headwaters.

Temeljna literatura in viri/Readings:

Mikoš M. 2008. Inženirska hidrotehnika – zbirka rešenih primerov, verzija 2008, UL FGG, Katedra za splošno hidrotehniko, 200 p. Mikoš M. 2009. Osnove hudourništva – varstvo pred hudourniki in zemeljskimi plazovi, UL FGG, Katedra za splošno hidrotehniko, 217 p. Spletne strani resornega ministrstva (MKO) s področja vodne infrastrukture (vodnih objektov). Dostopno na: http://www.hec.usace.army.mil/software/hec-ras/. Atlasa okolja in gospodarske javne infrastrukture (GJI) v Sloveniji. Dostopno na: http://gis.arso.gov.si/atlasokolja/.

Cilji in kompetence:	**Objectives and competences:**
Cilji - Nadgraditi znanje iz urejanja vodotokov z znanji o urejanju hudournikov in povirij (hudourniških območij). - Podati teoretične osnove za načrtovanje in dimenzioniranje hudourniških objektov. Kompetence - Sposobnost izdelave celovitih ureditvenih načrtov urejanja voda na nivoju povodij. - Sposobnost dimenzioniranja in projektiranja določenih vrst hudourniških objektov.	Objectives - Upgrade of knowledge of river engineering with knowledge of torrent, erosion, rockfall, and avalanche control (in torrential watersheds). - Giving theoretical basics for planning and design of torrent control works. Competencies - Ability to prepare integrated river basin management plans. - Ability to design and plan selected types of torrent control works.

Predvideni študijski rezultati:	**Intended learning outcomes:**

- Poglobljeno znanje iz hudourniške hidravlike in mehanike/dinamike.	- Acquired in-depth knowledge of torrent hydraulics and mechanics/dynamics.
- Razumevanje procesov erozije tal v prostoru.	- Understanding spatial soil erosion processes.
- Osvojene računske spretnosti za načrtovanje ureditvenih ukrepov na hudournikih in v povirjih.	- Learned numerical skills for planning control works in torrents and in torrential headwaters.
- Doseženo znanje uporabljajo pri izdelavi magistrske naloge oz. v inženirski praksi.	- Achieved knowledge applied when writing a master thesis or in engineering practice.
- Sposobnost abstraktne formulacije naravnih procesov.	- Ability of abstract formulation of natural processes.
- Sposobnost kritične presoje vhodnih podatkov in dobljenih računskih rezultatov pri načrtovanju ukrepov.	- Ability for critical analysis of input data and calculation results when planning interventions.
- Sposobnost upoštevanja dinamike naravnih procesov pri načrtovanju človekove dejavnosti v prostoru.	- Ability to take into account natural process dynamics in spatial planning of human activities.

Metode poučevanja in učenja: **Learning and teaching methods:**

Predavanja, seminarske vaje, terensko delo.	Lectures, seminar tutorials, field work.

Načini ocenjevanja: | **Delež/Weight** | **Assessment:**

Način	Delež/Weight	Assessment
Pisni in/ali ustni izpit	50,00 %	Written and/or oral examination
Seminarske vaje	40,00 %	Seminar tutorials
Terensko delo	10,00 %	Field work report

Reference nosilca/Lecturer's references:

Fidej, G., Mikoš, M., Rugani, T., Jež, J., Kumelj, Š., Diaci, J. (2015). Assessment of the protective function of forests against debris flows in a gorge of the Slovenian Alps. IForest 8, 73-81.

Sodnik, J., Kogovšek, B., Mikoš, M. (2015). Vlaganja v vodno infrastrukturo v Sloveniji in Avstriji = Investments into water infrastructure in Slovenia and in Austria. Gradbeni vestnik 64(1), 3-12.

Sodnik, J., Martinčič, M., Kryžanowski, A., Mikoš, M. (2015). Are Torrent Check-Dams Potential Debris-Flow Sources? V: Lollino, G. (ur.), et al. *Engineering geology for society and territory. Vol. 2, Landslide processes*. Springer International Publishing Switzerland, 485-488.

Sodnik, J., Mikoš, M. (2013). Vodarstvo in vzdrževanje vodne infrastrukture v Sloveniji. Gradbeni vestnik 62(8), 166-173.

Mikoš, M. (2012). Prispevek k zgodovinskemu pregledu razvoja hudourništva in hudourničarstva v Sloveniji. Gozdarski vestnik 70(10), 429-439.

Sodnik, J., Mikoš, M. (2010). Modeling of a debris flow from the Hrenovec torrential watershed above the village of Kropa = Modeliranje drobirskega toka v hudourniškem območju Hrenovecnad Kropo. Acta geographica Slovenica 50(1), 59-84.

UČNI NAČRT PREDMETA/COURSE SYLLABUS

Predmet:	
	NUMERIČNE METODE V DINAMIKI TEKOČIN
Course title:	
	NUMERICAL METHODS IN FLUID DYNAMICS

Študijski programi in stopnja	Študijska smer	Letnik	Semestri
Vodarstvo in okoljsko inženirstvo, druga stopnja, magistrski	Poplave in upravljanje z vodami (modul)	2. letnik	1. semester

Univerzitetna koda predmeta/University course code:	0037818
Koda učne enote na članici/UL Member course code:	1602

Predavanja	Seminar	Vaje	Klinične vaje	Druge oblike študija	Samostojno delo	ECTS
45	15	0	30	0	90	6

Nosilec predmeta/Lecturer:	Matjaž Četina

Vrsta predmeta/Course type:	Obvezni strokovni/Obligatory professional

Jeziki/Languages:	Predavanja/Lectures:	Slovenščina
	Vaje/Tutorial:	Slovenščina

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti: | **Prerequisites:**

Vsebina: | **Content (Syllabus outline):**

Predavanja

Osnovne enačbe dinamike tekočin: kontinuitetna, dinamična, enačba stanja, energijska, konvekcijsko difuzijska za transport snovi, izvorni členi za biogeokemične procese. Princip reševanja hidrodinamičnih problemov, začetni in robni pogoji. Nestalni tok s prosto gladino: vrste valov, St.Venantove enačbe, numerične metode reševanja, začetni in robni pogoji. Dvodimenzijski problemi, primeri gibanja nenewtonskih tekočin (drobirski

Lectures

Basic equations of fluid dynamics: continuity, dynamic, eq. of state, energy eq., advection-diffusion transport eq., source terms for biogeochemical processes. Basic principles of solving hydrodynamic problems, initial and boundary conditions. Unsteady free surface flows: waves in fluids, St.Venant equations, numerical methods, initial and boundary conditions. Two- dimensional problems, movement of non-Newtonian fluids

tokovi, snežni plazovi). Račun vodnega udara v ceveh pod tlakom. Račun masnih nihanj v vodostanih. Opis tridimenzijskih numeričnih modelov za račun tokov in širjenja onesnaženja v površinskih vodah: Reynoldsove enačbe, modeli turbulence, numerične metode reševanja.

Laboratorijske vaje:

Meritve vodnega skoka v šolskem žlebu ter masnih nihanj na fizičnem modelu vodostana. Uporaba 1D in 2D računalniških programov za račun poplavnih valov ter vodnega udara – samostojno in skupinsko delo v računalniški učilnici. Uporaba 2D in 3D računalniških programov za simulacijo tokov in širjenja onesnaženja v rekah, jezerih in morju.

(debris flows, snow avalanches). Water hammer analysis in pipeline systems under pressure. Computation of mass oscillations in surge tanks. Description of three-dimensional numerical models for the computation of flows and pollutant spreading in surface waters: Reynolds equations, turbulence models, numerical methods.

Laboratory tutorials:

Measurements of hydraulic jump and mass oscillations in surge tank in hydraulic laboratory.

The use of 1D and 2D computer codes to compute flood waves in open channels and water hammer in pipes (individual and group work on computers).

The use of 3D computer codes for computation of flows and transport of pollutants in rivers, lakes and coastal seas.

Temeljna literatura in viri/Readings:

Peyret, R. 1996. Handbook of Computational Fluid Mechanics. Academic Press.

Pozrikidis, C. 1997. Introduction to Theoretical and Computational Fluid Dynamics. Oxford University Press.

Jørgensen, S.E., Bendoricchio, G. 2001. Fundamentals of Ecological Modelling, 3rd ed., Amsterdam, Elsevier.

Cilji in kompetence:

Objectives and competences:

Cilji

- Nadgraditi znanje dinamike tekočin s teoretičnimi osnovami nestalnega toka in gibanja nenewtonskih tekočin ter načini numeričnega reševanja osnovnih enačb.

- Podati načine uporabe matematičnih modelov oz. računalniških programov za račun poplavnih valov, drobirskih tokov in snežnih plazov kot osnove za dimenzioniranje hidrotehničnih objektov.

- Spoznati, kako povezati pridobljena znanja s področja dinamike tekočin in okoljskega inženirstva v kompleksne ekološke modele.

 Kompetence

- Sposobnost pravilne definicije gonilnih sil, njim primerne izbire ustreznih osnovnih enačb in pravilne uporabe računalniških programov za določanje merodajnih količin pri nestalnih tokovih.

- Obvladovanje procesov umerjanja, validacije in kritične ocene rezultatov matematičnih modelov tokov in širjenja onesnaženja.

Objectives

- To deepen the knowledge of fluid dynamics with basic principles of unsteady flows and non-Newtonian fluids, including numerical solutions of basic equations.

- To show the use of mathematical models and computer codes for the computation of flood waves, debris flows and snow avalanches as a basis to design hydraulic structures.

- To find out how to join knowledge from fluid dynamics and environmental engineering in complex ecological models.

 Acquired competence

- Ability to determine basic equations according to forcing factors and to use appropriate computer codes for unsteady flow computations.

- To control the processes of calibration, validation and critical assessment of the results of mathematical models of flows and pollutant spreading.

- Sposobnost posploševanja in razumevanja sorodnih pojavov nestalnega toka s prosto gladino in v ceveh pod tlakom.	- Ability to generalize and to understand the analogy between unsteady free surface flows and pipe flows under pressure.
- Sposobnost izdelave kvantitativnih inženirskih ocen sprememb kakovosti v površinskih vodah vsled posegov v naravne procese.	- Ability to produce quantitative engineering assessments of water quality changes in surface waters.

Predvideni študijski rezultati: **Intended learning outcomes:**

- Poznavanje lastnosti nestalnega toka v odprtih koritih (valovi) in ceveh pod tlakom (vodni udar).	- To be acquainted with unsteady flow in open channels (waves) and water hammer in pipes
- Razumevanje procesov kakovostnih sprememb v vodnih telesih in sposobnost njihovih kvantitativnih napovedi z numeričnimi modeli.	- To understand the processes of water quality changes in water bodies with the ability to use numerical models for quantitative predictions.
- Doseženo znanje uporabljajo pri izdelavi najzahtevnejših hidravličnih izračunov pri urejanju vodotokov ter pri izdelavi ocen vplivov človekovih posegov v vodno okolje.	- The knowledge can be used in complex hydraulic computations of river training and in assessments of water quality changes due to human impact on water bodies.
- Študentje morajo dobro razumeti fizikalne osnove prehodnih pojavov v hidravličnih sistemih in iskati analogijo med pojavi v odprtih koritih in ceveh pod tlakom.	- The knowledge can be used in complex hydraulic computations of river training and in assessments of water quality changes due to human impact on water bodies.
- Interdisciplinarno znanje omogoča pravilno povezovanje modulov (hidrodinamični, biogeokemični) v kompleksne ekološke modele.	- Interdisciplinary knowledge enables correct integration of modules (hydrodynamic, biogeochemical) into complex ecological models.
- Sposobnost sestave lastnih računalniških programov na osnovi ustrezno izbranih enačb.	- Ability to choose appropriate basic equations and to produce own computer codes.
- Sposobnost uporabe in kritične presoje tujih računalniških programov za hidravlične in okoljske izračune.	- Ability of application and critical assessment of licensed computer codes for hydraulic and environmental computations.

Metode poučevanja in učenja: **Learning and teaching methods:**

Predavanja in laboratorijske vaje.	Lectures and laboratory tutorials.

Načini ocenjevanja: **Delež/Weight**   **Assessment:**

Načini ocenjevanja	Delež/Weight	Assessment
Domače naloge (pisno, oddaja več vaj)	50,00 %	Homework (written, several exercises)
Pisni izpit (izpit iz teorije)	50,00 %	Written exam (theory)

Reference nosilca/Lecturer's references:

DŽEBO, Elvira, ŽAGAR, Dušan, ČETINA, Matjaž, PETKOVŠEK, Gregor. Reducing the computational time of the SPH method with a coupled 2-D/3-D approach. Stroj. vestn., Oct. 2013, vol. 59, no. 10, str. 575-584.

KRZYK, Mario, KLASINC, Roman, ČETINA, Matjaž. Two-dimensional mathematical modelling of a dam-break wave in a narrow steep stream. Stroj. vestn., apr. 2012, vol. 58, no. 4, str. 255-262.

PETKOVŠEK, Gregor, DŽEBO, Elvira, ČETINA, Matjaž, ŽAGAR, Dušan. Application of Non-Discrete Boundaries with Friction to Smoothed Particle Hydrodynamics. Stroj. vestn., 2010, letn. 56, št. 5, str. 307-315.

UČNI NAČRT PREDMETA/COURSE SYLLABUS

Predmet:	
	OKOLJSKE TEHNOLOGIJE
Course title:	
	ENVIRONMENTAL TECHNOLOGIES

Študijski programi in stopnja	Študijska smer	Letnik	Semestri
Vodarstvo in okoljsko inženirstvo, druga stopnja, magistrski	Poplave in upravljanje z vodami (modul)	2. letnik	1. semester

Univerzitetna koda predmeta/University course code:	0037819
Koda učne enote na članici/UL Member course code:	1601

Predavanja	Seminar	Vaje	Klinične vaje	Druge oblike študija	Samostojno delo	ECTS
15	15	0	30	0	60	4

Nosilec predmeta/Lecturer: Mario Krzyk, Nataša Atanasova, Darja Istenič

Vrsta predmeta/Course type: Obvezni strokovni/Obligatory professional

Jeziki/Languages:

Predavanja/Lectures:	Slovenščina
Vaje/Tutorial:	Slovenščina

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:

Prerequisites:

Opravljeni izpiti iz predmetov Uvod v okoljsko inženirstvo, Osnove zdravstvene hidrotehnike na 1. stopnji študijskega programa BA VOI oz. osvojena ustrezna primerljiva znanja.Opravljen izpit iz predmetov Uvod v okoljsko inženirstvo, Osnove zaščite voda, Hidromehanika in Hidravlika I oz. osvojena ustrezna primerljiva znanja.

Passed exams in Introduction to Environmental Engineering, Basics in Water Protectionof Sanitary Engineering, of the study programme BA VOI or equivalentHydromechanics and Hydraulics I or equivalent.

Vsebina:

Content (Syllabus outline):

Predavanja:

V okviru tega predmeta so prikazane najnovejše okoljske tehnologije in celostne rešitve okoljskih problemov vezanih na vodne vire in vodno okolje

Lectures:

The lectures will present the latest environmental technologies and integrated solutions for

1. Opredelitev okoljskih tehnologij za reševanje problemov povezanih z vodnimi viri in vodnim okoljem.	environmental problems related to water sources and the aquatic environment
2. Voda in drugi naravni viri, koncepti ravnanja z naravnimi viri in analiza masnih tokov.	1. Environmental technologies framework for addressing water resources and the aquatic environment.
3. Tehnologije obdelave različnih odpadnih voda in blata iz ČN.	2. Management concepts for water and related natural resources, mass flow analysis.
4. Ekoremediacije in sonaravne tehnologije za obdelavo odpadne vode.	3. Wastewater treatment and management
5. Ponovna uporaba vode.	4. Ecoremediation and nature based solutions for wastewater treatment
6. Ukrepi za obvladovanje padavinskih voda (sonaravni) v mestih	5. Water Reuse.
7. Krožno ravnanje z vodo v mestih in naseljih.	6. Sustainable urban drainage and stormwater management (with nature based solutions)
	7. Circular water management in cities
Seminar:	Seminary work:
Študenti dobijo opis okoljskega problema za katerega je potrebno načrtovati koncept rešitve in dimenzionirati tehnologije.	An environmental problem is presented to the students, for which they need to conceptualize a solution and design technologies.

Temeljna literatura in viri/Readings:

Masi F, Langergraber G, Santoni M, Istenič D, Atanasova N, Buttiglieri G. Chapter Four - Possibilities of nature-based and hybrid decentralized solutions for reclaimed water reuse. In: Verlicchi Environmental Management and Protection PBT-A in CP, editor. Wastewater treatment and Reuse – Present and future perspectives in technological developments and management issues [Internet]. Elsevier; 2020. p. 145–87. Available from: http://www.sciencedirect.com/science/article/pii/S2468928920300046

Richard O. Mines, Laura W. Lackey (2009). Introduction to Environmental Engineering. Pearson. ISBN 0132347474

Cross K, Tondera K, Rizzo A, Andrews L, Pucher B, Istenič D, et al., editors. Nature-Based Solutions for Wastewater Treatment: A Series of Factsheets and Case Studies [Internet]. IWA Publishing; 2021. Available from: https://doi.org/10.2166/9781789062267

Larsen, T. A., Kai M. Udert and Judit Lienert, Editors. Source Separation and Decentralization for Wastewater Management, 2013, IWA Publising.

Ramaswami, A., Milford, J.B., Small, M.J., 2005. Integrated environmental modelling : pollutant transport, fate and risk in the environment.

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

Cilj	Goals
Cilj predmeta je študentom dati dodatna znanja in spretnosti pri reševanju najbolj kompleksnih okoljskih problemov.	Introduce students to additional knowledge and skills for solving complex environmental problems. Competences

Kompetence	Students will learn how to tackle complex environmental problem by decomposing it into smaller manageable components, finding suitable solutions for those components and also integrating those solutions into one for the entire problem. Student should be able to select an optimal solution in a wider context.
Študent se nauči kompleksen okoljski problem pravilno analizirati in razgraditi na posamezne obvladljive komponente, nato te podprobleme ustrezno reši in sestavi celovito rešitev. Rešitev variantira in poskuša optimizirati v širšem kontekstu.	

Predvideni študijski rezultati: **Intended learning outcomes:**

- Razumevanje kompleksnih okoljskih problemov in sposobnost analitskega ter sinteznega pristopa. - Izvajanje projektov sanacij okoljskih problemov.	- Understanding complex environmental problems and ability to apply analytical and integrative approaches. - Implementation of projects for solving environmental problems.

Metode poučevanja in učenja: **Learning and teaching methods:**

Predavanja in uporaba pridobljenih znanj pri individualnih seminarskih nalogah, laboratorijske vaje vajah.	Lectures and use of knowledge in elaborating individual seminary work, laboratory work.

Načini ocenjevanja: **Delež/Weight** **Assessment:**

Vaje	40,00 %	Coursework
Pisni in/ali ustni izpit	60,00 %	Written and/or oral exam

Reference nosilca/Lecturer's references:

ATANASOVA, Nataša, ISTENIČ, Darja, LANGERGRABER, Günter, et al. Nature-based solutions and circularity in cities. Circular economy and sustainability. 17 March 2021, str. 1-14, ilustr. ISSN 2730-5988. https://link.springer.com/article/10.1007/s43615-021-00024-1, DOI: 10.1007/s43615-021-00024-1. [COBISS.SI-ID 57776131]

RADINJA, Matej, ŠKERJANEC, Mateja, ŠRAJ, Mojca, DŽEROSKI, Sašo, TODOROVSKI, Ljupčo, ATANASOVA, Nataša. Automated modelling of urban runoff based on domain knowledge and equation discovery. Journal of Hydrology. [Print ed.]. dec. 2021, letn. 603 (part c), [12] str., ilustr. ISSN 0022-1694. https://doi.org/10.1016/j.jhydrol.2021.127077, [COBISS.SI-ID 83909123]

ATANASOVA, Nataša, DALMAU, Montserrat, COMAS, Joaquim, POCH ESPALLARGAS, Manel, RODRIGUEZ-RODA, Ignasi, BUTTIGLIERI, Gianluiggi. Optimized MBR for greywater reuse systems in hotel facilities. Journal of environmental management, ISSN 0301-4797, 2017, letn. 193, št. maj, str. 503-511, ilustr., doi: 10.1016/j.jenvman.2017.02.041. [COBISS.SI-ID 8125793]

ISTENIČ, Darja, BOŽIČ, Gregor. Short-rotation willows as a wastewater treatment plant: biomass production and the fate of macronutrients and metals. Forests. [Online ed.]. 2021, vol. 12, iss. 5, 1-21 str. ISSN 1999-4907. https://www.mdpi.com/1999-4907/12/5/554, DOI: 10.3390/f12050554. [COBISS.SI-ID 62017795]

Istenič, D., Bodik, I., Bulc, T. (2015). Status of decentralised wastewater treatment systems and barriers for implementation of nature-based systems in central and eastern Europe. Environ Sci Pollut R, 22(17), 12879-12884.

KRZYK, Mario, DREV, Darko, KOLBL, Sabina, PANJAN, Jože. Self-purification processes of Lake Cerknica as a combination of wetland and SBR reactor. Environmental science and pollution research international, ISSN 0944-1344., 2015, str. 1-9, ilustr., doi: 10.1007/s11356-015-5088-0. [COBISS.SI-ID 7133793].