UČNI NAČRT PREDMETA/COURSE SYLLABUS

Predmet:	Znanstveno raziskovanje grajenega okolja
Course title:	Scientific Research of Built Environment

Študijski programi in stopnja	Študijska smer	Letnik	Semestri
Grajeno okolje, tretja stopnja, doktorski	Vse smeri	1. letnik	Celoletni

Univerzitetna koda predmeta/University course code: 1063

Predavanja	Seminar	Vaje	Klinične vaje	Druge oblike študija	Samostojno delo	ECTS
50	0	8	17	0	50	5

Nosilec predmeta/Lecturer:	Matjaž Mikoš
Izvajalci predavanj:	Matjaž Mikoš
Izvajalci seminarjev:	
Izvajalci vaj:	Matjaž Mikoš
Izvajalci kliničnih vaj:	Cvetka Teja Koler-Povh
Izvajalci drugih oblik:	
Izvajalci praktičnega usposabljanja:	
Vrsta predmeta/Course type:	Obvezni predmet/Obligatory course

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

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:	Prerequisites:
Vpis v 1. letnik doktorskega študija.	Enrolment into the 1st year of doctoral studies.

Vsebina:	Content (Syllabus outline):
- Znanost in stroka; vrste raziskovanja (temeljno, uporabno, ciljno, razvojno); etika raziskovanja in osnovne metode raziskovalnega dela (hipoteza, terensko in laboratorijsko eksperimentalno delo, ponovljivost, standardi, natančnost, računalniško modeliranje). - Zbiranje in priprava podatkov; prikazovanje rezultatov; pisanje znanstvenih objav (izvirni in pregledni članek, IMRAD, poster, povzetek, monografija, recenzija, peer review, disertacija, primeri slabe in dobre prakse, avtorske pravice, citiranje virov, navodila za oblikovanje prispevkov na FGG) za periodiko in strokovna posvetovanja; zakoni	- Science and profession; ways of research (basic, applied, targeted, developmental); research ethics and basic research methods (hypothesis, field and laboratory experimental work, repeatability, standards, precision, computer modelling). - Data collection and handling; displaying of results; writing research publications (original and review paper, IMRAD, poster, abstract, monograph, review, peer review, dissertation, examples of good and bad practice, author rights, citing literature, guidelines for forming theses and works on FGG) for periodicals and professional conferences; laws and standards in the field of documentation in the Republic of Slovenia.

in standardi na področju dokumentalistike v Republiki Sloveniji. - Znanstvena odličnost, evalvacije ZR dela doma in v tujini, svetovne lestvice univerz (Shanghai, Times), citiranje in samocitiranje (Thomson Reuters, SCOPUS, SCIRUS, Google Scholar), h-index. - Raziskovalno delo v Republiki Sloveniji: organiziranost in viri financiranja (SAZU, IAS, SATENA, MVSZT, ARRS, MR, SGTP). - Raziskovalno delo v Evropi (evropski raziskovalni prostor, bilateralni projekti, platforme: ECTP) oziroma svetu (bilateralno sodelovanje), Lizbonska strategija, vpliv RR na razvoj in industrijsko proizvodnjo; inovativnost in konkurenčnost. - Intelektualna lastnina: glavni pojmi, patenti, izboljšave, izumi, varovanje intelektualne lastnine, avtorske pravice, patentna prijava, razmere na UL (LUI Ljubljanski univerzitetni inkubator, IRI Inovacijsko-razvojni inštitut UL), tehnološki park. - Podatkovne baze s primerno strokovno literaturo s področja grajenega okolja: CTK & NUK, DIKUL kot vstopna točka, DOAJ, specializirane podatkovne zbirke za področje tehnike (SCI-Expanded, SCOPUS, Thomson Reuters, Science Direct, Springer Link, Wiley, COMPENDEX, ICONDA, ASCE) in druge baze podatkov kot so standardoteke in patentne baze (PATLIB center CTK); svetovni splet in Google Scholar, SCIRUS; ključne besede, iskanje po avtorju in citiranih virih.	- Scientific excellence, evaluation of SR in the Republic of Slovenia and abroad, world lists of class universities (Shanghai, Times), citation and self-citation (Thomson Reuters, SCOPUS, SCIRUS, Google Scholar), h-index. - Research work in the Republic of Slovenia: organisation and financing sources (SAZU, IAS, SATENA, MVSZT, ARRS, MR, SGTP). - Research work in Europe (European Research Area, bilateral projects, platforms: ECTP) resp. in the world (bilateral cooperation), Lisbon strategy, Research & Development impact on the development and industrial productivity; innovation and competitive position. - Intellectual property: main terms, patents, improvements, inventions, protection of intellectual property, author rights, patent application, conditions at UL (LUI Ljubljana University Incubator, IRI UL Institute for Innovation & Research, technological park. - Data bases with adequate professional literature in the field of built environment: CTK & NUK, DIKUL as the entrance point, DOAJ, specialised data bases in the field of technics (SCI-Expanded, SCOPUS, Thomson Reuters, Science Direct, Springer Link, Wiley, Compendex, ICONDA, ASCE) and other data bases such as of standards and patents (PATLIB center CTK); world wide web and Google Scholar, SCIRUS; key words; author's search and search after cited works.

Temeljna literatura in viri/Readings:

Knjižni viri (izbrane vsebine) / Printed sources (selected contents):

- Gauch Jr, H.G. (2007). Scientific Method in Practice, Cambridge University Press, 454 p.
- Hames, I. (2007). Peer review and manuscript management in scientific journals – Guidelines for good practice, Blackwell Publishing, 312 p.
- Huckin, T.N., Olsen, L.A. (1991). Technical writing and professional communication – for nonnative speakers of English, 2nd ed. McGraw-Hill, 746 p.
- Kirkman, J. (1992). Good style – writing for science and technology. E & FN Spon, 221 p.
- Patience, G.S., Boffito, D.C., Patience, P.A. (2015). Communication science papers, presentations, and posters effectively. Academic Press, 264 p.
- Silyn-Roberts, H. (). Writing for science and engineering, 2nd ed. Elsevier, 265 p.
- Smith, R.V., Densmore, L.D., Lener, E.F. (2016). Graduate research – A guide for Students in the Sciences, 4th ed. Academic Press, 287 p.
- Young, M. (2002). The technical writer's handbook – Writing with style and clarity. University Science Books, 232 p.

Elektronski viri / Electronic sources:

- odložena gradiva v spletni učilnici / uploaded sources in the web classroom
- spletne strani s podatkovnimi bazami, predvsem DIKUL, CTK in NUK, UL FGG / Web pages with data bases, especially DIKUL, CTK and NUK, UL FGG
- svetovni splet in specializirani brskalniki / World wide web and specialised browsers

Cilji in kompetence:	Objectives and competences:
Cilji: - seznanitev s temeljnimi načeli, osnovnimi metodami in tehnikami ter pogoji znanstveno raziskovalnega (ZR) dela. - seznanitev z različnimi rezultati ZR dela. - spoznati področje intelektualne lastnine ter kreativnega in inovativnega okolja za ZR delo. **Kompetence:** - zna uporabljati informacijske sisteme, baze podatkov, knjižnične sisteme in drugo informacijsko gradivo na spletu s področja grajenega okolja pri izdelavi disertacije. - zna pripraviti osnutek teme za doktorsko disertacijo.	**Objectives:** - Acquaintance with basic principles, basic methods and techniques as well as conditions for scientific research (SR). - Acquaintance with different results of SR. - Insight into the field of intellectual property and creative and innovative environment for scientific research. **Competences:** - When working on a doctoral thesis he/she knows to use information systems, data bases, librarian systems and other information material on web in the field of built environment. - Knows to prepare a draft for a doctoral thesis' theme.

Predvideni študijski rezultati:	Intended learning outcomes:
Znanje in razumevanje: - študent razume pogoje in zakonitosti ZR dela in zna zasnovati raziskavo na izbranem področju. - študent dojema ZR delo kot proces in specifičen način ustvarjalnega dela s posebnimi vrstami končnega izdelka. - študent razume zakonitosti ZR dela (etika, preglednost, jasnost, ponovljivost, citiranje, in avtorske pravice) in jih upošteva pri lastnem raziskovalnem delu na disertaciji.	**Knowledge and understanding:** - Student understands conditions and laws of SR and knows how to make a research in a selected field. - Student understands SR as a process and a specific way of creative work with special kinds of final product. - Student understands laws of SR (ethics, clearness, intelligibility, repeatability, citations, and author rights) and regards them at his own research work on the doctoral thesis.

Metode poučevanja in učenja:	Learning and teaching methods:
Predavanja, seminarske vaje (predstavitev osnutka teme doktorske disertacije), laboratorijske vaje s praktičnimi primeri podatkovnih baz v računalniški učilnici.	Lectures, seminar exercises (presenting the draft of the theme of the doctoral thesis), laboratory exercises with practical work on data bases in a computer classroom.

Načini ocenjevanja:	Delež/Weight	Assessment:
Laboratorijske vaje	40,00 %	Laboratory coursework
Osnutek teze disertacije	30,00 %	Draft of the doctoral thesis
Ustni izpit (teorija)	30,00 %	Oral exam (theory)

Reference nosilca/Lecturer's references:

1. Mikoš, M., 2018. The bibliometric impact of books published by the International Consortium on Landslides. *Landslides*, 15/8, 1459-1482, doi: 10.1007/s10346-018-1019-8 [COBISS.SI-ID 8450401]
2. Mikoš, M., 2017. Landslides: a top international journal in geological engineering and engineering geology?. *Landslides*, 14/5, 1843-1854, doi: 10.1007/s10346-017-0869-9 [COBISS.SI-ID 8120161]
3. Sassa, K., Tsuchiya, S., Fukuoka, H., Doan, L., Mikoš, M., 2015. Landslides: review of achievements in the second 5-year period (2009-2013). *Landslides*, 12/2, 213-123, doi: 10.1007/s10346-015-0567-4 [COBISS.SI-ID 6979937]
4. Cerovšek, T., Mikoš, M., 201 A comparative study of cross-domain research output and citations: research impact cubes and binary citation frequencies. *Journal of informetrics*, 8/1, 147-161, doi: 10.1016/j.joi.2013.1004 [COBISS.SI-ID 6424673]
5. Koler-Povh, T., Mikoš, M., Turk, G., 2014. Institutional repository as an important part of scholarly communication. *Library hi tech*, 32/3, 423-434, 10.1108/LHT-10-2013-0146 [COBISS.SI-ID 6694241]
6. Mikoš, M., 2011. Landslides: A state-of-the art on the current position in the landslide research community. *Landslides*, 8/4, 451-551, doi: 10.1007/s10346-011-0297-1 [COBISS.SI-ID 5532513]

1. Koler-Povh, T., Turk, Ž., 2018. Information literacy of doctoral students in engineering and the librarian's role. *Journal of librarianship and information science*, ISSN 0961-0006, 2018, str. 1-13, doi: 10.1177/0961000618767726. [COBISS.SI-ID 8367969]

2. Schöpfel, J., Prost, H., Malleret, C., Južnič, P., Češarek, A., Koler-Povh, T. 2016. Dissertations and Data. *The grey journal*, ISSN 1574-1796, 2016, letn. 12, št. 3, str. 126-148, http://www.textrelease.com/publications/journal.html. [COBISS.SI-ID 7641953]
3. Koler-Povh, T., Južnič, P., Turk, G. 2014. Impact of open access on citation of scholarly publications in the field of civil engineering. *Scientometrics*, ISSN 0138-9130, 2014, letn. 98, št. 2, str. 1033-1045, doi: 10.1007/s11192-013-1101-x. [COBISS.SI-ID 6296673]

UČNI NAČRT PREDMETA/COURSE SYLLABUS

Predmet:	Matematika v raziskovanju grajenega okolja
Course title:	Mathematics in Research of Built Environment

Študijski programi in stopnja	Študijska smer	Letnik	Semestri
Grajeno okolje, tretja stopnja, doktorski	Geodezija, Gradbeništvo	1. letnik	Celoletni

Univerzitetna koda predmeta/University course code:	1063

Predavanja	Seminar	Vaje	Klinične vaje	Druge oblike študija	Samostojno delo	ECTS
30	10	0	0	0	85	5

Nosilec predmeta/Lecturer:	Ganna Kudryavtseva, Marjeta Kramar Fijavž
Izvajalci predavanj:	Gašper Jaklič, Marjeta Kramar Fijavž, Ganna Kudryavtseva, Mitja Lakner
Izvajalci seminarjev:	
Izvajalci vaj:	
Izvajalci kliničnih vaj:	
Izvajalci drugih oblik:	
Izvajalci praktičnega usposabljanja:	
Vrsta predmeta/Course type:	Obvezen predmet/Obligatory course
Jeziki/Languages:	Predavanja/Lectures: Slovenščina, Angleščina
	Vaje/Tutorial:

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:	**Prerequisites:**
Vpis v 1. letnik doktorskega študija.	Enrolment into the 1st year of doctoral studies.

Vsebina:	**Content (Syllabus outline):**
Repetitorij: logika in teorija množic, funkcije skalarnega in vektorskega argumenta, analitična in diferencialna geometrija, diferencialne enačbe, matrični račun, verjetnostni račun. Izbrana poglavja iz naslednjih področij 1. Linearna algebra in teorija grafov: linearni prostori, lineane preslikave in matrike, matrične funkcije, posebne matrike, osnove teorije grafov, uporaba v modeliranju (sistemi diferencialnih enačb, vodenje). 2. Numerične metode in optimizacija: teorija napak, numerično reševanje nelinearnih enačb in sistemov enačb, iskanje minimuma funkcije več spremenljivk, variacijski račun, kombinatorična optimizacija, linearno programiranje. Statistika: osnove slučajnih procesov, preizkušanje domnev, nadgradnja zahtevnejših statističnih metod, posebni statistični testi.	Refreshing the foundations: logic and set theory, functions of scalar and vector argument, analytic and differential geometry, differential equations, matrix calculus, probability. Selected topics from the following areas: 1. Linear algebra and graph theory: linear spaces, linear mappings and matrices, matrix functions, special matrices, basics in graph theory, applications in modelling (systems of differential equations, control). 2. Numerical methods and optimization: sources of error, numerical solution of nonlinear equations and systems of equations, finding extrema of multivariate functions, calculus of variations, combinatorial optimization, linear programing.

	3. Statistics: basics on random processes, hypothesis testing, advanced statistical methods, specialized statistical tests.

Temeljna literatura in viri/Readings:

Knjižni viri (izbrane vsebine) / Printed sources (selected contents):

Batkai, M. Kramar Fijavž, A. Rhandi, Positive Operator Semigroups: from Finite to Infinite Dimensions, Birkhauser-Verlag, Basel, 2017.

D.B. Bertsekas, Nonlinear Programming, Athena Scientific, 2nd Edition, 1999.

K. Eriksson, D.J. Estep, C. Johnson, Applied mathematics: body and soul, Volume 1-3, Springer-Verlag, 2004.

D. C. Montgomery, G. C. Runger, Applied Statistics and Probability for Engineers, John Wiley & Sons, 2007.

B. Plestenjak, Razširjen uvod v numerične metode. DMFA, Ljubljana, 2015.

Wilson, Watkins, Uvod v teorijo grafov, DMFA Slovenije, Ljubljana 1997.

Elektronski viri / Electronic sources:

- odložena gradiva v spletni učilnici / uploaded sources in the web classroom

Cilji in kompetence:	**Objectives and competences:**
Cilji: - Glavni cilj je osvežiti in nadgraditi znanje iz pomembnejših matematičnih pojmov in orodij ter hkrati študenta seznaniti z nekaterimi novejšimi matematičnimi področji. Poudarek je na matematičnih orodjih, ki so v uporabi v raziskovalnem delu v inženirstvu. Del vsebine se prilagodi interesom in raziskovalni usmerjenosti študentov. **Kompetence:** - Poznavanje pojmov matematike, ki so nujni za doktorski študij Grajeno okolje. - Sposobnost analize kvantitativnih podatkov s pomočjo različnih statističnih orodij. - Modeliranje nalog iz inženirstva s pomočjo numeričnih metod. - Učinkovito reševanje različnih optimizacijskih problemov. - Sposobnost uporabe matematičnih metod za reševanje konkretnih problemov.	**Objectives:** - The main goal is to refresh and extend the knowledge about the more important mathematical concepts and tools and at the same time introduce the student to recently developed areas of mathematics. The emphasis is on the mathematical tools used in engineering research. Part of the curriculum will be tailored to the interests and reseach preferences of the students. **Competences:** - Familiarity with mathematical concepts essential for the Built Environment program. - Ability of quantitative analysis of data by various statistical tools. - Modelling engineering tasks using numerical methods. - Effective solving of various optimization problems. - Ability of using mathematical methods for solving of real-life problems.

Predvideni študijski rezultati:	**Intended learning outcomes:**
Znanje in razumevanje: - Študent razume in zna uporabljati matematična orodja s področja modeliranja, optimizacije, numeričnih metod in statistike.	**Knowledge and understanding:** - Student understands and is able to use mathematical tools for modelling, optimization, numerical methods and statistics.

Metode poučevanja in učenja:	**Learning and teaching methods:**
Predavanja, domače naloge, seminarske naloge, študij literature in uporaba računalniških orodij, konzultacije.	Lectures, homework, projects using computer, programs readings, consultations.

Načini ocenjevanja:	**Delež/Weight**	**Assessment:**
Domače naloge	45,00 %	Homework assignments
Seminarska naloga in ustni zagovor	55,00 %	Project and oral defense

Reference nosilca/Lecturer's references:

Engel, K., **Kramar Fijavž, M.**, 2017. Exact and positive controllability of boundary control systems. *Networks and heterogeneous media*, 12/2, 319-337, doi: 10.3934/nhm.2017014. [COBISS.SI-ID 18039897]

Bezak, N., Rusjan, S., **Kramar Fijavž, M.**, Mikoš, M., Šraj, M., 2017. Estimation of suspended sediment loads using copula functions. *Water*, 9/8, 1-23, doi: 10.3390/w9080628. [COBISS.SI-ID 8124769]

Strnad, I., **Kramar Fijavž, M.**, Žura, M., 2016. Numerical optimal control method for shockwaves reduction at stationary bottlenecks. *Journal of advanced transportation,* 50/ 5, 841-856, doi: 10.1002/atr.1378. [COBISS.SI-ID 7586145]

Kudryavtseva, G., Leech J., 2016. Free skew Boolean algebras, *Internat. J. Algebra Comput,* 26 /7, 1323 – 1348, doi:10.1142/S0218196716500569. [COBISS.SI-ID 17800793]

Kudryavtseva, G., Lawson, M. V., 2017. A perspective on non-commutative frame theory*, Adv. Math.,* 311, 378-468, doi: 10.1016/j.aim.2017.02.028. [COBISS.SI-ID 18011737]

Kudryavtseva, G., 2018. Free skew Boolean intersection algebras and set partitions, *Order* 35/1, 1-22, doi: 10.1007/s11083-016-9414-z. [COBISS.SI-ID 17811545]

UČNI NAČRT PREDMETA/COURSE SYLLABUS

Predmet:	Raziskovanje v geodeziji
Course title:	Research in Geodesy

Študijski programi in stopnja	Študijska smer	Letnik	Semestri
Grajeno okolje, tretja stopnja, doktorski	Geodezija (znanstveno področje)	1. letnik	Zimski

Univerzitetna koda predmeta/University course code: 1064

Predavanja	Seminar	Vaje	Klinične vaje	Druge oblike študija	Samostojno delo	ECTS
40	20	20	20	0	150	10

Nosilec predmeta/Lecturer:	Bojan Stopar
Izvajalci predavanj:	Anka Lisec, Polona Pavlovčič Prešeren, Simona Savšek, Bojan Stopar
Izvajalci seminarjev:	
Izvajalci vaj:	
Izvajalci kliničnih vaj:	
Izvajalci drugih oblik:	
Izvajalci praktičnega usposabljanja:	
Vrsta predmeta/Course type:	Obveze predmet/Obligatory course

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

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:	Prerequisites:
Ni pogojev.	No prerequisites.

Vsebina:	Content (Syllabus outline):
1) Geodezija kot znanost, stroka in služba. Organiziranost geodezije na znanstvenem, institucionalnem in podatkovnem nivoju, v mednarodnem in domačem okolju (IUGG, IAG, FIG, ICA, ISPRS, ICA, IHO, SZGG, ZGS) 2) Matematični, fizikalni in konceptualni temelji geodezije in področij tesno povezanih z geodezijo: geodetska izmera, geodezija v inženirstvu, topografija, kartografija, fotogrametrija, geografski informacijski sistemi, zbirke in evidence prostorskih podatkov – stanje in trendi 3) Konceptualni in matematični modeli za opis prostora, koncept in namen opazovanj, vzpostavitev relacij med fizičnim in virtualnim prostorom, analize prostora, prikaz prostora – stanje in trendi 4) Koncepti, metodologije, tehnologije, instrumentarij in senzorji za zajem prostorskih	1) Geodesy as a science, branch and service. Organizational structures of geodesy at a scientific, institutional and data level in international and national level (IUGG, IAG, FIG, ICA, ISPRS, ICA, IHO, SZGG, ZGS) 2) Mathematical, physical and conceptual foundations of geodesy and disciplines closely related with geodesy: surveying, surveying engineering, topography, cartography, photogrammetry, remote sensing, GIS, spatial data sets and data registry – current state and trends 3) Conceptual and mathematical models for space description, concept and purpose of observations, establishment of the relations among physical and virtual space, spatial data analysis, presentation of model space – current state and trends 4) Concepts, methodologies, technologies, instrumentation and sensors for point to point and

podatkov, točkovni in masovni – stanje in trendi 5) Sodobni in klasični koordinatni sistemi v geodeziji, relacije in transformacije koordinatnih sistemov 6) Koncepti, pojmi in definicije merila kakovosti v geodeziji – stanje in trendi 7) Časovna spremenljivost prostora, zajem, analiza in prikaz časovno odvisnih komponent prostora 8) Geodezija in relacije z drugimi znanostmi in strokami: naravoslovnimi, tehničnimi, družboslovnimi,... v informacijski družbi – stanje in trendi	massive spatial data acquisition – current state and trends 5) Modern and traditional coordinate systems in geodesy, relation and transformation of coordinate systems 6) Concepts and definitions of quality measures in geodesy and surveying – current state and trends 7) Temporal variations of space, acquisition, analysis and presentation of temporal variations of space. 8) Geodesy and its relations with other disciplines and branches in contemporary information society – current state and trends.

Temeljna literatura in viri/Readings:

Knjige/Books

- Geodesy – the Concepts / P. Vaniček, E. Krakiwsky, Elsevier, 2006
- Torge, Wolfgang – Geodesy, 3rd completely rev. and extended ed. Berlin, New York : W. de Gruyter, 2001
- Cho George, 2005, Geographic Information Science: Mastering the Legal

Issues, John Wiley & Sons.

Revije/Journals

- Journal of Geodesy
- Survey Review
- Journal of Surveying Engineering
- GNSS Solutions
- International Journal of Applied Earth observation
- ISPRS Journal Of Photogrammetry And Remote Sensing
- Geoinformatica
- Cartographic Journal
- druge znanstvene revije s področja geodezije in geoinformatike/other scientific journals on the field of geodesy and geoinformatics.

Cilji in kompetence:	**Objectives and competences:**
Študenti pridobijo znanja o konceptih, metodologijah, tehnologijah, praktični uporabi in usmeritvah v geodetski znanosti, stroki in službi v mednarodnem okolju. Spoznajo organiziranost geodezije kot znanosti in službe v mednarodnem (IAG, FIG, ISPRS, ICA, IHO) ter nacionalnem okolju (SZGG, ZGS), njeno vlogo in pomen v sodobni družbi. Teoretične konceptualne in tehnološke vsebine se povezujejo s praktičnimi primeri. Študenti so se sposobni odločati in izbirati optimalne metode in podatkovne vire za določeno uporabo, študenti se naučijo uporabljati teorijo v reševanju zahtevnih strokovnih in znanstvenih problemov, usposobljeni so za razvoj novih postopkov reševanja konceptualnih in tehnoloških problemov v geodetski znanosti in geoinformatiki.	Students acquire knowledge of the concepts, methodologies, techniques, practical application and guidelines in geodetic science, profession and work in an international environment. Learn about the organization as a science of geodesy and services in the international (IAG, FIG, ISPRS, ICA, IHO) and the national environment (SZGG, SFS), its role and importance in modern society. Theoretical concepts and technical content link with practical examples. Students are able to decide and choose the optimal methods and data sources for a specific application, students learn to apply theory in solving complex professional and scientific problems, they are trained to develop new procedures for solving conceptual and technological problems in geodetic and geoinformation science.

Predvideni študijski rezultati:	**Intended learning outcomes:**
Znanje in razumevanje: Poznavanje in razumevanje teoretičnih konceptov, metod, tehnologij (satelitskih, letalskih in terestričnih) in orodij za pridobivanje, vrednotenje, analiziranje in vizualizacijo prostorskih podatkov s katerimi se ukvarja sodobna geodezija in geoinformatika. Študent je usposobljen za sodelovanje v sodobnih interdisciplinarnih raziskavah Zemlje kot planeta.	Knowledge and understanding: Knowledge and understanding of theoretical concepts, methods, technologies (satellite, aerial and terrestrial) and tools for acquiring, evaluating, analyzing and visualizing spatial data to be dealt with modern geodesy and geoinformatics. Student is qualified for cooperation in modern interdisciplinary research of the Earth as a planet.

Študent pridobi teoretična in praktična znanja za reševanje najzahtevnejših strokovnih in znanstvenih problemov v geodetski praksi. Usposobljen je za razvoj novih znanj na področju geodezije in geoinformatike.	Students will acquire theoretical and practical knowledge to solve the most complex professional and scientific problems in geodetic and surveying practice. Student is qualified for the development of new knowledge in the field of geodesy, surveying and geoinformatics.

Metode poučevanja in učenja:	**Learning and teaching methods:**
Predavanja, konzultacije, projektno orientirano delo v okviru seminarja	Lectures, consultations, project oriented seminar works

Načini ocenjevanja:	**Delež/Weight**	**Assessment:**
Obveznost študenta je izdelava seminarske naloge, ki predstavlja samostojno raziskovalno delo študenta. Predstavljena je v okviru seminarskih vaj in izdelana v obliki znanstvenega članka.	100,00 %	Students prepare a seminar paper, which represents research conducted by the student. It is written in the form of a scientific paper and presented in the frame of the tutorial.

Reference nosilca/Lecturer's references:

1. URBANČIČ, Tilen, KOSMATIN FRAS, Mojca, STOPAR, Bojan, KOLER, Božo. The influence of the input parameters selection on the RANSAC results. *International journal of simulation* m*odelling*, ISSN 1726-4529, 2014, letn. 13, št. 2, str. 159–170.
2. TRIGLAV, Joc, PETROVIČ, Dušan, STOPAR, Bojan. Spatio-temporal evaluation matrices for geospatial data. *ITC journal*, ISSN 0303-2434, feb. 2011, letn. 13, št. 1, str. 100–109.
3. MARJETIČ, Aleš, AMBROŽIČ, Tomaž, TURK, Goran, STERLE, Oskar, STOPAR, Bojan. Statistical Properties of Strain and Rotation Tensors in Geodetic Network. *Journal of surveying engineering*, ISSN 0733-9453, avgust 2010, letn. 136, št. 3, str. 102–110.
4. KOZMUS TRAJKOVSKI, Klemen, STERLE, Oskar, STOPAR, Bojan. Sturdy Positioning with High Sensitivity GPS Sensors Under Adverse Conditions. *Sensors*, ISSN 1424-8220, 2010, letn. 10, št. 9, str. 8332–8347
5. VEZOČNIK, Rok, AMBROŽIČ, Tomaž, STERLE, Oskar, BILBAN, Gregor, PFEIFER, Norbert, STOPAR, Bojan. Use of Terrestrial Laser Scanning Technology for Long Term High Precision Deformation Monitoring. *Sensors*, ISSN 1424-8220, 2009, letn. 9, št. 12, str. 9874–9895.
6. PAVLOVČIČ PREŠEREN, Polona, STOPAR, Bojan. GPS orbit approximation using radial basis function networks. *Computers & Geosciences*, ISSN 0098-3004. [Print ed.], 2009, letn. 35, št. 7, str. 1389–1396.

UČNI NAČRT PREDMETA/COURSE SYLLABUS

Predmet:	Prostorsko načrtovalsko raziskovanje
Course title:	Spatial Planning Research

Študijski programi in stopnja	Študijska smer	Letnik	Semestri
Grajeno okolje, tretja stopnja, doktorski	Načrtovanje in urejanje prostora (znanstveno področje)	1. letnik	Letni, Zimski

Univerzitetna koda predmeta/University course code:	1696

Predavanja	Seminar	Vaje	Klinične vaje	Druge oblike študija	Samostojno delo	ECTS
40	0	0	0	85	0	5

Nosilec predmeta/Lecturer:	Maruška Šubic-Kovač

Izvajalci predavanj:	Maruška Šubic-Kovač, Alma Zavodnik Lamovšek
Izvajalci seminarjev:	
Izvajalci vaj:	
Izvajalci kliničnih vaj:	
Izvajalci drugih oblik:	
Izvajalci praktičnega usposabljanja:	

Vrsta predmeta/Course type:	Obvezni predmet/Obligatory course

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

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:	Prerequisites:
Znanja iz urbanizma, regionalnega planiranja, prostorskega načrtovanja, statistike in varstva okolja, v obsegu in na ravni 2. bolonjske stopnje oz. univerzitetne diplome.	Knowledge of urbanism, regional planning, spatial planning, statistics and environmental protection is required to the extent and level on the 2nd level of a Bologna study programme or a university degree programme.

Vsebina:	Content (Syllabus outline):
Teorije, metode in tehnike v prostorskem raziskovanju; Privlačnost, ranljivost in nosilnost prostora; Projekcije potreb po prostoru; Lokacijske teorije; Bilance, modeli, simulacije, igre, optimizacije v načrtovanju prostora; Interpretacija in uporaba rezultatov družboslovnih raziskav v načrtovanju prostora; Načrtovanje variant in izvrednotenje; Oblikovanje grajenega okolja mest in drugih naselij, oblikovanje krajine; estetske presoje pri umeščanju objektov v prostor, vizualne simulacije;	Theories, methods and technics in spatial research; Attractiveness, vulnerability and capacity of the space; Projections of needs for land; Location theories; Balances, models, simulations, games, optimisation in spatial planning; Interpretation and use of results of sociological research in spatial planning; Planning of alternatives and their estimation; Design of urban built environment and other settlements, landscape design; aesthetic evaluation of installation of objects into space, visual simulations;

Raziskovanje prostora na lokalni ravni; Raziskovanje prostora na regionalni ravni; Raziskovanje prostora na državni ravni; Raziskovanje prostora na ravni EU in drugih mednarodnih integracij; Predavanja vabljenih predavateljev za specialne raziskovalne teme (po eno predavanje); Študij izbrane literature.	Spatial research on the local level; Spatial research on the regional level; Spatial research on the state level; Spatial research on the EU level and on the other international levels; Lectures of invited lecturers for special research topics (one lecture); Study of selected literature.

Temeljna literatura in viri/Readings:

Učbeniki: / Textbooks:
Pogačnik, A., Kako izdelamo prostorske načrte; Založba Obzorja, Maribor, 2006.
Mark Deakin, Robert Dixon-Gough, Reinfried Mansberger; Methodologies, models, and instruments for rural and urban land management, Aldershot, Hants, England ; Burlington, VT : Ashgate, cop. 2004
Mark Davidson & Deborah Martin, Urban politics : critical approaches, Los Angeles ; London : SAGE, 2014
Haall Peter, Urban and regional planning, London ; Boston : Allen and Unwin, 1985
Stefanie Dühr, The visual language of spatial planning : exploring cartographic representations for spatial planning in Europe, New York : Routledge, 2007
Judith E. Innes and David E. Booher, Planning with complexity : an introduction to collaborative rationality for public policy, Milton Park, Abingdon, Oxon ; New York, NY : Routledge, 2010
Website www.espon.eu and other current studies on the level of EU, OECD, and other European and global institutions.

Cilji in kompetence:	**Objectives and competences:**
Seznanitev s naprednimi raziskovalnimi metodami pri prostorskem načrtovanju na vseh ravneh načrtovanja. Študent spozna raziskovalno problematiko regionalnega in urbanističnega planiranja, urejanja in upravljanja prostora, načrtovanja urbanega prostora in procese urbanizacije ter spreminjanje prostora ob upoštevanju družbenih in ekonomskih procesov. Seznani se s temeljnimi in najnovejšimi teorijami in metodami raziskav v prostorskih znanostih. Poglobitev in pridobitev specifičnih znanj z izbranih vsebin s področja načrtovanja in upravljanja rabe prostora. Predmetno specifične kompetence, ki jih študent pridobi po opravljenem izpitu, so predvsem poznavanje in razumevanje teorij na posameznih obravnavanih področjih, poznavanje in razumevanje najnovejših metod in modelov ter potreb po informacijskih bazah in podatkih za potrebe načrtovanja in upravljanja s prostorom. Na podlagi tega je študent sposoben aplicirati pridobljena znanja na posamezna področja.	To get familiar with advanced research methods in spatial planning on all levels of planning. The student will gain understanding of research topics relating to regional and urban planning, land management, urban spatial planning and its procedures, including the change of spatial patterns, in consideration of social and economic processes. The theories and methods in the fields of spatial sciences will be introduced. To acquire and strengthen the specific competences in the selected chapters of spatial planning and land use management. Course-specific competences acquired by the student on having passed the examination include, in particular, the familiarisation with, and comprehension of, the theories presented in the respective courses, the familiarisation with, and comprehension of, the most recent methods and models, and of needs for the information bases and data required in spatial planning and land use management. Thereafter, a student shall be qualified for applying the knowledge acquired in the respective fields.

Predvideni študijski rezultati:	**Intended learning outcomes:**
Razumevanje procesov v prostoru občin ter regij; razumevanje različnih metod in tehnik načrtovanja, razumevanje vloge sektorjev in varstva okolja. Kritičen odnos do posegov v prostor, do uravnovešanja razvojnih in varovalnih vidikov. Lastna opažanja prostorskih procesov v občini in regiji, soočanje vloge raznih disciplin in sektorjev.	Understanding of spatial processes in municipalities and regions; understanding of different methods and techniques of planning, the role of sectors and environmental protection Critical attitude to spatial developments, towards balancing the aspects of development and protection. Students' own observations of spatial processes in municipality and region, confrontation of various fields and sectors.

Metode poučevanja in učenja:	Learning and teaching methods:
Predavanja, interaktivna predavanja, seminar.	Lectures, interactive lectures, seminar.

Načini ocenjevanja:	Delež/Weight	Assessment:
Seminarska naloga	50,00 %	Seminar work
Projekt	40,00 %	Project
Naloge	10,00 %	Coursework

Reference nosilca/Lecturer's references:

1. CELLMER, Radoslaw, BELEJ, Miroslaw, ŹRÓBEK, Sabina, ŠUBIC KOVAČ, Maruška. Karte vrednosti stavbnih zemljišč : metodološki pristop = Urban land value maps - a methodological approach. Geodetski vestnik, ISSN 0351-0271. [Tiskana izd.], 2014, letn. 58, št. 3, str. 535-551, ilustr. http://geodetski-vestnik.com/58/3/gv58-3_cellmer.pdf, doi: 10.15292/geodetski-vestnik.2014.03.535-551.
2. KRAJEWSKA, Małgorzata, ŹRÓBEK, Sabina, ŠUBIC KOVAČ, Maruška. The Role of Spatial Planning in the Investment Process in Poland and Slovenia. Real Estate Management and Valuation, ISSN 2300-5289, 2014, letn. 22, št. 2, str. 52-66, ilustr., doi: 10.2478/remav-2014-0017.
3. ŠUBIC KOVAČ, Maruška, RAKAR, Albin. Model vrednotenja zemljišč kategoriziranih cest za namene pravnega prometa. Geodetski vestnik, ISSN 0351-0271. [Tiskana izd.], 2010, letn. 54, št. 2, str. 253-266, ilustr. http://www.geodetski-vestnik.com/54/2/gv54-2_253-266.pdf.
4. SVETINA, Matija, ISTENIČ STARČIČ, Andreja, JUVANČIČ, Matevž, NOVLJAN, Tomaž, ŠUBIC KOVAČ, Maruška, VEROVŠEK, Špela, ZUPANČIČ-STROJAN, Tadeja. Beliefs about the environment : moving from the egocentric towards the ecocentric perspective. The international journal of sustainable development and world ecology, ISSN 1350-4509. [Print ed.], 2014, letn. 21, št. 6, str. 540-545, ilustr., doi: 10.1080/13504509.2014.963735.
5. KUŠAR, Matej, ŠUBIC KOVAČ, Maruška, ŠELIH, Jana. Selection of Efficient Retrofit Scenarios for Public Buildings. V: JUOZAPAITIS, Algirdas (ur.). 11th International Conference on Modern Building Materials, Structures and Techniques, MBMST 2013, 16 - 17 May 2013, Vilnius, Lithuania, (Procedia engineering, ISSN 1877-7058, Vol. 57). Kidlington: Elsevier, 2013, vol. 57, str. 651-656, ilustr., doi: 10.1016/j.proeng.2013.04.082.
6. SITAR, Metka, LORBER, Lučka, ŠUBIC KOVAČ, Maruška. Revitalization of Industrial Zones in the Context of Sustainable Urban Land Development: Case Study of Business and Industrial Zone Tezno, Maribor. V: TIRA, Maurizio (ur.), IVANIČKA, Koloman (ur.), ŠPIRKOVÁ, Daniela (ur.). Industrial urban land redevelopment : COST Action TU0602 - land management for urban dynamics : proceedings of Bratislava meeting. COST office: Maggiolli; Santarcangelo di Romagna, 2011, str. 89-106.
7. ŠUBIC KOVAČ, Maruška. Land Development Potential under Conditions of Sustainable Development in the Republic of Slovenia. V: HEPPERLE, Erwin (ur.). Land Management : Potential, Problems and Stumbling Blocks = Landmanagement - Potenzial, Problemfelder und Stolpersteine. Zürich: VDF Hochschulverlag AG an der ETH, 2013, str. 177-185. http://www.vdf.ethz.ch/service/3479/3480_Landmanagement_OA.pdf.

UČNI NAČRT PREDMETA/COURSE SYLLABUS

Predmet:	Aplikativna geokemija okolja
Course title:	Applied Environmental Geochemistry

Študijski programi in stopnja	Študijska smer	Letnik	Semestri
Grajeno okolje, tretja stopnja, doktorski	Ni členitve (študijski program)		Letni, Zimski

Univerzitetna koda predmeta/University course code: 1280

Predavanja	Seminar	Vaje	Klinične vaje	Druge oblike študija	Samostojno delo	ECTS
30	0	20	0	75	0	5

Nosilec predmeta/Lecturer: Nastja Rogan Šmuc

Vrsta predmeta/Course type: Izbirni predmet/Elective course

Jeziki/Languages:

Predavanja/Lectures:	Slovenščina, Angleščina
Vaje/Tutorial:	Slovenščina, Angleščina

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:	Prerequisites:
Predhodno osvojena znanja iz geokemije, fizikalne kemije	Prior knowledge from geochemistry, physical chemistry

Vsebina:	Content (Syllabus outline):
Onesnaževanje z nitrati in fosfati: biološki nutrienti, Eh-pH diagrami, mikrobiološka oksidacija in redukcija, fiksacija N in P, dušikov in fosfatni cikel, inertnost, nitrati v vodi, eutrofikacija, fosfati v tleh; Kisli dež: pH meteorne vode, precipitacija, kisle baze - pufri v tleh, specije Al (ph, topnostni produkt); Strukture in mineralogija tal in sedimentov, nastanek tal, gline v tleh, Fe oksidi/hidroksidi, mineralogija glin v tleh, preperevanje mineralov v tleh; Geokemična kinetika - hitrosti posameznih reakcij, razpolovna doba, odprti sistem, reakcijska hitrost, reakcijski zakon, difuzija... Težke kovine v vegetaciji, tleh in meteornih vodah: Onesnaženje in geokemija: Pb, As, Hg, Zn, Cd, NO3, PGE; Radionuklidi (radioaktivni odpadki) - U, Rd, geokemija 90Sr in 137Cs, specije aktinidov; Organski onesnaževalci: (DNAPL in LNAPL, alkoholi, ketoni, aldehidi, klorogljikovodiki, nafta - BTEX in aromati, biodegradacija ogljikovodikov); Remediacija tal in vode: EPA 2000, shranjevanje in izolacija, bioremediacija, biodegradacija, vitrifikacija, elektrokinetična remediacija, monitoring; Kisle rudniške odplake: Pirit, težke kovine - Eh in pH diagrami, modeliranje reakcijskega transporta onesnaženega oblaka s polutanti - primeri, sulfatna redukcija, remediacija, metanogeneza, težke kovine pri	Pollution by nitrates and phosphates: biological nutrients, Eh - pH diagrams, microbial oxidation and reduction, fixation of N and P, nitrogen and phosphate cycle, inertia, nitrates in the water eutrophication, phosphates in the soil; Acid rain: rain water pH, precipitation, acidic base - buffers in the ground, a species Al (ph, solubility product); Structure and mineralogy of the soil and sediment formation of soil, clay soil, Fe oxides/hydroxides, clay mineralogy of the soil, weathering of minerals in the soil; Geochemical Kinetics - the speed of individual reactions, half-life, open system, reaction speed, reaction law, diffusion... Heavy metals in vegetation, soil and meteoric waters: Pollution and geochemistry: Pb, As, Hg, Zn, Cd, NO3, PGE; Radionuclides (radioactive waste) - U, Rd, geochemistry 90Sr and 137Cs, a species of actinides; Organic contaminants: (DNAPL and LNAPL , alcohols , ketones , aldehydes, klorogljikovodiki , oil - and BTEX aromatics biodegradation of hydrocarbons); Remediation of Soil and Water: EPA 2000 storage and sequestration, bioremediation, biodegradation, vitrification, electrokinetic remediation, monitoring; Acidic mine effluent: Pyrite, heavy metals - Eh and pH diagrams, modeling the reaction transport of polluted cloud of pollutants - examples, sulfate reduction,

ekstrakciji; Odpadne vode: geokemija; Okoljska kemija - strategije.	remediation, methanogenesis, heavy metals extraction; Waste water: geochemistry; Environmental Chemistry - Strategy.

Temeljna literatura in viri/Readings:

Izbrana poglavja iz knjig / Selected chapters from books:
1) J.E. Andrews et al., 2000 - An Itroduction to Environmental Chemistry;
2) Broder J. Merkel and B. Planer-Friedrich, 2005 - Groundwater Geochemistry;
3) R. Harrison (Ed), 2006 - An introduction to pollution science;
4) H.B. Bradl (Ed.), 2005 - Heavy Metals in the Environment;
5) C.M. Bethke, 1996 - Geochemical Reaction Modeling

Cilji in kompetence:	**Objectives and competences:**
Študent se nauči interpretirati podatke s terena oziroma laboratorija (analiza geokemičnih podatkov) ter izdelati osnoven model ali več modelov za konkreten geokemični primer ter se nauči in razume različne principe, procese in fenomene človeške aktivnosti na okolje in jih zna medseboj povezati.	Student learn to interpret field data and laboratory results (analysis of geochemical data). He is able to create a basic model or more models for a concrete geochemical example. He understands different principles , processes and phenomena of human activities on the environment and finds a connection between them.

Predvideni študijski rezultati:	**Intended learning outcomes:**
Znanje in razumevanje: Študent razume potrebo po ločevanju sprememb, ki jih povzroča človek od sprememb, ki jih povzroči narava ter znati predvideti posledico obeh. Prepoznati nekatere metode in tehnike za zmanjšanje vpliva nekaterih nevarnih geoloških procesov in človeške aktivnosti na okolje (čistilne naprave - aktivno blato, septične jame, kanalizacija, marikulturne dejavnosti, rudarjenje ...).	Knowledge and understanding: The student understands the need to separate the changes caused by man from the changes caused by nature and to be able to predict a results of both. Students identify some of the methods and techniques used to reduce the impact of certain hazardous geological processes and human activities on the environment (water treatment plants - activated sludge, septic pits, drainage, mariculture activities, mining ...).

Metode poučevanja in učenja:	**Learning and teaching methods:**
Predavanja, prikaz slikovnega gradiva (LCD projektor), delo na računalniku	Lectures, display images (LCD projector), work on the computer

Načini ocenjevanja:	**Delež/Weight**	**Assessment:**
Način (pisni izpit, ustno izpraševanje, naloge, projekt) pisni izpit iz predavanj in vaj (izdelava samostojnega modela s pomočjo programa GWB)	100,00 %	Type (examination, oral, coursework, project): written exam based on lectures and tutorial (formation of model with the GWB software)

Reference nosilca/Lecturer's references:

1. **ROGAN, Nastja**, SERAFIMOVSKI, Todor, DOLENEC, Matej, TASEV, Goran, DOLENEC, Tadej. Heavy metal contamination of paddy soils and rice (Oryza sativa L.) from Kočani field (Macedonia). Environ. geochem. health, 2009, issue 4, vol. 31, str. 439-451, doi: 10.1007/s10653-008-9197-2.

2. ROGAN ŠMUC, Nastja, DOLENEC, Tadej, SERAFIMOVSKI, Todor, TASEV, Goran, DOLENEC, Matej. Distribution and mobility of heavy metals in paddy soils of the Kočani Field in Macedonia. Environmental earth sciences, 2010, vol. 61, no. 5, str. 899-907, doi: 10.1007/s12665-009-0405-x.

3. ROGAN ŠMUC, Nastja, DOLENEC, Tadej, SERAFIMOVSKI, Todor, TASEV, Goran, DOLENEC, Matej, VRHOVNIK, Petra. Heavy metal characteristics in Kočani Field plant system (Republic of Macedonia). Environ. geochem. health, doi: 10.1007/s10653-011-9439-6.

UČNI NAČRT PREDMETA/COURSE SYLLABUS

Predmet:	Bioklimatsko načrtovanje
Course title:	Bioclimatic Design

Študijski programi in stopnja	Študijska smer	Letnik	Semestri
Grajeno okolje, tretja stopnja, doktorski	Ni členitve (študijski program)		Letni, Zimski

Univerzitetna koda predmeta/University course code: 1065

Predavanja	Seminar	Vaje	Klinične vaje	Druge oblike študija	Samostojno delo	ECTS
20	20	0	0	85	0	5

Nosilec predmeta/Lecturer: Aleš Krainer

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):**
Vloga sonaravnosti v oblikovanju pametnega grajenega okolja in zdravega bivanja. Filozofska misel o položaju človeka v grajenem okolju. Klima v prostoru. Individualizacija prostorov kot izhodišče za ukrepe na ravni učinkovitosti in varčne rabe energije: fiziološki, psihološki in sociološki vplivi. Integracija stavbe v naravno in urbano okolje. Gradbena bionika. Sistemi procesov načrtovanja in okviri za oblikovanja sistemov ocenjevanja učinkovitosti bivalnega in delovnega okolja. Inovativni sistemi in proizvodi.	Role of sustainability in the design of built environment and healthy living environment. Philosophical thought on situation of man in built environment. Environmental climate. Individualization of environment as a basis for measures in the field of energy efficiency: physiological, psychological, sociological influences. Integration of building in natural and urban environment. Building bionics. Systems of design processes and frameworks for design of systems for assessment of efficiency of living and working environment. Innovative systems and products.

Temeljna literatura in viri/Readings:

Sustainable architecture, bioclimatic architecture, on line teaching package. SARA – Sustainable Architecture Applied to Replicable Public Access Buildings / Krainer A, http://kske.fgg.uni-lj.si/Index_SI.htm, 2008.

Tekoča periodika: Indoor & built environment, Energy & Buildings, Building & Environment

Cilji in kompetence:	**Objectives and competences:**
Oblikovanje nadgradnje naprednega, specifičnega znanja o konceptualizaciji in kritični analizi delovanja bivalnega in delovnega prostora	Reaching advanced, specific knowledge on conceptualisation and critical analyses of functioning of living and working environment on the basis of

na osnovi povezanega splošnega teoretičnega znanja s področja tehnike in vedenjskih znanosti. Študent si bo zgradil metodološki in tehnološki instrumentarij za reševanje zahtevnih problemov načrtovanja bivalnega okolja s področja regulacije toplotnih in svetlobnih tokov in za identifikacijo in konceptualizacijo novih zasnov.	interconnected general theoretical knowledge in the technical field and in the behavioural sciences. Student will build methodological and technological instrument for solving of problems in the design of living environment dealing with regulation of thermal and optical flows and for identification and conceptualisation of new schemes.

Predvideni študijski rezultati:	**Intended learning outcomes:**
Znanje in razumevanje: Znanje: Študent bo nadgradil znanje o konceptualizaciji in kritični analizi delovanja bivalnega in delovnega prostora na osnovi povezanega splošnega teoretičnega znanja s področja tehnike in vedenjskih znanosti. Pridobil bo napredna znanja o metodologiji in tehnološkem instrumentariju za reševanje zahtevnih problemov načrtovanja bivalnega okolja s področja regulacije toplotnih in svetlobnih tokov in za identifikacijo in konceptualizacijo novih zasnov. Razumevanje: Študent bo razumel pomen regulacije toplotnih in svetlobnih tokov za identifikacijo in konceptualizacijo novih zasnov.	Knowledge and understanding: Knowledge: Students will upgrade the knowledge abot conceptualisation and critical analyses of functioning of living and working environment on the basis of interconnected general theoretical knowledge in the technical field and in the behavioural sciences. Student will get advanced knowledge on methodological and technological instrument for solving of problems in the design of living environment dealing with regulation of thermal and optical flows and for identification and conceptualisation of new schemes. Understanding: Student will understand the meaning of regulation of thermal and optical flows for identification and conceptualisation of new schemes.

Metode poučevanja in učenja:	**Learning and teaching methods:**
Predavanja, izdelava individualnih seminarskih nalog, študij tekočih znanstvenih publikacij.	Lectures, seminar work, study of current scientific publications.

Načini ocenjevanja:	**Delež/Weight**	**Assessment:**
Zagovor seminarske naloge s predstavitvijo portfelja	30,00 %	Defending seminar work by presenting of portfolio
Priprava članka za publikacijo	70,00 %	Writing an article for publication

Reference nosilca/Lecturer's references:

1. DOVJAK, Mateja, SHUKUYA, Masanori, OLESEN, Bjarne W., KRAINER, Aleš. Analysis on exergy consumption patterns for space heating in Slovenian buildings. Energy policy, ISSN 0301-4215. [Printed.], junij 2010, letn. 38, št. 6, str. 2998-3007, ilustr. [COBISS.SI-ID 4969825]
2. KOŠIR, Mitja, KRAINER, Aleš, DOVJAK, Mateja, KRISTL, Živa. Automatically controlled daylighting for visual and nonvisual effects. Lighting research & technology, ISSN 1477-1535. [Print ed.], 2011, letn. 43, št. 4, str. 439-455, ilustr., doi: 10.1177/1477153511406520. [COBISS.SI-ID 5347425]
3. KOŠIR, Mitja, KRAINER, Aleš, DOVJAK, Mateja, PERDAN, Rudi, KRISTL, Živa. Alternative to the Conventional Heating and Cooling Systems in Public Buildings. Strojniški vestnik, ISSN 0039-2480, 2010, letn. 56, št. 9, str. 575-283, ilustr. [COBISS.SI-ID 5327713]
4. DOVJAK, Mateja, KUKEC, Andreja, KRISTL, Živa, KOŠIR, Mitja, BILBAN, Marjan, SHUKUYA, Masanori, KRAINER, Aleš. Integral control of health hazards in hospital environment. Indoor + built environment, ISSN 1420-326X, okt. 2013, letn. 22, št. 5, str. 776-795, ilustr. [COBISS.SI-ID 5988705],
5. KOŠIR, Mitja, KRAINER, Aleš, KRISTL, Živa. Integral control sistem of indoor environment in continuously occupied spaces. Automation in construction, ISSN 0926-5805. [Print ed.], 2012, letn. 21, št. 1, str. 199-209, ilustr., doi: 10.1016/j.autcon.2011.06.004. [COBISS.SI-ID 5442145]
6. DOVJAK, Mateja, KRAINER, Aleš, SHUKUYA, Masanori. Individualisation of personal space in hospital environment. International journal of exergy, ISSN 1742-8297. [Print ed.], 2014, letn. 14, št. 2, str. 125-155, ilustr. [COBISS.SI-ID 6529121]

UČNI NAČRT PREDMETA/COURSE SYLLABUS

Predmet:	Biotski odgovor na globalne paleoekološke spremembe
Course title:	Biotic Response to Global Paleoecological Change

Študijski programi in stopnja	**Študijska smer**	**Letnik**	**Semestri**
Grajeno okolje, tretja stopnja, doktorski	Ni členitve (študijski program)		Letni, Zimski

Univerzitetna koda predmeta/University course code: 1284

Predavanja	**Seminar**	**Vaje**	**Klinične vaje**	**Druge oblike študija**	**Samostojno delo**	**ECTS**
20	30	0	0	75	0	5

Nosilec predmeta/Lecturer: Luka Gale

Vrsta predmeta/Course type: Izbirni predmet/Elective course

Jeziki/Languages:

Predavanja/Lectures:	Slovenščina, Angleščina
Vaje/Tutorial:	Slovenščina, Angleščina

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:	**Prerequisites:**
Predhodno osvojena znanja iz geologije in/ali biologije v obsegu 2. bolonjske stopnje	M.Sc. of Natural or Technical Science

Vsebina:	**Content (Syllabus outline):**
- razvoj biosfere	- evolution of biosphere
- Geološki faktorji, ki vplivajo na ekološke spremembe	- Geological factors of ecological changes
- Fosili kot ekološki indikatorji	- Fossils as ecological (environmental) indicators
- Vpliv ekoloških faktorjev na biotsko razširjenost	- Environmental control on biotic distribution
- Globalni dogodki in biotska interakcija	- Global change and biotic interaction
- Biotski odgovor na okoljske spremembe	- Biotic response to environmental change
- Izumiranja in radiacije	- Extinction and radiation
- Tafonomija	- Taphonomy
- Funkcionalna in adaptivna morfologija	- Functional and adaptive morphology
- Evolucijska paleoekologija	- Evolutionary paleoecology
- Paleobiogeografija	- Paleobiogeography
- biostratigrafske metode	- methods in biostratigraphy

Temeljna literatura in viri/Readings:

1.) Brenchley, P.J. & Harper, D.A.T. 1998: Palaeoecology: Ecosystem, environements and evolution. – Chapman & Hall, 402 pp.
2.) Culver, S. J. & Rawson, P. F. 2000: Biotic response to global change. The last 145 million years. Cambridge Uni. Press, 501 pp.
3.) Cockell, C. (Ed.) 2008: Earth-Life system. Cambridge Uni. Press, 319 pp. Cowen, R. 1995: History of Life. - Blackwell Sci. 462 pp.
4.) Moore, J. R., Norman, D. B. & Upchurch, P. 2007: Assessing relative abundances in fossil assemblages. - Palaeogeography, Palaeoclimatology, Palaeoecology, 253, 317-322.
7.) Bromley, R.G. 1990, Trace fossils. - Unwin Hyman, 280 pp.
Dodd, J. & Stanton, R.J. 1990, Paleoecology Concepts and applications. - John Wiley & sons, 502 pp.
8.) Gall, J.C.1995, Paléoécologie Paysages et environments disparus. - Masson, 239 pp.

9.) Donovan, K.S.(ed.)1991, The processes of fossilization. - Belhaven Press, 303 pp

Revije/Journals:
Palaeogeography, Palaeoclimatology, Palaeoecology
Palaios
Paleobiology
Marine Micropaleontology
Palaeontology
Lethaia
Journal of Paleontology

Cilji in kompetence:	**Objectives and competences:**
Cilji predmeta so spoznati vzroke za globalne okoljske spremembe (tektonski, klimatski, vulkanski, evstatični), spoznati njihov geološki zapis, biotski odgovor in prilagoditve (izumiranja, radiacija, morfološke in funkcionalne prilagoditve) na okoljske spremembe ter metode njihovega odkrivanja.	The aim of the course is to recognize the sources of global environmental change (tectonic, paleoclimatic, volcanic, eustatic), to recognize the geological record of global change, biotic response to that and methods and steps how to indentify global change in sedimentary record. The subject provides review of the response of different animal and plant groups to global change through geological history.

Predvideni študijski rezultati:	**Intended learning outcomes:**
Znanje in razumevanje: Slušatelj bo sposoben vrednotiti nekdanja okolja in globalne spremembe na osnovi najdenih fosilnih ostankov različnih živalskih in rastlinskih skupin v sedimentnih zaporedjih, znal jih bo primerno predstaviti, časovno umestiti in interpretirati. Zemlja se skozi svojo zgodovino neprestano spreminja in namen predmeta je seznaniti slušatelje z dolgoročnimi okoljskim spremembami in geološkimi perspektivami današnjega sveta.	Knowledge and understanding: Student will be able to recognize and interpret the scenario of global changes on natural environments and ecology of sedimentary basins in different geological time series with multidisciplinary techiques (paleontological, sedimentological, paleoecological). The world has been changing continually throughout its history so the aim of the course is to bring the global change on longer-term and geological perspective to the issues that concern us today.

Metode poučevanja in učenja:	**Learning and teaching methods:**
Konzultacije, študij obvezne in priporočene literature, izdelava in zagovor seminarske naloge, projektno delo, priprava na izpit, ustni/pisni izpit.	Consultations, reading of reference literature, writing on seminar and project work essay, examamination preparing, written and/or oral examination.

Načini ocenjevanja:	**Delež/Weight**	**Assessment:**
pisni izpit/ustno izpraševanje	80,00 %	Written exam/oral exam coursework or project
seminarska naloga ali projekt	20,00 %	coursework or project

Reference nosilca/Lecturer's references:

Gale, L., Kolar-Jurkovšek, T., Šmuc, A., Rožič, B. (2012) - *Integrated Rhaetian foraminiferal and conodont biostratigraphy from the Slovenian Basin, eastern Southern Alps*. Swiss journal of geosciences, 105/3, p. 435-462, doi: 10.1007/s00015-012-0117-1.

Gale, L., Rettori, R., Martini, R., Kastelic, S., Praprotnik, J., Jamnik, M. Šmuc, A., Rožič, B. (2012) - *Miliolipora species (Foraminifera, Miliolina) from the Rhaetian Dachstein Limestone of Karavanke Mts (Slovenia): Palaeoecological and palaeobiogeographic implications*. *Revue de Micropaléontologie*, 55/3, p. 99-112, doi: 10.1016/j.revmic.2012.05.001.

Gale, L., Kastelic, A., Rožič, B. (2013) – Taphonomic features of Late Triassic foraminifera from Mount Begunjščica, Karavanke Mountains, Slovenia. Palaios, 28, p. 771-792, doi: 10.2110/palo.2014.102.

UČNI NAČRT PREDMETA/COURSE SYLLABUS

Predmet:	Deformacijska analiza naravnega in grajenega okolja
Course title:	Deformation Analysis of Natural and Built Environment

Študijski programi in stopnja	Študijska smer	Letnik	Semestri
Grajeno okolje, tretja stopnja, doktorski	Ni členitve (študijski program)		Letni, Zimski

Univerzitetna koda predmeta/University course code: 1066

Predavanja	Seminar	Vaje	Klinične vaje	Druge oblike študija	Samostojno delo	ECTS
30	10	0	0	0	85	5

Nosilec predmeta/Lecturer: Tomaž Ambrožič

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:
Znanja iz vsebin predmetov dodiplomskih študijev geodezije FGG UL: UNI: Geodezija I, Geodezija II, Terenske vaje I, terenske vaje II, Izravnalni račun I, Izravnalni račun II, Izravnalni račun III, Statistika z elementi informatike (47,5 KT). GG: Uvod v geodezijo, Detajlna izmera, Statistične metode v geodeziji, Izravnalni račun, Precizna klasična geodetska izmera, Optimizacija geodetskih tehničnih del (38 KT) TUN: Geodezija, Terestrična detajlna izmera, Statistika z elementi informatike, Geodetski instrumenti in metode, Analiza opazovanj v geodeziji, Meritve povečane natančnosti (35 KT)	Finished courses thematically related to the following topics: UNI: Geodezija I, Geodezija II, Terenske vaje I, Terenske vaje II, Izravnalni račun I, Izravnalni račun II, Izravnalni račun III, Statistika z elementi informatike (47,5 ECTS). GG: Uvod v geodezijo, Detajlna izmera, Statistične metode v geodeziji, Izravnalni račun, Precizna klasična geodetska izmera, Optimizacija geodetskih tehničnih del (38 ECTS) TUN: Geodezija, Terestrična detajlna izmera, Statistika z elementi informatike, Geodetski instrumenti in metode, Analiza opazovanj v geodeziji, Meritve povečane natančnosti (35 ECTS)

Vsebina:	Content (Syllabus outline):
- pridobitev podatkov za deformacijsko analizo in njihova analiza - priprava podatkov in orodij za deformacijsko analizo - obravnava klasičnih postopkov deformacijske analize - predstavitev možnosti uporabe umetnih nevronskih mrež v napovedovanju premikanja točk	- Obtaining of data for the deformation analysis and its analysis - Data and equipment preparation for the deformation analysis - Presentation of the classical deformation analysis methods - Presentation of possible use of the artificial neural networks in predicting point

Temeljna literatura in viri/Readings:

- Caspary, W. F. (1988). Concepts of network and deformation analysis. Kensington: The University of New South Wales, School of Surveying.
- Mihailović, K., Aleksić, I. R. (1994). Deformaciona analiza geodetskih mreža.

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

Cilji: - spoznati in razumeti sodobne merske tehnologije, metode in postopke kompleksnih meritev v inženirskih merskih mrežah ter postopke izračuna - na podlagi različnih izračunov in analiz določiti, ali določena točka miruje, ali ne - slediti razvoju in raziskavam tega področja Kompetence: - študent zna uporabljati mersko opremo, pridobiti podatke, jih obdelati in analizirati - študent zna uporabiti razpoložljiva računalniška orodja in programje - študent zna uporabljati strokovno in znanstveno literaturo iz tega področja - študent zna predstaviti izsledke deformacijske analize drugim strokovnjakom	Goals: - To understand modern measurement technologies, methods and procedures of the kompleksnih measurements in the geodetic networks as well as calculation procedures - To determine the stability of the point on the basis of different calculations and analyses - To follow the research and development of the scientific field Competence: - Candidate is able to use measurement equipment, extract data, process and analyse them - Candidate is able to use available hardware and software - Candidate is able to use relevant specialist literature - Candidate is able to present results of the deformation analysis to other experts

Predvideni študijski rezultati:	**Intended learning outcomes:**
Znanje in razumevanje: Rezultati: - študent razume principe tehnologij in jih zna pravilno uporabljati - študent obdela rezultate najnatančnejših meritev z vsemi vplivi in jih zna analizirati - študent razume postopke deformacijske analize - študent zna interpretirati rezultate deformacijske analize - študent je sposoben komunicirati in sodelovati s strokovnjaki iz drugih področij (gradbenik, geologi, rudarji ...)	Knowledge and understanding: Results: - Candidate understands technology principles and uses them correctly - Candidate processes the results of the most precise measurements together with all relevant impacts and knows how to analyse them - Candidate understands the method of the deformation analysis - Candidate is able to interpret the results of the deformation analysis - Candidate is able to communicate and cooperate with the experts from other scientific fields (civil engineering, geology, mining)

Metode poučevanja in učenja:	**Learning and teaching methods:**
Predavanja, individualne konzultacije in izdelava individualne seminarske naloge na izbrano temo.	Lectures, individual consultations and preparation of individual term-paper regarding the chosen topic.

Načini ocenjevanja:	**Delež/Weight**	**Assessment:**
Način (pisni izpit, ustno izpraševanje, naloge, projekt) Izdelava in zagovor seminarske naloge na izbrano temo. Ustni izpit, ki obsega teoretični del (vsebino predavanj ter obvezne in priporočene literature).	100,00 %	Type (examination, oral, coursework, project): Preparation and presentation of term-paper regarding the chosen topic, oral examination regarding the theory (contents of the lectures and compulsory and recommended literature).

Reference nosilca/Lecturer's references:

- KLOPČIČ, Jure, AMBROŽIČ, Tomaž, MARJETIČ, Aleš, GAMSE, Sonja, PULKO, Boštjan, LOGAR, Janko. Use of automatic target recognition system for the displacement measurements in a small diameter tunnel ahead of the face of the motorway tunnel during excavation. Sensors, , vol. 8, no. 12, str. 8139-8155, ISSN 1424-8220, 2008. [COBISS.SI-ID 4396641]
- MARJETIČ, Aleš, AMBROŽIČ, Tomaž, TURK, Goran, STERLE, Oskar, STOPAR, Bojan. Statistical Properties of Strain and Rotation Tensors in Geodetic Network. Journal of surveying engineering, let. 136, št. 3, 102-110, ISSN 0733-9453, 2010. [COBISS.SI-ID 4805473]
- A. Marjetič, M. Zemljak, T. Ambrožič, Deformacijska analiza po postopku Delft = Deformation analysis: The Delft approach, Geodetski vestnik, let. 56, št. 1, 9-26, ISSN 0351-0271, 2012. [COBISS. SI-ID 5786209]
- SAVŠEK, Simona, GREGORN, Zoran, AMBROŽIČ, Tomaž. Measuring meteorological data along the ray path of a

distance meter with an ultra-light aircraft. Survey review, let. 45, št. 328, 3-12, ISSN 0039-6265, 2013. [COBISS.SI-ID 6136673]
- VREČKO, Anja, AMBROŽIČ, Tomaž. Deformacijska analiza po postopku Fredericton = Deformation analysis: the Fredericton approach. Geodetski vestnik, let. 57, št. 3, 479-497, ISSN 0351-0271, 2013. [COBISS.SI-ID 6344289]

UČNI NAČRT PREDMETA/COURSE SYLLABUS

Predmet:	Dinamika gradbenih konstrukcij z uporabo v potresnem inženirstvu
Course title:	Dynamics of Structures with Applications to Earthquake Engineering

Študijski programi in stopnja	Študijska smer	Letnik	Semestri
Grajeno okolje, tretja stopnja, doktorski	Ni členitve (študijski program)		Celoletni, Letni

Univerzitetna koda predmeta/University course code: 1067

Predavanja	Seminar	Vaje	Klinične vaje	Druge oblike študija	Samostojno delo	ECTS
25	15	0	0	0	85	5

Nosilec predmeta/Lecturer: Peter Fajfar

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:
Opravljen izpit iz predmeta Dinamika gradbenih konstrukcij in potresno inženirstvo na II. stopnji FGG ali osvojeno primerljivo znanje	Course in Dynamics of structures and earthquake engineering or comparable knowledge

Vsebina:	Content (Syllabus outline):
Pregled linearnih metod dinamične analize konstrukcij (ponovitev, poglobitev in dopolnitev snovi, predelane na II. stopnji). Osnove nelinearne analize konstrukcij pri potresni obtežbi (modeliranje z metodo plastičnih členkov, »pushover« analiza, neelastični spektri, N2 metoda). Teoretične osnove in komentar Evrokoda 8 (določanje potresnih obremenitev in analiza konstrukcij stavb). Seminar: izdelava linearne in nelinearne potresne analize gradbenega objekta po Evrokodu 8.	Overview of linear methods for dynamic analysis of structures (repetition, deepening, and extension of the material covered at the II. degree) • The fundamentals of the nonlinear analysis of structures under seismic action (modelling with plastic hinges, pushover analysis, inelastic spectra, the N2 method) • The theoretical background and the commentary of Eurocode 8 (the determination of seismic actions and analysis of structures) Seminar: Linear and nonlinear analysis of a building or a civil engineering structure according to Eurocode 8

Temeljna literatura in viri/Readings:

P.Fajfar, Dinamika gradbenih konstrukcij, UL, FAGG, 1984
A. Chopra, Dynamics of Structures, Theory and Applications to Earthquake Engineering, Third Edition, Pearson/Prentice Hall, 2007
M.N.Fardis, E.C.Carvalho, P.Fajfar, A.Pecker, Seismic Design of Concrete Buildings to Eurocode 8, CRC Press, 2015

EN1998 Design of structures for earthquake resistance
Papers in domestic and international journals

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

- Poglobiti in dopolniti osnovno znanje o dinamike gradbenih konstrukcij, potresni obtežbi in potresnoodpornem projektiranju gradbenih konstrukcij in opreme - Spoznati osnove nelinearne analize konstrukcij pri potresnih obremenitvah **Kompetence**: **Za 5 KT** - Sposobnost uporabe metod analize dinamičnih problemov - Razumevanje in obvladovanje projektiranja potresnoodpornih stavb	• To gain and extend the basic knowledge on dynamics of structures, seismic action, and earthquake resistant design of structures and equipment • To become familiar with the nonlinear analysis of structures under seismic action Competences: For 5 ECTS • Capability to perform dynamic analyses of structures • Understanding and knowledge of the fundamentals of design of buildings for earthquake resistance

Predvideni študijski rezultati:	**Intended learning outcomes:**
Znanje in razumevanje: Dinamike konstrukcij, potresne obtežbe, linearne in nelinearne analize, potresnoodpornega projektiranja konstrukcij in opreme	Knowledge and understanding: on dynamics of structures, seismic action, linear and nonlinear analysis and earthquake resistant design of structures and equipment

Metode poučevanja in učenja:	**Learning and teaching methods:**
Predavanja, seminarji, konzultacije, študij literature	Lectures, seminars, consultations, study of literature

Načini ocenjevanja:	**Delež/Weight**	**Assessment:**
Način (pisni izpit, ustno izpraševanje, naloge, projekt) Izdelava seminarske naloge in njena predstavitev	50,00 %	Type (examination, oral, coursework, project): Preparation of the seminar work and its presentation
ustni izpit	50,00 %	oral exam

Reference nosilca/Lecturer's references:

VUKOBRATOVIĆ, Vladimir, FAJFAR, Peter. A method for the direct determination of approximate floor response spectra for SDOF inelastic structures. *Bulletin of earthquake engineering*, ISSN 1570-761X, [in press] 2014, letn. XX, št. XX, str. 1–20, doi: 10.1007/s10518-014-9667-0.
PERUŠ, Iztok, FAJFAR, Peter. Prediction of site factors by a non-parametric approach. *Earthquake engineering & structural dynamics*, ISSN 0098-8847. [Print ed.], okt. 2014, letn. 43, št. 12, str. 1743–1761.
KRESLIN, Maja, FAJFAR, Peter. The extended N2 method considering higher mode effects in both plan and elevation. *Bulletin of earthquake engineering*, ISSN 1570-761X, 2012, letn. 10, št. 2, str. 695–715.
FAJFAR, Peter, DOLŠEK, Matjaž. A practice-oriented estimation of the failure probability of building structures. *Earthquake engineering & structural dynamics*, ISSN 0098-8847. [Print ed.], 2012, letn. 41, št. , str. 531–547.
KRESLIN, Maja, FAJFAR, Peter. The extented N2 method taking into account higher mode effects in elevation. *Earthquake engineering & structural dynamics*, ISSN 0098-8847. [Print ed.], 2011, letn. 40, št. 14, str. 1571–1589.
KRESLIN, Maja, FAJFAR, Peter. Seismic evaluation of an existing complex RC building. *Bulletin of earthquake engineering*, ISSN 1570-761X, April 2010, letn. 8, št. 2, str. 363–385.
PERUŠ, Iztok, FAJFAR, Peter. Ground-motion prediction by a non-parametric approach. *Earthquake engineering & structural dynamics*, ISSN 0098-8847. [Print ed.], 2010, letn. 39, št. 12, str. 1395–1416.
ROZMAN, Matej, FAJFAR, Peter. Seismic response of a RC frame building designed according to old and modern practices. *Bulletin of earthquake engineering*, ISSN 1570-761X, 2009, letn. 7, št. 3, str. 779–799.

UČNI NAČRT PREDMETA/COURSE SYLLABUS

Predmet:	Dinamika gradbenih konstrukcij z uporabo v potresnem inženirstvu
Course title:	Dynamics of Structures with Applications to Earthquake Engineering

Študijski programi in stopnja	Študijska smer	Letnik	Semestri
Grajeno okolje, tretja stopnja, doktorski	Ni členitve (študijski program)		Celoletni, Letni

Univerzitetna koda predmeta/University course code: 1068

Predavanja	Seminar	Vaje	Klinične vaje	Druge oblike študija	Samostojno delo	ECTS
50	30	0	0	0	170	10

Nosilec predmeta/Lecturer: Peter Fajfar

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:
Opravljen izpit iz predmeta Dinamika gradbenih konstrukcij in potresno inženirstvo na II. stopnji FGG ali osvojeno primerljivo znanje	Course in Dynamics of structures and earthquake engineering or comparable knowledge

Vsebina:	Content (Syllabus outline):
Pregled linearnih metod dinamične analize konstrukcij (ponovitev, poglobitev in dopolnitev snovi, predelane na II. stopnji). Osnove nelinearne analize konstrukcij pri potresni obtežbi (modeliranje z metodo plastičnih členkov, »pushover« analiza, neelastični spektri, N2 metoda). Teoretične osnove in komentar Evrokoda 8 (določanje potresnih obremenitev in analiza konstrukcij stavb). Dodatno za 10 KT: Nelinearna dinamična analiza konstrukcij Analiza inženirskih objektov pri potresnih obremenitvah Seminar: izdelava linearne in nelinearne potresne analize gradbenega objekta po Evrokodu 8.	Overview of linear methods for dynamic analysis of structures (repetition, deepening, and extension of the material covered at the II. degree) • The fundamentals of the nonlinear analysis of structures under seismic action (modelling with plastic hinges, pushover analysis, inelastic spectra, the N2 method) • The theoretical background and the commentary of Eurocode 8 (the determination of seismic actions and analysis of structures) Additional for 10 ECTS • Nonlinear dynamic analysis of structures • Analysis of civil engineering structures under seismic action Seminar: Linear and nonlinear analysis of a building or a civil engineering structure according to Eurocode 8

Temeljna literatura in viri/Readings:

P.Fajfar, Dinamika gradbenih konstrukcij, UL, FAGG, 1984
A. Chopra, Dynamics of Structures, Theory and Applications to Earthquake Engineering, Third Edition, Pearson/Prentice Hall, 2007
M.N.Fardis, E.C.Carvalho, P.Fajfar, A.Pecker, Seismic Design of Concrete Buildings to Eurocode 8, CRC Press, 2015

EN1998 Design of structures for earthquake resistance

Papers in domestic and international journals

Cilji in kompetence:	**Objectives and competences:**
Cilji: - Poglobiti in dopolniti osnovno znanje o dinamike gradbenih konstrukcij, potresni obtežbi in potresnoodpornem projektiranju gradbenih konstrukcij in opreme - Spoznati osnove nelinearne analize konstrukcij pri potresnih obremenitvah **Kompetence**: **Za 5 KT** - Sposobnost uporabe metod analize dinamičnih problemov - Razumevanje in obvladovanje projektiranja potresnoodpornih stavb **Dodatno za 10 KT** - Sposobnost uporabe metod nelinearne analize pri potresnih obremenitvah - Razumevanje in obvladovanje osnov projektiranja izbranih inženirskih objektov	Objectives: • To gain and extend the basic knowledge on dynamics of structures, seismic action, and earthquake resistant design of structures and equipment • To become familiar with the nonlinear analysis of structures under seismic action Competences: For 5 ECTS • Capability to perform dynamic analyses of structures • Understanding and knowledge of the fundamentals of design of buildings for earthquake resistance For 10 ECTS • Capability to perform nonlinear dynamic analyses of structures subjected to seismic loading • Understanding and knowledge of the fundamentals of design of civil engineering structures for earthquake resistance

Predvideni študijski rezultati:	**Intended learning outcomes:**
Znanje in razumevanje: Dinamike konstrukcij, potresne obtežbe, linearne in nelinearne analize, potresnoodpornega projektiranja konstrukcij in opreme	Knowledge and understanding: on dynamics of structures, seismic action, linear and nonlinear analysis and earthquake resistant design of structures and equipment

Metode poučevanja in učenja:	**Learning and teaching methods:**
Predavanja, seminarji, konzultacije, študij literature	Lectures, seminars, consultations, study of literature

Načini ocenjevanja:	**Delež/Weight**	**Assessment:**
Način (pisni izpit, ustno izpraševanje, naloge, projekt) Izdelava seminarske naloge in njena predstavitev	50,00 %	Type (examination, oral, coursework, project): Preparation of the seminar work and its presentation
Ustni izpit	50,00 %	Oral exam

Reference nosilca/Lecturer's references:

VUKOBRATOVIĆ, Vladimir, FAJFAR, Peter. A method for the direct determination of approximate floor response spectra for SDOF inelastic structures. *Bulletin of earthquake engineering*, ISSN 1570-761X, [in press] 2014, letn. XX, št. XX, str. 1–20, doi: 10.1007/s10518-014-9667-0.
PERUŠ, Iztok, FAJFAR, Peter. Prediction of site factors by a non-parametric approach. *Earthquake engineering & structural dynamics*, ISSN 0098-8847. [Print ed.], okt. 2014, letn. 43, št. 12, str. 1743–1761.
KRESLIN, Maja, FAJFAR, Peter. The extended N2 method considering higher mode effects in both plan and elevation. *Bulletin of earthquake engineering*, ISSN 1570-761X, 2012, letn. 10, št. 2, str. 695–715.
FAJFAR, Peter, DOLŠEK, Matjaž. A practice-oriented estimation of the failure probability of building structures. *Earthquake engineering & structural dynamics*, ISSN 0098-8847. [Print ed.], 2012, letn. 41, št. , str. 531–547.
KRESLIN, Maja, FAJFAR, Peter. The extented N2 method taking into account higher mode effects in elevation. *Earthquake engineering & structural dynamics*, ISSN 0098-8847. [Print ed.], 2011, letn. 40, št. 14, str. 1571–1589.
KRESLIN, Maja, FAJFAR, Peter. Seismic evaluation of an existing complex RC building. *Bulletin of earthquake engineering*, ISSN 1570-761X, April 2010, letn. 8, št. 2, str. 363–385.
PERUŠ, Iztok, FAJFAR, Peter. Ground-motion prediction by a non-parametric approach. *Earthquake engineering & structural dynamics*, ISSN 0098-8847. [Print ed.], 2010, letn. 39, št. 12, str. 1395–1416.
ROZMAN, Matej, FAJFAR, Peter. Seismic response of a RC frame building designed according to old and modern practices. *Bulletin of earthquake engineering*, ISSN 1570-761X, 2009, letn. 7, št. 3, str. 779–799.

UČNI NAČRT PREDMETA/COURSE SYLLABUS

Predmet:	Dnevna svetloba
Course title:	Daylighting

Študijski programi in stopnja	Študijska smer	Letnik	Semestri
Grajeno okolje, tretja stopnja, doktorski	Ni členitve (študijski program)		Letni, Zimski

Univerzitetna koda predmeta/University course code: 1539

Predavanja	Seminar	Vaje	Klinične vaje	Druge oblike študija	Samostojno delo	ECTS
20	20	0	0	85	0	5

Nosilec predmeta/Lecturer: Mitja Košir

Vrsta predmeta/Course type: Izbirni predmet/Elective course

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

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:	**Prerequisites:**
Ni posebnih pogojev.	No prerequisits.

Vsebina:	**Content (Syllabus outline):**
Pristop: fizikalni in fiziološki vidiki (opravljanje vidnih nalog in regulacija bioloških ur), razvoj in težnje. Sonce in nebo: vir svetlobe, novi modeli projektnega neba. Numerična analiza dnevne svetlobe, direktna, difuzna in refleksirana dnevna svetloba. Kakovost dnevnega osvetljevanja prostorov: vir, spekter, smer, distribucija, kontrasti, bleščanje. Modeliranje: meritve in izračuni. Načrtovanje naselij, načrtovanje aktivnih prostorov (inovativni sistemi, učinkovitosti sistemov, individualizacija). Regulacija dnevne svetlobe v prostoru in integracija v ostale nadzorne mehanizme v stavbi.	Approach: the physical and physiological aspects (performance of visual task and regulation of biological clock), development and trends. The sun and sky: light source, the new models of project skies. Numerical analysis of daylight, direct, diffuse and reflected daylight. The quality of daylighting in building: source, spectrum, direction, distribution, contrast, glare. Modelling: measurements and calculations. Urban planning, design of active spaces (innovative systems, performance of systems, individualization). Control of daylight in the space and integration into other control mechanisms in the building.

Temeljna literatura in viri/Readings:

Daylight design of buildings / Nick Baker and Koen Steemers. London: James & James, c2002.
Daylighting / R.G. Hopkinson, P. Petherbridge, J. Longmore. Heinemann, London, 1966.
Daylighting: natural light in architecture / Derek Phillips; with a foreword by Carl Gardner. Amsterdam: Elsevier, 2004.
Introduction to architectural science : the basis of sustainable design / Steven V. Szokolay. Burlington: Architectural Press, 2004.
Daylighting: Performance and design / Gregg D. Ander. Hoboken: John Wiley & Sons, Inc., 2003.
Tekoča periodika/Current periodicals: Energy & Buildings, Building s& Environment, Solar energy, Renewable energy, Lighting research and technology

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

Cilj predmeta je seznaniti študente s poglobljeno obravnavo pojavov povezanih z dnevno svetlobo v grajenem okolju. Študent bo osvojil znanja, ki mu bodo omogočila kvantitativno in kvalitativno obravnavanje: izkoriščanja in obvladovanja virov dnevne svetlobe, vplivov na človekovo fiziologijo in kvaliteto bivalnega okolja.	The course aims to acquaint students with an in-depth analysis of phenomena associated with natural daylight in the built environment. Students will acquire skills that will enable a quantitative and qualitative treatment: exploitation and management of daylight sources, effects on human physiology and quality of living environment.

Predvideni študijski rezultati:	**Intended learning outcomes:**
Znanje in razumevanje: Naučil se bo uporabljati instrumentarij obravnavanja dnevne svetlobe v stavbah in v naseljih. Pridobljeno znanje o kvantitativnih in kvalitativnih vplivih na vizualno okolje in razumevanje simulacijskih in merilnih tehnik bo študenta usposobilo za samostojen pristop k manipuliranju s svetlobnimi tokovi in njihovim vplivom na bivalno in delovno okolje.	Knowledge and understanding: The student will learn to use the instrumentarium for treating of daylight in buildings and urban environments. Knowledge on quantitative and qualitative impact on the visual environment and understanding of simulation and measurement techniques will enable the student for independent approach to manipulate with light patterns and their impact on living and working environment.

Metode poučevanja in učenja:	**Learning and teaching methods:**
Predavanja, izdelava individualnih seminarskih nalog, študij tekočih znanstvenih publikacij in novih tehničnih rešitev.	Lectures, working on individual seminar assignments, study of scientific publications and new technical solutions

Načini ocenjevanja:	**Delež/Weight**	**Assessment:**
Način (pisni izpit, ustno izpraševanje, naloge, projekt)	70,00 %	Type (examination, oral, coursework, project):
Zagovor seminarske naloge s predstavitvijo portfelja, priprava članka za publikacijo	30,00 %	Defending seminar work with presentation of portfolio, preparing a paper for publication

Reference nosilca/Lecturer's references:

KOŠIR, Mitja, CAPELUTO, Isaac Guedi, KRAINER, Aleš, KRISTL, Živa. Solar potential in existing urban layouts : critical overview of the existing building stock in Slovenian context. Energy policy, ISSN 0301-4215. [Print ed.], [v tisku] 2014, letn. XX, št. X, str. 1-14, ilustr., doi: 10.1016/j.enpol.2014.01.045. [COBISS.SI-ID 6496609]
KOŠIR, Mitja, KRAINER, Aleš, KRISTL, Živa. Integral control sistem of indoor environment in continuously occupied spaces. Automation in construction, ISSN 0926-5805. [Print ed.], 2012, letn. 21, št. 1, str. 199-209, ilustr., doi: 10.1016/j.autcon.2011.06.004. [COBISS.SI-ID 5442145]

KOŠIR, Mitja, KRAINER, Aleš, DOVJAK, Mateja, KRISTL, Živa. Automatically controlled daylighting for visual and nonvisual effects. Lighting research & technology, ISSN 1477-1535. [Print ed.], 2011, letn. 43, št. 4, str. 439-455, ilustr., doi: 10.1177/1477153511406520. [COBISS.SI-ID 5347425]

KRISTL, Živa, KOŠIR, Mitja, TROBEC LAH, Mateja, KRAINER, Aleš. Fuzzy control system for thermal and visual comfort in building. Renewable energy, ISSN 0960-1481. [Print ed.], apr. 2008, vol. 33, iss. 4, str. 694-702, ilustr., doi: 10.1016/j.renene.2007.03.020. [COBISS.SI-ID 3476065]

UČNI NAČRT PREDMETA/COURSE SYLLABUS

Predmet:	Duktilnost in stabilnost jeklenih konstrukcij
Course title:	Ductility and Stability of Steel Structures

Študijski programi in stopnja	Študijska smer	Letnik	Semestri
Grajeno okolje, tretja stopnja, doktorski	Ni členitve (študijski program)		Letni, Zimski

Univerzitetna koda predmeta/University course code: 1077

Predavanja	Seminar	Vaje	Klinične vaje	Druge oblike študija	Samostojno delo	ECTS
10	20	0	10	0	85	5

Nosilec predmeta/Lecturer: Franc Sinur

Vrsta predmeta/Course type: Izbirni predmet/Elective course

Jeziki/Languages:

Predavanja/Lectures:	Angleščina, Slovenščina
Vaje/Tutorial:	Angleščina, Slovenščina

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:	Prerequisites:
Opravljena izpita iz predmetov jeklene konstrukcije in nelinearne analize konstrukcij na II. stopnji študija gradbeništva na UL FGG ali osvojeno primerljivo znanje.	Courses in Steel structures and Nonlinear analysis of structures (Master programme in Civil engineering at the University of Ljubljana) or comparable knowledge.

Vsebina:	Content (Syllabus outline):
Pomen duktilnosti za obnašanje jeklenih konstrukcij Zahteve za zagotavljanje lokalne in globalne duktilnosti Duktilnost spojev Duktilnost jeklenih konstrukcij, izpostavljenih potresnim vplivom Plastična analiza jeklenih linijskih konstrukcij Posebni problemi stabilnosti v jeklenih konstrukcijah in povezava z duktilnostjo Vpliv začetnih nepopolnosti na obnašanje in mejno nosilnost jeklenih konstrukcij	Importance of ductility for the behaviour of steel structures Requirements for ensuring local and global ductility Ductility of connections Ductility of steel structures exposed to seismic actions Plastic analysis of steel structures Special stability problems in steel structures and relations to ductility Influence of initial imperfections on the behaviour and ultimate resistance of steel structures

Temeljna literatura in viri/Readings:

P.J. Dowling, J.E. Harding, R. Bjorhovde, Constructional steel design (an international guide), Elsvier Applied Science, 1992.
B. Johansson, R. Maquoi, G. Sedlacek, C. Muller, D. Beg, Commentary and worked examples to EN 1993-1-5 »Plated structural elements«, Joint JRC-ECCS report, 2007
International Workshop on Connections, zborniki zadnjih treh delavnic (2002, 2005, 2008), AISC-ECCS
BEG, Darko, KUHLMANN, Ulrike, DAVAINE, Laurence, BRAUN, Benjamin. Design of plated structures : Eurocode 3 : design of steel structures : part 1-5 - design of plated structures, (ECCS Eurocode design manuals). Brussels: ECCS - European Convention for Constructional Steel Work; Berlin: Ernst & Sohn, 2010. 272 str., ilustr. ISBN 978-92-9147-100-3. ISBN 978-3-433-02980-0. [COBISS.SI-ID 5237601]
M. Bruneau, C.M. Uang, A. Whittaker, Ductile design of Steel Structures, McGraw-Hill, 1998
Članki v mednarodnih revijah (Papers in international journals)

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

Cilji:	**Objectives:**
Poglobiti in dopolniti osnovno znanje o obnašanju jeklenih konstrukcij Spoznati metode za napredno analizo jeklenih konstrukcij **Kompetence:** Sposobnost aktivne uporabe pridobljenega znanja pri bodočem razvojnem in raziskovalnem delu Sposobnost uporabe zahtevnejših programskih orodij za nelinearno analizo jeklenih konstrukcij Sposobnost analize realnega obnašanja jeklenih konstrukcij Sposobnost projektiranja zahtevnih jeklenih konstrukcij	To extend the basic knowledge on the behaviour of steel structures To understand the methods for advanced analysis of steel structures **Competences:** Capability to actively use the acquired knowledge in the future research and development Capability to work with advanced software for nonlinear analysis of structures Capability to analyse real behaviour of steel structures Capability to design demanding steel structures

Predvideni študijski rezultati:	**Intended learning outcomes:**
Znanje in razumevanje: Poznavanje terminologije in pomebnosti duktilnosti pri jeklenih konstrukcijah Sposobnost uporabe numeričnih metod za določitev nosilnosti jeklenih konstrukcij Poglobljeno znanje s področja duktilnosti in stabilnosti jeklenih konstrukcij je osnova za nadaljne raziskovalno delo na področju jeklenih konstrukcij.	Knowledge and understanding: To get familiarwith terminology and to understand the importance of ductility and stability of steel structures. The student will be able to use appropriate numerical method to detrmine bearing capacity of steel structures. In-depth knowledge of ductility and stability of steel structures is the basis for further research work in the filed of steel structures.

Metode poučevanja in učenja:	**Learning and teaching methods:**
Predavanja, vaje, konzultacije, seminarji. Študent pripravi seminarsko nalogo, ki se nanaša na določitev mejne obteţbe jeklene konstrukcije ali konstrukcijskega sklopa. Pri tem redno hodi na konzultacije k nosilcu predmeta, kjer mora poročati o napredku in pripraviti diskusijo o posameznih problemih, ki jih rešuje.	Lectures, seminars, consultations. A student prepares the project work related to the analysis of ultimate resistance of a steel structure or a structural component. Regular consultation with the teacher and report on the progress of work are mandatory.

Načini ocenjevanja:	**Delež/Weight**	**Assessment:**
Način (pisni izpit, ustno izpraševanje, naloge, projekt): Predstavitev in zagovor seminarske naloge.	100,00 %	Type (examination, oral, coursework, project): Presentation of the project work and the oral exam.

Reference nosilca/Lecturer's references:

SINUR, Franc, BEG, Darko. Moment-shear interaction of stiffened plate girders -Tests and numerical model verification. Journal of Constructional Steel Research, ISSN 0143-974X. [Print ed.], jun. 2013, letn. 85, str. 116-119, ilustr., doi: 10.1016/j.jcsr.2013.03.007.

SINUR, Franc, BEG, Darko. Moment-shear interaction of stiffened plate girders - Numerical study and reliability analysis. Journal of Constructional Steel Research, ISSN 0143-974X. [Print ed.], sept. 2013, letn. 88, str. 231-243, ilustr., doi: 10.1016/j.jcsr.2013.05.016.

SINUR, Franc, ZIZZA, Antonio, KUHLMANN, Ulrike, BEG, Darko. Buckling interaction of slender plates - Experimental and numerical investigations. Thin-walled structures, ISSN 0263-8231. [Print ed.], dec. 2012, letn. 61, str. 121-131, ilustr., doi: 10.1016/j.tws.2012.03.024

MOŽE, Primož, CAJOT, Luis-Guy, SINUR, Franc, REJEC, Klemen, BEG, Darko. Residual stress distribution of large steel equal leg angles. Engineering structures, ISSN 0141-0296. [Print ed.], 2014, letn. 71, št. jul., str. 35-47, ilustr. http://authors.elsevier.com/TrackPaper.html?trk_article=JEST4895&trk_surname=Moze, doi:10.1016/j.engstruct.2014.03.040.

SINUR, Franc, BEG, Darko. Intermediate transverse stiffeners in plate girders. Steel construction, ISSN 1867-0520. [Print ed.], feb. 2012, letn. 5, št. 1, str. 23-32, ilustr., doi: 10.1002/stco.201200004. [COBISS.SI-ID 5775201]
KUHLMANN, Ulrike, BEG, Darko, ZIZZA, Antonio, SINUR, Franc. Beulverhalten längsausgesteifter Platten unter Interaktion von Biegung und Querkraft : Experimentelle und numerische Untersuchungen. Der Stahlbau, ISSN 0038-9145, nov. 2012, letn. 81, št. 11, str. 820-827, ilustr., doi: 10.1002/stab.201201609.
SINUR, Franc, BEG, Darko. Reliability Analysis of Net Cross-section Resistance with Accidental Eccentricity of Holes. International journal of steel structures, ISSN 1598-2351, junij 2009, letn. 9, št. 2, str. 153-160, ilustr. [COBISS.SI-ID 4701025]

UČNI NAČRT PREDMETA/COURSE SYLLABUS

Predmet:	Duktilnost in stabilnost jeklenih konstrukcij
Course title:	Ductility and Stability of Steel Structures

Študijski programi in stopnja	Študijska smer	Letnik	Semestri
Grajeno okolje, tretja stopnja, doktorski	Ni členitve (študijski program)		Letni, Zimski

Univerzitetna koda predmeta/University course code: 1507

Predavanja	Seminar	Vaje	Klinične vaje	Druge oblike študija	Samostojno delo	ECTS
20	40	0	20	0	170	10

Nosilec predmeta/Lecturer: Franc Sinur

Vrsta predmeta/Course type: Izbirni predmet/Elective course

Jeziki/Languages:

Predavanja/Lectures:	Angleščina, Slovenščina
Vaje/Tutorial:	Angleščina, Slovenščina

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:	Prerequisites:
Opravljena izpita iz predmetov jeklene konstrukcije in nelinearne analize konstrukcij na II. stopnji študija gradbeništva na UL FGG ali osvojeno primerljivo znanje.	Courses in Steel structures and Nonlinear analysis of structures (Master programme in Civil engineering at the University of Ljubljana) or comparable knowledge.

Vsebina:	Content (Syllabus outline):
Pomen duktilnosti za obnašanje jeklenih konstrukcij	Importance of ductility for the behaviour of steel structures
Zahteve za zagotavljanje lokalne in globalne duktilnosti	Requirements for ensuring local and global ductility
Duktilnost spojev	Ductility of connections
Duktilnost jeklenih konstrukcij, izpostavljenih potresnim vplivom	Ductility of steel structures exposed to seismic actions
Plastična analiza jeklenih linijskih konstrukcij	Plastic analysis of steel structures
Posebni problemi stabilnosti v jeklenih konstrukcijah in povezava z duktilnostjo	Special stability problems in steel structures and relations to ductility
Vpliv začetnih nepopolnosti na obnašanje in mejno nosilnost jeklenih konstrukcij	Influence of initial imperfections on the behaviour and ultimate resistance of steel structures
Dodatno za 10 KT:	**Additionally for 10 ECTS:**
Podrobna analiza mejne nosilnosti vijačenih in varjenih spojev	Detailed analysis of ultimate resistance of bolted and welded connections
Stabilnostni problemi hladno oblikovanih tankostenskih jeklenih elementov	Stability related problems of cold-formed thin-walled steel elements
Stabilnost vzdolţno in prečno obremenjenih panelov polnostenskih in škatlastih nosilcev	Stability of longitudinally and transversely stiffened panels of plate and box girders
Metode laboratorijskega testiranje jeklenih elementov, kadar je pričakovan način porušitve izguba stabilnosti	Methods of laboratory testing of steel elements when the expected failure mode is loss of stability

Temeljna literatura in viri/Readings:

P.J. Dowling, J.E. Harding, R. Bjorhovde, Constructional steel design (an international guide), Elsvier Applied Science, 1992.

B. Johansson, R. Maquoi, G. Sedlacek, C. Muller, D. Beg, Commentary and worked examples to EN 1993-1-5 »Plated structural elements«, Joint JRC-ECCS report, 2007

International Workshop on Connections, zborniki zadnjih treh delavnic (2002, 2005, 2008), AISC-ECCS BEG, Darko, KUHLMANN, Ulrike, DAVAINE, Laurence, BRAUN, Benjamin. Design of plated structures : Eurocode 3 : design of steel structures : part 1-5 - design of plated structures, (ECCS Eurocode design manuals). Brussels: ECCS - European Convention for Constructional Steel Work; Berlin: Ernst & Sohn, 2010. 272 str., ilustr. ISBN 978-92-9147-100-3. ISBN 978-3-433-02980-0. [COBISS.SI-ID 5237601] M. Bruneau, C.M. Uang, A. Whittaker, Ductile design of Steel Structures, McGraw-Hill, 1998 Članki v mednarodnih revijah (Papers in international journals)

Cilji in kompetence:	**Objectives and competences:**
Cilji: Poglobiti in dopolniti osnovno znanje o obnašanju jeklenih konstrukcij Spoznati metode za napredno analizo jeklenih konstrukcij **Kompetence:** Sposobnost aktivne uporabe pridobljenega znanja pri bodočem razvojnem in raziskovalnem delu Sposobnost uporabe zahtevnejših programskih orodij za nelinearno analizo jeklenih konstrukcij Sposobnost analize realnega obnašanja jeklenih konstrukcij Sposobnost projektiranja zahtevnih jeklenih konstrukcij	**Objectives:** To extend the basic knowledge on the behaviour of steel structures To understand the methods for advanced analysis of steel structures **Competences:** Capability to actively use the acquired knowledge in the future research and development Capability to work with advanced software for nonlinear analysis of structures Capability to analyse real behaviour of steel structures Capability to design demanding steel structures

Predvideni študijski rezultati:	**Intended learning outcomes:**
Znanje in razumevanje: Poznavanje terminologije in pomebnosti duktilnosti pri jeklenih konstrukcijah Sposobnost uporabe numeričnih metod za določitev nosilnosti jeklenih konstrukcij Poglobljeno znanje s področja duktilnosti in stabilnosti jeklenih konstrukcij je osnova za nadaljne raziskovalno delo na področju jeklenih konstrukcij.	Knowledge and understanding: To get familiarwith terminology and to understand the importance of ductility and stability of steel structures. The student will be able to use appropriate numerical method to detrmine bearing capacity of steel structures. In-depth knowledge of ductility and stability of steel structures is the basis for further research work in the filed of steel structures.

Metode poučevanja in učenja:	**Learning and teaching methods:**
Predavanja, vaje, konzultacije, seminarji. Študent pripravi seminarsko nalogo, ki se nanaša na določitev mejne obteţbe jeklene konstrukcije ali konstrukcijskega sklopa. Pri tem redno hodi na konzultacije k nosilcu predmeta, kjer mora poročati o napredku in pripraviti diskusijo o posameznih problemih, ki jih rešuje.	Lectures, seminars, consultations. A student prepares the project work related to the analysis of ultimate resistance of a steel structure or a structural component. Regular consultation with the teacher and report on the progress of work are mandatory.

Načini ocenjevanja:	**Delež/Weight**	**Assessment:**
Način (pisni izpit, ustno izpraševanje, naloge, projekt): Predstavitev in zagovor seminarske naloge.	100,00 %	Type (examination, oral, coursework, project): Presentation of the project work and the oral exam.

Reference nosilca/Lecturer's references:

SINUR, Franc, BEG, Darko. Moment-shear interaction of stiffened plate girders -Tests and numerical model verification. Journal of Constructional Steel Research, ISSN 0143-974X. [Print ed.], jun. 2013, letn. 85, str. 116-119, ilustr., doi: 10.1016/j.jcsr.2013.03.007.

SINUR, Franc, BEG, Darko. Moment-shear interaction of stiffened plate girders - Numerical study and reliability analysis. Journal of Constructional Steel Research, ISSN 0143-974X. [Print ed.], sept. 2013, letn. 88, str. 231-243, ilustr., doi: 10.1016/j.jcsr.2013.05.016.

SINUR, Franc, ZIZZA, Antonio, KUHLMANN, Ulrike, BEG, Darko. Buckling interaction of slender plates - Experimental and numerical investigations. Thin-walled structures, ISSN 0263-8231. [Print ed.], dec. 2012, letn. 61, str. 121-131, ilustr., doi: 10.1016/j.tws.2012.03.024

MOŽE, Primož, CAJOT, Luis-Guy, SINUR, Franc, REJEC, Klemen, BEG, Darko. Residual stress distribution of large steel equal leg angles. Engineering structures, ISSN 0141-0296. [Print ed.], 2014, letn. 71, št. jul., str. 35-47, ilustr. http://authors.elsevier.com/TrackPaper.html?trk_article=JEST4895&trk_surname=Moze, doi:10.1016/j.engstruct.2014.03.040.

SINUR, Franc, BEG, Darko. Intermediate transverse stiffeners in plate girders. Steel construction, ISSN 1867-0520. [Print ed.], feb. 2012, letn. 5, št. 1, str. 23-32, ilustr., doi: 10.1002/stco.201200004. [COBISS.SI-ID 5775201]

KUHLMANN, Ulrike, BEG, Darko, ZIZZA, Antonio, SINUR, Franc. Beulverhalten längsausgesteifter Platten unter Interaktion von Biegung und Querkraft : Experimentelle und numerische Untersuchungen. Der Stahlbau, ISSN 0038-9145, nov. 2012, letn. 81, št. 11, str. 820-827, ilustr., doi: 10.1002/stab.201201609.

SINUR, Franc, BEG, Darko. Reliability Analysis of Net Cross-section Resistance with Accidental Eccentricity of Holes. International journal of steel structures, ISSN 1598-2351, junij 2009, letn. 9, št. 2, str. 153-160, ilustr. [COBISS.SI-ID 4701025]

UČNI NAČRT PREDMETA/COURSE SYLLABUS

Predmet:	Eksperimentalno podprto projektiranje zidanih stavb
Course title:	Experimentally Supported Design of Masonry Buildings

Študijski programi in stopnja	Študijska smer	Letnik	Semestri
Grajeno okolje, tretja stopnja, doktorski	Ni členitve (študijski program)		Letni, Zimski

Univerzitetna koda predmeta/University course code: 1712

Predavanja	Seminar	Vaje	Klinične vaje	Druge oblike študija	Samostojno delo	ECTS
20	10	10	0	0	85	5

Nosilec predmeta/Lecturer: Vlatko Bosiljkov

Vrsta predmeta/Course type: Izbirni predmet/Elective course

Jeziki/Languages:

Predavanja/Lectures:	Angleščina, Slovenščina
Vaje/Tutorial:	Slovenščina, Angleščina

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:	Prerequisites:
Vpis na doktorski študij »Grajeno okolje« ali na druge tehnične ali naravoslovne usmeritve	Solid knowledge of civil engineering materials, basics of earthquake engineering

Vsebina:	Content (Syllabus outline):
• Uvodni del: Zidovina, konstrukcijski elementi in sistemi. • Analiza konstrukcijskega sklopa in uporaba tradicionalnih in sodobnih materialov v zidanih stavbah. (10T) • Laboratorijske in in-situ eksperimentalne metode za zidovino in zidane stavbe. • Diagnostika obstoječih zidanih stavb (neporušne, delno porušne in porušne metode). (10T) • Modelne in prototipne preiskave zidanih objektov. Analiza poškodb in porušni mehanizmi. • Potres kot primer obtežbe. Izračun parametrov, analiza poškodb in porušni mehanizmi. • Sodobni koncept projektiranja zidanih stavb. • Tradicionalni sistemi projektiranja in grajenja. Interdisciplinarni pristop pri analizi objektov kulturne dediščine (tradicionalne hiše, gradovi, sakralni objekti). (10T) • Teoretične osnove računskega modeliranja zidovine. Več nivojev računskega modeliranja zidanih konstrukcij v odvisnosti od tipa in arhitekture stavb. • Energetska in konstrukcijska sanacija in utrditev obstoječih zidanih stavb. (10T) • Izbrana poglavja, ki se nanašajo na doktorsko nalogo študenta	• Introduction: Masonry materials, structural elements and structural systems of masonry buildings. • Analysis of building envelopes typical for traditional and contemporary masonry buildings. (10T) • Laboratory and in-situ experimental methods for masonry buildings. • Diagnostic of masonry structures (non-destructive, minor destructive or destructive methods). (10T) • Model and prototype tests of masonry buildings. Damage analysis and failure mechanisms. • Structural response of masonry buildings due to seismic loading. • Contemporary design of masonry buildings. • Traditional design and building techniques for masonry structures. Interdisciplinary approach for analysis of cultural heritage stock (traditional houses, castles, churches). (10T) • Theoretical background for numerical modelling of masonry. Different levels of numerical modelling of masonry structures depending from their type and architecture. • Strengthening and energy refurbishment actions for existing masonry buildings. (10T) • Chosen chapters related to PhD thesis of the candidate.

Temeljna literatura in viri/Readings:

J.Donea in P.M.Jones: Experimental and Numerical Methods in Earthquake Engineering, Kluwer Academic Publishers, 1991.
R.G.Drysdale, A.A.Hamid in L.R.Baker: Masonry Structures – Behavior and Design, Prentice Hall, 1994. P. Beckmann: Structural aspects of building conservation, McGraw-Hill, 1994.
P. Roca, J.L. González, E. Oñate and P.B. Lourenço (uredniki.), STRUCTURAL ANALYSIS OF HISTORICAL CONSTRUCTIONS II, CIMNE, Barcelona 1998
A.W.Hendry: Structural Masonry, Macmillan Press, 1998.
J.W.Bull (urednik): Computational Modelling of Masonry, Brickwork and Blockwork Structures, Saxe- Coburg Publications, Stirling, Scotland, 2001.
Papers in international journals

Cilji in kompetence:	**Objectives and competences:**
Študent bo seznanjen s tradicionalnimi in sodobnimi pristopi k projektiranju in numeričnem modeliranju zidanih stavb. V svojem delu se bo seznanil z laboratorijskimi in in-situ eksperimentalnimi metodami, ki jih uporabljamo za določanje parametrov za projektiranje novih in preprojektiranje obstoječih (vključno z objekti kulturne dediščine) zidanih objektov.	Traditional and contemporary masonry design and numerical modelling of masonry buildings. Laboratory and in-situ experimental techniques for determination of parameters for design of new masonry structures as well as for redesign and energy refurbishment of existing masonry buildings (including cultural heritage buildings).

Predvideni študijski rezultati:	**Intended learning outcomes:**
Znanje in razumevanje: Na podlagi eksperimentalno določenih parametrov bo študent projektiral zidani objekt v obstoječem in predvidenem ojačanem stanju.	Knowledge and understanding: Case study analysis of selected building with proposals for its strengthening and energy refurbishment.

Metode poučevanja in učenja:	**Learning and teaching methods:**
Predavanja, praktično delo v laboratoriju in na terenu (opciono), delo na računalniku, konzultacije in sprotno poročanje o napredku.	Lectures, practical on-site (optional) and laboratory work, work on PC and workstation, consultations and report on the progress.

Načini ocenjevanja:	**Delež/Weight**	**Assessment:**
Predstavitev in zagovor seminarske naloge	100,00 %	Presentation of the project work and the oral exam.

Reference nosilca/Lecturer's references:

1. BOSILJKOV, V., PAGE, A. W., BOKAN-BOSILJKOV, V., ŽARNIĆ, R. Evaluation of the seismic performance of brick masonry walls. Structural control & health monitoring, ISSN 1545-2255. [Print ed.], feb. 2010, letn. 17, št. 1, str. 100-118, ilustr., doi: 10.1002/stc.299. [COBISS.SI-ID 4963169]
2. BOSILJKOV, V., MAIERHOFER, C., KOEPP, C., WÖSTMANN, J. Assessment of Structure Through Non-Destructive Tests (NDT) and Minor Destructive Tests (MDT) Investigation: Case Study of The Church at Carthusian Monastery at Žice (SLOVENIA). International Journal of Architectural Heritage [Print ed.], 2010, št. 1, letn. 4, str. 1-15, ilustr. [COBISS.SI-ID 4795233]
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5. COTIČ, P., JAGLIČIĆ, Z., NIEDERLEITHINGER, E., STOPPEL, M., BOSILJKOV, V. Image fusion for improved detection of near-surface defects in NDT-CE using unsupervised clustering methods. Journal of nondestructive evaluation, ISSN 0195-9298, 2014, vol. 33, iss. 3, str. 284-397, ilustr. http://dx.doi.org/10.1007/s10921-014-0232-1. [COBISS.SI-ID 16909145]

6. COTIČ, P., JAGLIČIĆ, Z., BOSILJKOV, V. Validation of non-destructive characterization of the structure and seismic damage propagation of plaster and texture in multi-leaf stone masonry walls of cultural-artistic value. Journal of cultural heritage, ISSN 1296-2074, 2014, vol. 15, iss. 5, str. 490-498, ilustr. http://dx.doi.org/10.1016/j.culher.2013.11.004. [COBISS.SI-ID 16804697]
7. URANJEK, M., ŽARNIĆ, R., BOKAN-BOSILJKOV, V., BOSILJKOV, V. Seizmička otpornost zidanih kamenih građevina i utjecaj injektiranja = Seismic resistance of stone masonry building and effect of grouting. Građevinar, ISSN 0350-2465, 2014, letn. 66, št. 8, str. 715-726, ilustr., doi: 10.14256/JCE.1031.2014. [COBISS.SI-ID 6721889]
8. KRŽAN, M., GOSTIČ, S., BOSILJKOV, V. Application of different in-situ testing techniques and vulnerability assessment of Kolizej palace in Ljubljana. Bulletin of earthquake engineering, ISSN 1570-761X, [v tisku] 2014, letn. XX, št. X, str. 1-22, ilustr., doi: 10.1007/s10518-014-9639-4. [COBISS.SI-ID 6642529]
9. CALDERINI, C., ABBATI, S. D., COTIČ, P., KRŽAN, M., BOSILJKOV, V. In-plane shear tests on masonry panels with plaster: correlation of structural damage and damage on artistic assets. Bulletin of earthquake engineering, ISSN 1570-761X, [v tisku] 2014, letn. XX, št. X, str. 1-20, ilustr., doi: 10.1007/s10518-014-9632-y. [COBISS.SI-ID 6643297]
10. BOSILJKOV, Vlatko, D`AYALA, Dina, NOVELLI, Viviana. Evaluation of uncertainties in determining the seismic vulnerability of historic masonry buildings in Slovenia: use of macro-element and structural element modelling. Bulletin of earthquake engineering, ISSN 1570-761X, [v tisku] 2014, letn. XX, št. X, str. 1-19, ilustr., doi: 10.1007/s10518-014-9652-7. [COBISS.SI-ID 6649441]
11. KARATZETZOU, A., PITILAKIS, Kyriazis, KRŽAN, Meta, BOSILJKOV, Vlatko. Soil-foundation-structure interaction and vulnerability assessment of the Neoclassical School in Rhodes, Greece. Bulletin of earthquake engineering, ISSN 1570-761X, [v tisku] 2014, letn. XX, št. X, str. 1-18, ilustr., doi: 10.1007/s10518-014-9637-6. [COBISS.SI-ID 6643809]
12. KRŽAN, Meta, GOSTIČ, Samo, CATTARI, Serena, BOSILJKOV, Vlatko. Acquiring reference parameters of masonry for the structural performance analysis of historical buildings. Bulletin of earthquake engineering, ISSN 1570-761X, [v tisku] 2014, letn. XX, št. X, str. 1-34, ilustr., doi: 10.1007/s10518-014-9686-x. [COBISS.SI-ID 6794849]
13. CATTARI, Serena, LAGOMARSINO, Sergio, BOSILJKOV, Vlatko, D`AYALA, Dina. Sensitivity analysis for setting up the investigation protocol and defining proper confidence factors for masonry buildings. Bulletin of earthquake engineering, ISSN 1570-761X, [v tisku] 2014, letn. XX, št. X, str. 1-23, ilustr., doi: 10.1007/s10518-014-9648-3. [COBISS.SI-ID 6642785]

UČNI NAČRT PREDMETA/COURSE SYLLABUS

Predmet:	Eksperimentalno podprto projektiranje zidanih stavb
Course title:	Experimentally Supported Design of Masonry Buildings

Študijski programi in stopnja	Študijska smer	Letnik	Semestri
Grajeno okolje, tretja stopnja, doktorski	Ni členitve (študijski program)		Letni, Zimski

Univerzitetna koda predmeta/University course code: 1713

Predavanja	Seminar	Vaje	Klinične vaje	Druge oblike študija	Samostojno delo	ECTS
40	20	20	0	0	170	10

Nosilec predmeta/Lecturer: Vlatko Bosiljkov

Vrsta predmeta/Course type: Izbirni predmet/Elective course

Jeziki/Languages:

Predavanja/Lectures:	Angleščina, Slovenščina
Vaje/Tutorial:	Slovenščina, Angleščina

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:	Prerequisites:
Vpis na doktorski študij »Grajeno okolje« ali na druge tehnične ali naravoslovne usmeritve	Solid knowledge of civil engineering materials, basics of earthquake engineering

Vsebina:	Content (Syllabus outline):
• Uvodni del: Zidovina, konstrukcijski elementi in sistemi. • Analiza konstrukcijskega sklopa in uporaba tradicionalnih in sodobnih materialov v zidanih stavbah. (10T) • Laboratorijske in in-situ eksperimentalne metode za zidovino in zidane stavbe. • Diagnostika obstoječih zidanih stavb (neporušne, delno porušne in porušne metode). (10T) • Modelne in prototipne preiskave zidanih objektov. Analiza poškodb in porušni mehanizmi. • Potres kot primer obtežbe. Izračun parametrov, analiza poškodb in porušni mehanizmi. • Sodobni koncept projektiranja zidanih stavb. • Tradicionalni sistemi projektiranja in grajenja. Interdisciplinarni pristop pri analizi objektov kulturne dediščine (tradicionalne hiše, gradovi, sakralni objekti). (10T) • Teoretične osnove računskega modeliranja zidovine. Več nivojev računskega modeliranja zidanih konstrukcij v odvisnosti od tipa in arhitekture stavb. • Energetska in konstrukcijska sanacija in utrditev obstoječih zidanih stavb. (10T) • Izbrana poglavja, ki se nanašajo na doktorsko nalogo študenta	• Introduction: Masonry materials, structural elements and structural systems of masonry buildings. • Analysis of building envelopes typical for traditional and contemporary masonry buildings. (10T) • Laboratory and in-situ experimental methods for masonry buildings. • Diagnostic of masonry structures (non-destructive, minor destructive or destructive methods). (10T) • Model and prototype tests of masonry buildings. Damage analysis and failure mechanisms. • Structural response of masonry buildings due to seismic loading. • Contemporary design of masonry buildings. • Traditional design and building techniques for masonry structures. Interdisciplinary approach for analysis of cultural heritage stock (traditional houses, castles, churches). (10T) • Theoretical background for numerical modelling of masonry. Different levels of numerical modelling of masonry structures depending from their type and architecture. • Strengthening and energy refurbishment actions for existing masonry buildings. (10T) • Chosen chapters related to PhD thesis of the candidate.

Temeljna literatura in viri/Readings:

J.Donea in P.M.Jones: Experimental and Numerical Methods in Earthquake Engineering, Kluwer Academic Publishers, 1991.
R.G.Drysdale, A.A.Hamid in L.R.Baker: Masonry Structures – Behavior and Design, Prentice Hall, 1994. P. Beckmann: Structural aspects of building conservation, McGraw-Hill, 1994.
P. Roca, J.L. González, E. Oñate and P.B. Lourenço (uredniki.), STRUCTURAL ANALYSIS OF HISTORICAL CONSTRUCTIONS II, CIMNE, Barcelona 1998
A.W.Hendry: Structural Masonry, Macmillan Press, 1998.
J.W.Bull (urednik): Computational Modelling of Masonry, Brickwork and Blockwork Structures, Saxe- Coburg Publications, Stirling, Scotland, 2001.
Papers in international journals

Cilji in kompetence:	**Objectives and competences:**
Študent bo seznanjen s tradicionalnimi in sodobnimi pristopi k projektiranju in numeričnem modeliranju zidanih stavb. V svojem delu se bo seznanil z laboratorijskimi in in-situ eksperimentalnimi metodami, ki jih uporabljamo za določanje parametrov za projektiranje novih in preprojektiranje obstoječih (vključno z objekti kulturne dediščine) zidanih objektov.	Traditional and contemporary masonry design and numerical modelling of masonry buildings. Laboratory and in-situ experimental techniques for determination of parameters for design of new masonry structures as well as for redesign and energy refurbishment of existing masonry buildings (including cultural heritage buildings).

Predvideni študijski rezultati:	**Intended learning outcomes:**
Znanje in razumevanje: Na podlagi eksperimentalno določenih parametrov bo študent projektiral zidani objekt v obstoječem in predvidenem ojačanem stanju.	Knowledge and understanding: Case study analysis of selected building with proposals for its strengthening and energy refurbishment.

Metode poučevanja in učenja:	**Learning and teaching methods:**
Predavanja, praktično delo v laboratoriju in na terenu (opciono), delo na računalniku, konzultacije in sprotno poročanje o napredku.	Lectures, practical on-site (optional) and laboratory work, work on PC and workstation, consultations and report on the progress.

Načini ocenjevanja:	**Delež/Weight**	**Assessment:**
Predstavitev in zagovor seminarske naloge	100,00 %	Presentation of the project work and the oral exam.

Reference nosilca/Lecturer's references:

1. BOSILJKOV, V., PAGE, A. W., BOKAN-BOSILJKOV, V., ŽARNIĆ, R. Evaluation of the seismic performance of brick masonry walls. Structural control & health monitoring, ISSN 1545-2255. [Print ed.], feb. 2010, letn. 17, št. 1, str. 100-118, ilustr., doi: 10.1002/stc.299. [COBISS.SI-ID 4963169]
2. BOSILJKOV, V., MAIERHOFER, C., KOEPP, C., WÖSTMANN, J. Assessment of Structure Through Non-Destructive Tests (NDT) and Minor Destructive Tests (MDT) Investigation: Case Study of The Church at Carthusian Monastery at Žice (SLOVENIA). International Journal of Architectural Heritage [Print ed.], 2010, št. 1, letn. 4, str. 1-15, ilustr. [COBISS.SI-ID 4795233]
3. BOSILJKOV, V., URANJEK, M., ŽARNIĆ, R., BOKAN-BOSILJKOV, V. An integrated diagnostic approach for the assessment of historic masonry structures. Journal of cultural heritage, ISSN 1296-2074, 2010, letn. 11, št. 3, str. 239-249, ilustr., doi: 10.1016/j.culher.2009.11.007. [COBISS.SI-ID 4963681] 9.
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5. COTIČ, P., JAGLIČIĆ, Z., NIEDERLEITHINGER, E., STOPPEL, M., BOSILJKOV, V. Image fusion for improved detection of near-surface defects in NDT-CE using unsupervised clustering methods. Journal of nondestructive evaluation, ISSN 0195-9298, 2014, vol. 33, iss. 3, str. 284-397, ilustr. http://dx.doi.org/10.1007/s10921-014-0232-1. [COBISS.SI-ID 16909145]

6. COTIČ, P., JAGLIČIĆ, Z., BOSILJKOV, V. Validation of non-destructive characterization of the structure and seismic damage propagation of plaster and texture in multi-leaf stone masonry walls of cultural-artistic value. Journal of cultural heritage, ISSN 1296-2074, 2014, vol. 15, iss. 5, str. 490-498, ilustr. http://dx.doi.org/10.1016/j.culher.2013.11.004. [COBISS.SI-ID 16804697]
7. URANJEK, M., ŽARNIĆ, R., BOKAN-BOSILJKOV, V., BOSILJKOV, V. Seizmička otpornost zidanih kamenih građevina i utjecaj injektiranja = Seismic resistance of stone masonry building and effect of grouting. Građevinar, ISSN 0350-2465, 2014, letn. 66, št. 8, str. 715-726, ilustr., doi: 10.14256/JCE.1031.2014. [COBISS.SI-ID 6721889]
8. KRŽAN, M., GOSTIČ, S., BOSILJKOV, V. Application of different in-situ testing techniques and vulnerability assessment of Kolizej palace in Ljubljana. Bulletin of earthquake engineering, ISSN 1570-761X, [v tisku] 2014, letn. XX, št. X, str. 1-22, ilustr., doi: 10.1007/s10518-014-9639-4. [COBISS.SI-ID 6642529]
9. CALDERINI, C., ABBATI, S. D., COTIČ, P., KRŽAN, M., BOSILJKOV, V. In-plane shear tests on masonry panels with plaster: correlation of structural damage and damage on artistic assets. Bulletin of earthquake engineering, ISSN 1570-761X, [v tisku] 2014, letn. XX, št. X, str. 1-20, ilustr., doi: 10.1007/s10518-014-9632-y. [COBISS.SI-ID 6643297]
10. BOSILJKOV, Vlatko, D`AYALA, Dina, NOVELLI, Viviana. Evaluation of uncertainties in determining the seismic vulnerability of historic masonry buildings in Slovenia: use of macro-element and structural element modelling. Bulletin of earthquake engineering, ISSN 1570-761X, [v tisku] 2014, letn. XX, št. X, str. 1-19, ilustr., doi: 10.1007/s10518-014-9652-7. [COBISS.SI-ID 6649441]
11. KARATZETZOU, A., PITILAKIS, Kyriazis, KRŽAN, Meta, BOSILJKOV, Vlatko. Soil-foundation-structure interaction and vulnerability assessment of the Neoclassical School in Rhodes, Greece. Bulletin of earthquake engineering, ISSN 1570-761X, [v tisku] 2014, letn. XX, št. X, str. 1-18, ilustr., doi: 10.1007/s10518-014-9637-6. [COBISS.SI-ID 6643809]
12. KRŽAN, Meta, GOSTIČ, Samo, CATTARI, Serena, BOSILJKOV, Vlatko. Acquiring reference parameters of masonry for the structural performance analysis of historical buildings. Bulletin of earthquake engineering, ISSN 1570-761X, [v tisku] 2014, letn. XX, št. X, str. 1-34, ilustr., doi: 10.1007/s10518-014-9686-x. [COBISS.SI-ID 6794849]
13. CATTARI, Serena, LAGOMARSINO, Sergio, BOSILJKOV, Vlatko, D`AYALA, Dina. Sensitivity analysis for setting up the investigation protocol and defining proper confidence factors for masonry buildings. Bulletin of earthquake engineering, ISSN 1570-761X, [v tisku] 2014, letn. XX, št. X, str. 1-23, ilustr., doi: 10.1007/s10518-014-9648-3. [COBISS.SI-ID 6642785]

UČNI NAČRT PREDMETA/COURSE SYLLABUS

Predmet:	Empirično modeliranje okoljskih sistemov
Course title:	Data-driven Modelling of Environmental Systems

Študijski programi in stopnja	Študijska smer	Letnik	Semestri
Grajeno okolje, tretja stopnja, doktorski	Ni členitve (študijski program)		Letni, Zimski

Univerzitetna koda predmeta/University course code: 1697

Predavanja	Seminar	Vaje	Klinične vaje	Druge oblike študija	Samostojno delo	ECTS
30	10	0	0	0	85	5

Nosilec predmeta/Lecturer: Nataša Atanasova

Vrsta predmeta/Course type: Izbirni predmet/Elective course

Jeziki/Languages:

Predavanja/Lectures:	Angleščina, Slovenščina
Vaje/Tutorial:	Slovenščina, Angleščina

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:	Prerequisites:
Vpis v doktorski študij. Predznanje matematike, fizike ter drugih naravoslovnih in tehniških predmetov.	Enrolment to Ph.D. studies. Knowledge of mathematics, physics and other natural sciences and technology subjects

Vsebina:	Content (Syllabus outline):
osnovni koncepti okoljskih modelov populacijske dinamike, nekataliziranih, kataliziranih in encimatskih bio-geo-kemijskih reakcij, kompleksni bio-geo- kemijski modeli, hidrološki in hidravlični modeli modelna paradigma: konceptualni vs. empirični modeli uvod v metode strojnega učenja iz podatkov pregled in analyza različnih primerov uporaba programskega paketa WEKA priprava podatkov za dinamično modeliranje z nedinamičnimi orodji modeliranje in analiza modelov- natančnost in interpretacija	basic concepts of environmental models of e.g. population dynamics, noncatalytic, catalytic and enzymatic bio-geo-chemical reactions, complex bio-geo-chemical models, hydrological and hydraulic models, etc. modeling paradigm: conceptual vs. empirical models introduction to machine learning tools from data review and analysis of different applications use of the program package WEKA data preparation for dynamic modeling with nondynamic tools modelling and model analysis – accuracy and interpretation

Temeljna literatura in viri/Readings:

Jørgensen, S.E., Bendoricchio, G. (2001). Fundamentals of Ecological Modelling, 3rd Ed., Elsevier, 530 str.
Odum, H.T., Odum, E.C. (2000). Modelling for all Scales. An Introduction to System Simulation. Academic Press, 458 str.
Ian H. Witten; Eibe Frank (2005). "Data Mining: Practical machine learning tools and techniques, 2nd Edition". Morgan Kaufmann, San Francisco.
ATANASOVA, Nataša, KOMPARE, Boris. Data Mining and EDSS. In: GARRIDO BASERBA, Manel (Ed.). Environmental Decision Support Systems (EDSSs) : a tool for wastewater management in the XXI century, (Novedar_Consolider, Vol. 8). [Gerona]: Universitat de Girona, 2011, str. 117-144, ilustr. [COBISS.SI-ID 6055009]
Journal of Ecological Modelling

Cilji in kompetence:	Objectives and competences:
Cilji: Študent mora razumeti: osnovni koncepti okoljskih modelov: populacijska dinamika, nekatalizirane, katalizirane in encimatske kemijske reakcije, kompleksni bio- geo-kemijski modeli, hidrološki in hidravlični modeli, itd. ter podatki, ki jih uporabljajo razliko med konceptualnimi in empiričnimi modeli metode modeliranja podatkov in modeliranja okoljskih sistemov **Kompetence**: Študent zna: uporabljati dostopne programske pakete za generiranje in simulacijo modelov. samostojno zgraditi in interpretirati matematični model iz merskih podatkov	**Objectives:** The student shall understand: basic concepts of environmental models: population dynamics, noncatalyitic, catalytic and enzymatic chemical reactions, complex bio-geo-chemical models, hydrological and hydraulic models, etc. and data that they operate with. the difference between conceptual and empirical models data-mining methods for modelling environmental systems **Competences**: Students can: use the accessible modelling tools to generate and simulate models. induce and interpret an empirical ecological model from measured data

Predvideni študijski rezultati:	Intended learning outcomes:
Znanje in razumevanje: študent zna optimalno izkoristiti tako teoretično znanje kot izvedene meritve zna zasnovati robusten, a uporaben model obravnavanega okoljskega sistema	Knowledge and understanding: the student can optimally use the theory as well as the experimental measured data can concept a robust, but useful model of the considered environmental system

Metode poučevanja in učenja:	Learning and teaching methods:
Predavanja, diskusije, učenje na primerih, spoznavanje orodij, izdelava individualne seminarske naloge ter predstavitev seminarja pred kolegi	Lectures, discussions, learning by examples, getting familiar with modeling tools, elaboration and public defense of seminar work in front of the class.

Načini ocenjevanja:	Delež/Weight	Assessment:
Zagovor seminarske naloge ter pisni in/ali ustni izpit, ki obsega vsebino predavanj ter študijskih virov.	100,00 %	Defense of seminary work. Written and/or oral exam from the theoretical part including lecture contents and prescribed literature.

Reference nosilca/Lecturer's references:

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

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]

ATANASOVA, Nataša, DŽEROSKI, Sašo, KOMPARE, Boris, TODOROVSKI, Ljupčo, GAL, Gideon. Automated discovery of a model for dinoflagellate dynamics. Environmental Modelling & Software, ISSN 1364-8152. [Print ed.], 2011, vol. 26, no. 5, str. 658-668, doi: 10.1016/j.envsoft.2010.11.003. [COBISS.SI-ID 24367399]

VOLF, Goran, ATANASOVA, Nataša, KOMPARE, Boris, PRECALI, Robert, OŽANIĆ, Nevenka. Descriptive and prediction models of phytoplankton in the northern Adriatic. Ecological modelling, ISSN 0304-3800, vol. 222, no. 14, 2011), doi: 10.1016/j.ecolmodel.2011.02.013. [COBISS.SI-ID 6320993]

ATANASOVA, Nataša, KOMPARE, Boris. Data Mining and EDSS. V: GARRIDO BASERBA, Manel (ur.). Environmental Decision Support Systems (EDSSs) : a tool for wastewater management in the XXI century, (Novedar_Consolider, Vol. 8). [Gerona]: Universitat de Girona, 2011, str. 117-144, ilustr. [COBISS.SI-ID 6055009]

UČNI NAČRT PREDMETA/COURSE SYLLABUS

Predmet:	Geoarheologija
Course title:	Geoarchaeology

Študijski programi in stopnja	Študijska smer	Letnik	Semestri
Grajeno okolje, tretja stopnja, doktorski	Ni členitve (študijski program)		Letni, Zimski

Univerzitetna koda predmeta/University course code: 1286

Predavanja	Seminar	Vaje	Klinične vaje	Druge oblike študija	Samostojno delo	ECTS
20	20	0	0	85	0	5

Nosilec predmeta/Lecturer: Nina Zupančič

Vrsta predmeta/Course type: Izbirni predmet/Elective course

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

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:	**Prerequisites:**
Vpis v prvi ali drugi letnik doktorskega programa. Poznavanje osnov mineralogije in geokemije.	Matriculation in first or second year of Ph.D. study. Basic knowledge of mineralogy and geochemistry.

Vsebina:	**Content (Syllabus outline):**
- Uvod v arheologijo. Prazgodovinska obdobja. Zgodovinska obdobja. - Pregled nedestruktivnih in destruktivnih analitskih metod (radiometrično datiranje, stabilni izotopi, INAA, ICP- ES in MS, termoluminiscenca, elektronska spinska resonanca, optično stimulirana luminiscenca, SEM-EDS, rentgenska difrakcija, mikroskopija, statistične metode) - Arheološki materiali in njihove lastnosti (kamen, keramika, estrihi, ometi, malta, opleski) - Ugotavljanje izvora surovin - Ugotavljanje tehnologije izdelave - Interpreatcija rezultatov	- Introduction to geoarcheaology. Prehistoric periods. Historic periods. -Undestructive and destructive analytical techniques (radiometric dating, stable isotopes, INAA, ICP- ES and MS, termoluminiscence, electronic spin resonance, optical stimulated luminiscence, SEM- EDS, X-ray diffraction, microscopy, statistical methods) - Archaeological materials and their properties (stone, ceramics, estrich, plaster, mortar, paintings) - Determination of source material - Determination of manufacturing techniques - Interpretation of results

Temeljna literatura in viri/Readings:

Izbrana poglavja iz knjig in revij, glede na obseg izbranih ECTS/Selected chapters from books and journal papers according to the range of selected ECTS:

1. Goldberg, P. & Macphail, R. 2006: Practical and Theoretical Geoarchaeology. Blackwell Publishing, 472 pp.
2. Hertz, N. & Garrison. 1998: Geological Methods for Archaeology. Oxford University Press, 342 pp.
3. Goldberg, P., Holliday, V.T. & Reid Ferring, C. 2000: Earth Sciences and Archaeology. Kluwer Academic/Plenum Publishers, 513 pp.
4. Garrison, E. 2010: Techniques in Archaeological Geology. Springer, 304 pp.
5. Izbrani članki iz relevantnih revij.

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

Študent se seznani z osnovnimi arheološkimi obdobji ter tipi arheološkega materiala. Nauči se uporabiti geološko znanje pri reševanju problemov izvornega material ter tehnik izdelave arheoloških predmetov.	Student learns about basic archaeological periods and types of archaeological materials. Learns how to use geological knowledge for solving the problems of provenience and manufacturing of artefacts.

Predvideni študijski rezultati:	**Intended learning outcomes:**
Znanje in razumevanje: Študent pozna osnove arheologije in geologije. Razume pomen uporabe geoloških metod v arheologiji. Naravoslovne tehnike zna uporabiti pri interpretaciji izvora arheološkega materiala in uporabljenih tehnologij pri njegovi izdelavi.	Knowledge and understanding: The student knows the basics of archeology and geology . Student understood the importance of using geological methods in archeology . He is able to use natural science techniques in the interpretation of the origin of archaeological materials and technologies used in their manufacture.

Metode poučevanja in učenja:	**Learning and teaching methods:**
Predavanja, seminarji, individualne konzultacije	Lectures, seminars and individual consultations

Načini ocenjevanja:	**Delež/Weight**	**Assessment:**
Izdelava in zagovor seminarske naloge	50,00 %	Completed seminar elaborate
Ustni izpit	50,00 %	Oral exam

Reference nosilca/Lecturer's references:

1. JARC, Simona, MANIATIS, Yannis, DOTSIKA, Elissavet, TAMBAKOPOULOS, Dimitris, ZUPANCIC, Nina. Scientic Characterisation of the Pohorje Marbles, Slovenia. Archaeometry 2010, vol 52, issue 2, str. 177-190, 2010. JCR IF: 581
2. JARC, Simona, ZUPANČIČ, Nina. A cathodoluminescence and petrographical study of marbles from the Pohorje area in Slovenia. Chem. Erde, 2009,vol. 69, issue 1, str. 75-80, 2009. JCR IF: 1.261
3. 3. ZUPANČIČ, Nina, ŠEBELA, Stanka, MILER, Miloš. Mineralogical and chemical characteristics of black coatings in Postojna cave system. Acta carsologica, vol. 40, issue 2, str. 307-317, 2011. JCR IF: 0.727

UČNI NAČRT PREDMETA/COURSE SYLLABUS

Predmet:	Geofizikalne metode raziskav
Course title:	Geophysical Investigation Methods

Študijski programi in stopnja	Študijska smer	Letnik	Semestri
Grajeno okolje, tretja stopnja, doktorski	Ni členitve (študijski program)		Letni, Zimski

Univerzitetna koda predmeta/University course code: 1287

Predavanja	Seminar	Vaje	Klinične vaje	Druge oblike študija	Samostojno delo	ECTS
20	10	10	0	85	0	5

Nosilec predmeta/Lecturer: Andrej Gosar

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:
Ni posebnih pogojev.	None.

Vsebina:	Content (Syllabus outline):
- Refleksijska seizmična metoda: metoda skupne sredinske točke, hitrostna analiza, statične in dinamične korekcije, večkratni refleksi, migracija podatkov, ločljivost, interpretacija, značilni strukturni in sedimentološki stili, sintetični seizmogrami, 3D refleksijska seizmika, naftne seizmične raziskave, visokoločljiva refleksijska seizmika. - Refrakcijska seizmična metoda: metodi presečnega časa in razdalje prehitevanja, čas zakasnitve, nagnjene plasti, prelom, zvezno naraščanje hitrosti z globino, skrita plast in inverzija hitrosti, generalizirana recipročna metoda, globoke seizmične raziskave. - Posebne seizmične raziskave: seizmične meritve v vrtinah, vertikalno seizmično profiliranje, seizmična tomografija, raziskave s strižnimi valovi. - Geoelektrične metode: lastni potencial, telurika in magnetotelurika, upornostne metode: vertikalno električno sondiranje, električno kartiranje, električna tomografija, inducirana polarizacija, kvalitativna in kvantitativna interpretacija. - Elektromagnetne metode: pasivne in aktivne metode, dielektričnost kamnin, primarno in sekundarno EM polje, kožna globina, TURAM, VLF, SLINGRAM, TDEM, zračne EM metode, georadar. - Gravimetrija: težnostni popravki, vrste gravimetrov, Bouguerjeva anomalija, regionalna in lokalna težnostna anomalija ter postopki ločevanja, grafične metode ločevanja polj, prilagajanje površin, interpolacija v	- Reflection seismic method: common midpoint method, velocity analysis, static and dynamic corrections, multiple reflections, migration, data resolution, interpretation, structural and stratigraphic styles, synthetic seismograms, 3D reflection seismics, seismic investigations for oil, high-resolution reflection seismics. - Refraction seismic method: time-intercept in crossover methods, delay time, dipping layers, fault, continuous increase of velocity with depth, hidden layer and velocity inversion, generalized reciprocal method, deep seismic sounding. - Special seismic methods: seismic measurements in boreholes, vertical seismic profiling, seismic tomography, shear-waves investigations. - Geoelectrical methods: self-potential, telluric and magnetotelluric methods, resistivity methods: vertical electrical sounding, geoelectrical mapping, electric tomography, induced polarization, qualitative and quantitative interpretation. - Electromagnetic methods: passive and active methods, dielectric properties of rocks, primary and secondary EM field, skin depth, TURAM, VLF, SLINGRAM, TDEM, aerial EM methods, ground penetrating radar. - Gravimetry: gravity corrections, gravity meters, Bougurer anomaly, regional and residual anomaly and methods of field separation, graphic methods, surface fitting, grid interpolation, extension of gravity field,

mreži, podaljšanje težnostnega polja, drugi odvodi, direktna interpretacija (modeliranje), inverzna interpretacija, mikrogravimetrija. - Magnetometrija: magnetizem kamnin, histereza, remanenca, meritve magnetne susceptibilnosti, vrste magnetometrov, aeromagnetne meritve, gradientne meritve, časovne korekcije, odstranitev regionalnega polja, kvalitativna in kvantitativna interpretacija, modeliranje. - Geotermija: izvor Zemljine toplote, termične lastnosti kamnin, temperatura, toplotna prevodnost, gostota toplotnega toka, meritve geotermičnih parametrov, načini prevajanja toplote, geotermalni sistemi, izkoriščanje geotermalne energije, geotermične karte. - Geofizikalna karotaža: geofizikalne meritve v vrtinah, meritve odklona in premera vrtine, elektrokarotaža (normalna, laterolog, mikrolog, indukcijska karotaža), naravna radioaktivnost (gama in spektralna gama karotaža), gostotna (gama-gama) in nevtronska (poroznost) karotaža, akustična karotaža, diplog, slikovna karotaža, korekcije meritev, kvalitativna in kvantitativna interpretacija, določanje geoloških, petrofizikalnih, geokemičnih in hidrogeoloških parametrov.	second derivative, direct interpretation (modelling), inverse interpretation, microgravimetry. - Magnetic methods: magnetic properties of rocks, hysteresis loop, remanence, measurement of magnetic susceptibility, magnetometers, aeromagnetic measurements, gradient measurements, corrections of temporal variations, elimination of regional field, qualitative andquantitative interpretation, modelling.- Geothermy: sources of Earth's heat, thermal properties of rocks, temperature, thermal conductivity, heath-flow density, measurements of geothermal parameters, types of heat transfer, geothermal systems, exploitation of geothermal energy, geothermal maps. - Geophysical well logging: geophysical measurements in boreholes, caliper, electric logging (normal, laterolog, microlog, induction log), natural radioactivity (gamma and spectral gamma log), density (gamma-gamma log), porosity (neutron) log, acoustic log, diplog, image log, corrections of measurements, qualitative and quantitative interpretation, determination of geological, petrophysical, geochemical and hydrogeological parameters.

Temeljna literatura in viri/Readings:

1.) Gosar, A., Ravnik, D. 2007: Uporabna geofizika - univerzitetni učbenik. Naravoslovnotehniška fakulteta, 218 str.
2.) Kaerey, P., Brooks, M., Hill, I. 2002: An introduction to geophysical exploration. Blackwell, 3rd ed., 262 pp.
3.) Reynolds, J.M. 1997: An introduction to applied and environmental geophysics. John Wiley & Sons, 769 pp.
4.) Everett, M.E. 2013: Near-surface applied geophysics. Cambridge University Press, 403 pp.
- članki v domačih in mednarodnih revijah /papers from national and international journals

Cilji in kompetence:	**Objectives and competences:**
Cilji: - poglobiti osnovno znanje o geofiziki Zemlje in geofizikalnih metodah raziskav, - razumevanje principov delovanja geofizikalnih metod raziskav. Kompetence: - zmožnost pridobivanja, obdelave in interpretacije geofizikalnih podatkov, - sposobnost raziskovalnega dela v geofiziki, - sposobnost vključevana geofizikalnih metod v različne geološke raziskave.	Objectives: - deepen the basic knowledge on global geophysics and geophysical investigation methods, - understanding the principles of geophysical investigation methods. Competences: - ability to acquire, process and interpret geophysical data, - ability of research work in geophysics, - ability to include geophysical methods in different geological investigations.

Predvideni študijski rezultati:	**Intended learning outcomes:**
Znanje in razumevanje: - fizikalnih lastnosti kamnin - principov delovanja različnih geofizikalnih metod raziskav - Zemljinih polj (težnostno, magnetno, električno, toplotno) in valovanj (elektromagnetno, seizmično)	Knowledge and understanding: - physical properties of rocks - principles of different geophysical investigation methods - Earth's fields (gravity, magnetic, electric, thermal) and wavefields (electromagnetic, seismic)

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

Predavanja, seminarske vaje za utrditev vsebine predavanj in laboratorijske vaje s praktičnimi primeri v računalniški učilnici, izdelava seminarske naloge	Lectures, seminar exercises, laboratory work with practical examples in computer room, preparation of seminar

Načini ocenjevanja:	**Delež/Weight**	**Assessment:**
Zagovor laboratorijskih vaj	30,00 %	Defence of laboratory work
Zagovor seminarske naloge	20,00 %	Presentation of seminar
Pisni izpit	50,00 %	Written exam

Reference nosilca/Lecturer's references:

1. Gosar, A., Lenart, A. 2010: Mapping the thickness of sediments in the Ljubljana Moor basin (Slovenia) using microtremors. *Bulletin of earthquake engineering*, vol. 8, no. 3, str. 501-518.
2. Rošer, J., Gosar, A. 2010: Determination of Vs30 for seismic ground classification in the Ljubljana area, Slovenia. *Acta geotech. Slov.*, vol. 7, no. 1, str. 60-76.
3. Gosar, A. 2012: Analysis of the capabilities of low frequency ground penetrating radar for cavities detection in rough terrain conditions: the case of Divača cave, Slovenia. *Acta carsologica*, vol. 41, no. 1, str. 77-88.
4. Atanackov, J., Gosar, A. 2013: Field comparison of seismic sources for high resolution shallow seismic reflection profiling on the Ljubljana Moor (central Slovenia). *Acta Geodynamica et Geomaterialia*, Vol. 10, No. 1, str. 19-40.
5. Zajc, M., Pogačnik, Ž., Gosar, A. 2014: Ground Penetrating Radar and structural geological mapping investigation of karst and tectonic features in flyschoid rocks as geological hazard for exploitation. *Int. Journal of Rock Mechanics and Mining Sciences*, 67, 78-87.

UČNI NAČRT PREDMETA/COURSE SYLLABUS

Predmet:	Geoinformatika v znanosti in ontologija nepremičnin
Course title:	Geoinformatics in Science and Ontology of Real Properties

Študijski programi in stopnja	Študijska smer	Letnik	Semestri
Grajeno okolje, tretja stopnja, doktorski	Ni členitve (študijski program)		Letni, Zimski

Univerzitetna koda predmeta/University course code: 1698

Predavanja	Seminar	Vaje	Klinične vaje	Druge oblike študija	Samostojno delo	ECTS
40	60	25	0	0	125	10

Nosilec predmeta/Lecturer: Anka Lisec

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:
Ustrezno poznavanje veščin dela z GIS-orodij.	Appropriate knowledge of GIS tools and GIS skills are required.

Vsebina:	Content (Syllabus outline):
Predmet se izvaja v dveh fazah – v prvem delu se obravnava splošne koncepte geoinformatike in zemljiške administracije. V drugi fazi sta dve usmeritvi po izboru kandidata in sicer: 1. Geoinformatika v znanosti ali 2. Ontologija nepremičnin. Prvi del: osnovni strokovni pojmi oziroma ontologija problemskega področja nepremičnin in geoinformatike; teorije in metode raziskav na področju geoinformatike, prostorskih analiz, urejanja in upravljanja z nepremičninami; raziskovalna problematika geoinformatike in nepremičninske administracije ter tehnološkega in konceptualnega razvoja teh področij; koncepti prostorske podatkovne infrastrukture, zemljiške administracije in prostorsko usposobljene družbe. ***Geoinformatika v znanosti*** Kognitivno zaznavanje prostora, modeliranje stvarnega ali navideznega sveta v GIS, časovni podatki, časovni in geografski referenčni sistemi; Ontologija prostora geografskih razsežnosti, semantika zbirk prostorskih podatkov, podatkovni modeli, semantično povezovanje baz prostorskih podatkov; Razvojno-življenjski ciklus GIS in arhitektura baze GIS;	The course consists of two phases – in the first part, szdent gets knowledge on general concepts in geoinformatics and land administration. In the second phase, there are two selective streams: 1. Geoinformatics in Science or 2. Ontology of Real Properties. First part: basic professional concepts and ontology of realproperty and geoinformatics problem fields. theories and research methods in the fields of geoinformatics, spatial analyses, land and real property management; current research topics in the field of geoinformatics and real property administration as well as research issues from technological and conceptual point of view; concepts of spatial data infrastructure, land administration and spatially enabled society. ***Geoinformatics in Scienc*** Cognitive perception of space, modeling of real and virtual world in GIS, spatial data models and data acquisition, spatial and geographic reference systems; Ontology of geographic space, semantics of spatial data collections, semantic integration of spatial databases, GIS life-cycle and architecture of GIS databases; Development and maintenance of GIS, architecture of GIS;

Kakovost podatkov, ocena in analiza kakovosti prostorskih podatkov in informacij, zagotavljanje kakovosti podatkov in storitev; Medopravilnost ter formalna in industrijska standardizacija področja GI; Pravni in gospodarski in poslovni pomen vidiki tehnologije GIS; Koncept prostorske podatkovne infrastrukture, stroškovna in cenovna politika prostorskih podatkov in storitev, analiza stroškov in koristi v bazah GIS; Analiza prostorskih podatkov v GIS, napredne prostorske analize v GIS, metode prostorske statistike, teorija odločanja in analize v podporo odločanju; Spletni GIS in napredne metode vizualizacije prostorskih podatkov. ***Sklop - Ontologija nepremičnin*** Ontologija nepremičnin, pravni in ekonomski vidik zbirk podatkov o nepremičninah; Semantični (konceptualni) modeli nepremičnin, nepremičninske baze podatkov, integracija zbirk podatkov o zemljiščih/nepremičninah, 3D kataster, časovni vidik nepremičninskih podatkov; Teorija institucionalne stvarnosti, institucije, pravni in institucionalni vidik upravljanja z zemljišči/ nepremičninami; Modeliranje stvarnih postopkov, stroškovni vidik in transparentnost postopkov, formaliziranje pravnih osnov na področju upravljanja z nepremičninami; Teorija množičnega vrednotenja nepremičnin, konceptualni model množičnega vrednotenja, sistem za računalniško podprto množično vrednotenje, podatkovna podpora, zakonodaja, predpisi in standardizacija področja; Analize podatkov o nepremičninah v okoljih GIS, metode operacijskih raziskav v GIS, analiza nepremičninskega trga v GIS, množično vrednotenje nepremičnin v GIS, več-namenskost ocenjenih tržnih vrednosti nepremičnin.	Data Quality, Spatial Data and Spatial Information Quality Assessment and Analyses, Quality Assurance for Data and Services; Interoperability, and Formal and Industrial Standardization of GI field; Legal, Economic and Business Aspects of GIS technology; Concept of Spatial Data Infrastructure, Cost and Pricing Policy for Spatial Data and Services, Analyses of Cost and Benefit in GIS Databases; Spatial Data Analysis in GIS, Advanced Spatial Analysis in GIS, Methods of Spatial Statistics, Decision Theory and Spatial Analyses for Dspatial ecision Making; Web-Based GIS and Advanced Methods for Visualization of Spatial Data;. ***Ontology of Real Properties.*** Ontology of Real Properties, Legal and Economic Aspects of Real Property Databases; Semantic (Conceptual) Models of Real Properties, Real Property Databases, Integration of Real Property/Land Databases, 3D Cadastre, Time Aspect of Real Property Data; Institutional Theory of Social Reality, Institutions, Legal and Institutional Aspects of Real Property/ Land Management; Modeling of Real Procedures, Costs and Transparency of Procedures, Formalization of the Legal Basis for Real Property Management; Theory of Real Property Mass Valuation, Conceptual Model of Mass Valuation, Computer Assisted System for Mass Valuation, Data Support, Legislation, Regulation and Standardization of the Field; Real Property Data Analyses in a GIS Environment, Methods of operational research in GIS domain, Real Property Market Analysis in GIS, Multi-Purpose of Appraisal of Real Property Market Values.

Temeljna literatura in viri/Readings:

Chaowei Yang, David W. S. Wong, Menas Kafatos, 2008, ***Network GIS***, Springer-Verlag. Cho George, 2005, Geographic Information Science: Mastering the Legal Issues, JohnWiley & Sons.

Wolfgang Kresse, David M. Danko, 2012. ***Springer Handbook of Geographic Information***.

Lake Ron, Burggraf David, Trninić Milan, Rae Lairie, 2004, ***Geography Mark-Up Language (GML),*** John Wiley & Sons.

Kang-Tsung Chang, 2010, ***Introduction to Geographic Information Systems with Data Set CD-ROM*** [Paperback] (McGraw-Hill Higher Education, 6 edition, 2011)

Ramanathan Sugumaran, John Degroote, 2010, ***Spatial Decision Support Systems: Principles and Practices***. November 2010.

Rumbaugh James, Booch Grady, Jacobson Ivar, 2005, ***The Unified Modeling Language Reference Manual***, Addison-Wesley - Object Technology Series.

Smith Barry, 2008, ***The Mystery of Capital and the Construction of Social Reality,*** Open Court Publishing Comp.

Wilkinson J. Sara and Reed G. Richard, 2008, ***Property Development***, Taylor & Francis.

Ian Williamson, Stig Enemark, Jude Wallace, Abbas Rajabifard, 2009. ***Land Administration for sustainable development.*** Esri Press.

Worboys F. Michael, Matt Duckham, 2004, ***GIS: A Computing Perspectve***, Taylor & Francis.

Cilji in kompetence:	Objectives and competences:
Razumevanje strokovnega in znanstvenega področja geodezije in ontologije nepremičnin; poznavanje najnovejših izzivov; Poznavanje prednosti (nujnosti) sistemskega in inženirskega pristopa na področju obravnave; Poznavanje nove tehnologije in konceptov, sposobnost kritične analize prednosti in slabosti; Sposobnost objektivne ocene kakovosti sistemov GIS in zemljiške administracije, kot tudi kakovosti podatkov; kritična uporaba le teh pri prostorskih analizah ter odločitvenih procesih.	Understanding of professional and scientific fields of geoinformatics and ontology of real property; familiarity with the newest challenges in the fields; Ability to recognize the benefits (needs) to use system and engineering approach in the fields of discussion; Familiarity with new technology and cocnepts, ability of critical analyses of waekness and benefits; Ability of objective quality assessment of GIS and land administration systems, as well as data quality and critical data use in spatial analyses and decision procedures.

Predvideni študijski rezultati:	Intended learning outcomes:
Študent pridobi znanja o konceptih, metodologijah, tehnologijah, praktični uporabi in razvojnih usmeritvah ter znanstvenih izzivih na področju geoinformatike in zemljiške administracije oziroma upravljanja in urejanja nepremičnin. Študent pridobi specifična znanja o konceptualizaciji in kritični analizi delovanja geografskih informacijskih sistemov oziroma sistemov zemljiške administracije na osnovi povezanega splošnega teoretičnega znanja s področja tehnike in inženirstva.	The student gets knowledge on concepts, methodologies, technologies, practical applications and development trends as well as scientific challenges in the fields of geoinformation and land administration, i.e. land management. The student will gain specific knowledge on conceptualization and critical analyses of functioning of geographical information systems or systems of land administration – based on combination of theoretical knowledge with knowledge from the fields of technical and engineering fields.

Metode poučevanja in učenja:	Learning and teaching methods:
Predavanja (40 ur), vaje (20 ur) v računalniški učilnici, delo na praktičnih primerih.	Lectures (40 hours), tutorials (20 hours) in the computer room, work on practical examples.

Načini ocenjevanja:	Delež/Weight	Assessment:
Ustni izpit	50,00 %	Oral exam
Naloge, Seminar	50,00 %	Coursework, Seminar

Reference nosilca/Lecturer's references:

1. LISEC, Anka, PRIMOŽIČ, Tomaž, FERLAN, Miran, ŠUMRADA, Radoš, DROBNE, Samo. Land owners' perception of land consolidation and their satisfaction with the results - Slovenian experiences. *Land use policy*, 2014, letn. 38, str. 550-563, doi: 10.1016/j.landusepol.2014.01.003. [COBISS.SI-ID 6476641].

2. HENDRICKS, Andreas, LISEC, Anka. Komasacije pri velikih infrastrukturnih projektih v Nemčiji = Land consolidation for large-scale infrastructure projects in Germany. *Geodetski vestnik*, 2014, letn. 58, št. 1, str. 46-68, doi: 10.15292/geodetski-vestnik.2014.01.046-068. [COBISS.SI-ID 6540897].

3. LISEC, Anka, NAVRATIL, Gerhard. The Austrian land cadastre - from the earliest beginnings to the modern land information system. *Geodetski vestnik*, 2014, letn. 58, št. 3, str. 482-516, doi: 10.15292/geodetski-vestnik.2014.03.482-516. [COBISS.SI-ID 6750561].

4. LISEC, Anka, PIŠEK, Jernej, DROBNE, Samo. Suitability analysis of land use records of agricultural and forest land for detecting land use change on the case of the Pomurska statistical region. *Acta geographica Slovenica*, 2013, 53, št. 1, str. 70-90, doi: 10.3986/AGS53104. [COBISS.SI-ID 35778349].

5. ŠUMRADA, Radoš, FERLAN, Miran, LISEC, Anka. Acquisition and expropriation of real property for the public benefit in Slovenia. *Land use policy*, 2013, letn. 32, str. 14-22, doi: 10.1016/j.landusepol.2012.10.004. [COBISS.SI-ID 6086753]

6. ŠMID HRIBAR, Mateja, LISEC, Anka. Protecting trees through an inventory and typology : heritage trees in the Karavanke mountains, Slovenia. *Acta geographica Slovenica*, 51, št. 1, str. 169-188, doi: 10.3986/AGS51108. [COBISS.SI-ID 33475629].

7. DROBNE, Samo, LISEC, Anka. Multi-attribute Decision Analysis in GIS : Weighted Linear Combination and Ordered Weighted Averaging. *Informatica*, 2009, letn. 33, št. 4, str. 459-474, [COBISS.SI-ID 4806241]

UČNI NAČRT PREDMETA/COURSE SYLLABUS

Predmet:	Geokemijski procesi
Course title:	Geochemical Processes

Študijski programi in stopnja	Študijska smer	Letnik	Semestri
Grajeno okolje, tretja stopnja, doktorski	Ni členitve (študijski program)		Letni, Zimski

Univerzitetna koda predmeta/University course code: 1288

Predavanja	Seminar	Vaje	Klinične vaje	Druge oblike študija	Samostojno delo	ECTS
20	0	20	0	85	0	5

Nosilec predmeta/Lecturer: Nina Zupančič

Vrsta predmeta/Course type: Izbirni predmet/Elective course

Jeziki/Languages:

Predavanja/Lectures:	Slovenščina, Angleščina
Vaje/Tutorial:	Slovenščina, Angleščina

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:	Prerequisites:
Predhodno osvojena znanja iz geokemije, kemije in geologije	Prior knowledge from geochemistry, chemistry and geology

Vsebina:	Content (Syllabus outline):
Predmet je sestavljen iz sledečih področij: - geokemije magmatskih kamnin in njihovih procesov - geokemije metamorfnih kamnin in njihovih procesov - geokemije sedimentnih kamnin in njihovih procesov - geokemije tal in njihovih procesov - geokemije vod in njihovih procesov - geokemije okolja - analitskih tehnik v geokemiji	The course consists of the following fields: - Geochemistry of igneous rocks and their processes - Geochemistry of metamorphic rocks and their processes - Geochemistry of sedimentary rocks and their processes - Soil geochemistry and their processes - Water geochemistry and their processes - Environmental geochemistry - Analytical techniques in geochemistry

Temeljna literatura in viri/Readings:

Izbrana poglavja iz knjig in člankov v revijah v obsegu predvidenih KT / Selected chapters from books and journal papers to the extent of predicted KT:

Knjige / Books:

1.) Li Y. H. 2000: A compendium of geochemistry. Princeton University Press, 475 str., Princeton.
2.) Rollinson, H. 1993: Using geochemical data: evaluation, presentation, interpretation. Longman Scientific & Technical, 352 str., London.
3.) Albarède, F. 1995: Introduction to geochemical modelling. Cambridge University Press, 543 str., Cambridge.
4.) Valley, J. W. & Cole, D. R. 2001: Stable isotope geochemistry, Mineralogical Society of America, 662 str., Washington.
5.) Dickin, A. P. 2005: Radiogenic isotope geology. Cambridge University Press, 492 str., Cambridge.

Revije:

- Chemical Geology
- Geochemica and cosmochemica Acta
- Earth and Planetary Science Letters

- Applied Geochemistry - Journal of Geochemical Exploration - Chemie der Erde.

Cilji in kompetence:	**Objectives and competences:**
Študent poglobi osnovno znanje geokemije. Povdarek bo na razumevanju procesov, ki vodijo do razporeditve kemijskih prvin v različnih vrstah kamnin, tal in vode ter interpretacija njihove geneze z uporabo geokemije ter aplikacija na področje varovanja okolja.	The student extends the basic knowledge of geochemistry. The main goal will be to understand the processes that lead to the distribution of chemical elements in different types of rock, soil and water; to interpret their genesis using geochemistry and their application in the field of environmental protection.

Predvideni študijski rezultati:	**Intended learning outcomes:**
Znanje in razumevanje: Znanje bodo kandidati sposobni uporabiti v eksperimentalnih pristopih študija geokemijskih procesov ter kroženja prvin v naravi s poudarkom na njihovi aplikaciji na področju geologije in varstva okolja.	Knowledge and understanding: Candidates will be able to use the knowledge for experimental approaches to the study of geochemical processes and circulations of elements in nature, with emphasis on their application in the field of geology and environmental protection.

Metode poučevanja in učenja:	**Learning and teaching methods:**
Predavanja, seminarji, individualne konzultacije	Lectures, seminars, individual consultations

Načini ocenjevanja:	**Delež/Weight**	**Assessment:**
Način (pisni izpit, ustno izpraševanje, naloge, projekt) Izdelava in zagovor seminarske naloge ter ustni izpit.	100,00 %	Type (examination, oral, coursework, project): Preparation and presentation of seminar paper and oral exam.

Reference nosilca/Lecturer's references:

ZUPANČIČ, Nina, SKOBE, Simona. Anthropogenic environmental impact in the Mediterranean coastal area of Koper/Capodistria, Slovenia. *Journal of soils and sediments*, 2013, 11 str. ISSN Y503-9819.
SKOBE, Simona, GORIČAN, Špela, SKABERNE, Dragomir, VERBIČ, Tomaž, MIŠIČ, Miha, ZUPANČIČ, Nina. K-feldspar rich shales from Jurassic bedded cherts in Southeastern Slovenia. *Swiss Jour. Geosci.,* 2013, DOI : 10.1007/s00015-013-0147-3. ISSN 1661-8734
ZUPANČIČ, Nina, HORVAT, Aleksander, SKOBE, Simona. Environmental impact of dusting from the bulk cargo terminal on the agricultural soils. *Acta Geographica,* 2015 – *in press.*

UČNI NAČRT PREDMETA/COURSE SYLLABUS

Predmet:	GNSS v geodeziji in geofiziki
Course title:	GNSS in Geodesy and Geophysics

Študijski programi in stopnja	Študijska smer	Letnik	Semestri
Grajeno okolje, tretja stopnja, doktorski	Ni členitve (študijski program)		Letni, Zimski

Univerzitetna koda predmeta/University course code: 1073

Predavanja	Seminar	Vaje	Klinične vaje	Druge oblike študija	Samostojno delo	ECTS
20	10	0	10	0	85	5

Nosilec predmeta/Lecturer: Bojan Stopar

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:
Ni pogojev.	No prereqiusites.

Vsebina:	Content (Syllabus outline):
1) Uvod, definicije in koncepti satelitske geodezije, nameni in koncept GNSS 2) Organizacija in hierarhija služb in organizacij na področju geodezije in geofizike v nalogah realizacije terestričnih koordinatnih sistemov: IAG, IERS, IGS, Federation of Astronomical and Geophysical Data Analysis Services 3) Koordinatni in časovni sistemi v geodeziji in geofiziki, globalni in regionalni terestrični referenčni sistemi ITRS, ITRF, ETRS 4) Tirnice GNSS satelitov, modeliranje tirnic GNSS satelitov, kakovost tirnic GNSS satelitov 5) Opazovanja v GNSS, vplivi na opazovanja v GNSS, določitev položaja v GNSS, omrežja GNSS postaj: globalna, regionalna, lokalna, produkti služb in omrežij GNSS postaj, problem geodetskega datuma v omrežjih GNSS postaj 6) Globalna, regionalna in lokalna geokinematika in geodinamika, kinematika tektonskih litosferskih plošč, Eulerjeva teorija kinematike litosferskih plošč 7) GNSS v študijah globalne in lokalne geodinamike, programska oprema za uporabo GNSS v raziskavah v geodeziji in geodinamiki, GNSS meteorologija, kombinirane geodetske mreže 8) Časovne vrste, Kalmanov filter in kolokacija v geodeziji in geofiziki	1) Introduction, definitions and concepts of satellite geodesy, concept and purpose of GNSS 2) Organization and hierarchy of services on the field of geodesy and geophysics at the realization of terrestrial coordinate systems: IAG, IERS, IGS, Federation of Astronomical and Geophysical Data Analysis Services 3) Coordinate and time systems in geodesy and geophysics, global and regional terrestrial reference systems ITRS, ITRF, ETRS, IGS,... 4) Orbits of GNSS satellites, modeling orbits of GNSS satellites, quality of orbits of GNSS satellites 5) Observations in GNSS, impacts on GNSS observations, position determination in GNSS, networks of GNSS stations: global, regional, local, products of GNSS networks and services, problem of geodetic datum within GNSS networks 6) Global, regional and local geo-kinematics and geodynamics, plate tectonics, Euler theory of plate tectonics 7) GNSS in global and local geodynamics, software packages for GNSS in geodetic and geodynamic research, GNSS meteorology, combined geodetic networks 8) Time series, Kalman filter, collocation in geodesy and geodynamics

Temeljna literatura in viri/Readings:

Knjige/Books
- GPS for geodesy / P.J.G. Teunissen, A. Kleusberg / Berlin, Springer -Verlag, 1998
- GPS Theory, Algorithms and Applications / Guochang Xu / Berlin, Springer - Verlag, 2003
- GPS Satellite Surveying / A. Leick – 3. izdaja, Wiley, 2004
- Geodynamics / D.L. Turcotte, G. Schubert / Cambridge University Press, 2002
- M. S. Grewal, A. P. / Kalman filtering : theory and practice, Englewood CliffsPrentice-Hall, 1993

Revije/Journals
- Journal of Geodesy
- Survey Review
- Journal of Surveying Engineering
- GNSS Solutions
- Journal of Geodynamics
- Journal of Geophysical Research – Solid Earth
- druge znanstvene revije s področja geodezije, geofizike in geoinformatike/other scientific journals on the field of geodesy, geophysics and geoinformatics

Cilji in kompetence:	**Objectives and competences:**
Študenti pridobijo znanja o konceptih, metodologiji in praktični uporabi GNSS tehnologije, s poudarkom na uporabi v geodeziji ter nekaterih področjih geofizike, kot sta geodinamika in GNSS meteorologija. Spoznajo postopke kakovostne obdelave GNSS opazovanj in se usposobijo za nekaj samostojnih uporab tehnologije. Teoretične vsebine se povezujejo s praktičnimi primeri, študenti se naučijo uporabljati teorijo v praksi, so se sposobni odločati in izbirati primerne metode in podatkovne vire za določeno uporabo. Študent izdela projekt, v katerem uporabi GNSS tehnologijo na področju geodezije ali omenjenih področij geofizike.	A student acquires an understanding and knowledge of concepts, methodologies and practical usage of GNSS technologies with the emphasis on the field of geodesy and some areas of geophysics, such as geodynamics and GNSS meteorology. Students get to know procedures of usage of GNSS in some specific tasks and to know of high quality processing of GNSS observations. Theoretical knowledge is further used in case studies from practice with proper decision making. Students get to know how to use information sources and proper data bases on the field of high quality GNSS processing. Students perform a prroject with the usage of GNSS technology on the chosen field of geodesy or geophysics.

Predvideni študijski rezultati:	**Intended learning outcomes:**
Znanje in razumevanje: Poznavanje in razumevanje metod satelitske geodezije. Razumevanje možnosti uporabe GNSS v raziskavah v geodeziji in geodinamiki. Razumevanje kompleksnih sodobnih interdisciplinarnih raziskav v povezavi z Zemljo kot planetom, v katere so vključene geodetske satelitske tehnologije. Zmožnost reševanja praktičnih raziskovalnih problemov s koncepti in tehnologijami GNSS. Študent pridobi potrebno znanje povezovanja in razumevanja teorije in prakse. Študent pridobi teoretično podlago za sodelovanje v interdisciplinarnih raziskovanjih Zemlje.	Knowledge and understanding: Knowledge and understanding of the methods of satellite geodesy. Understanding the possibility of using GNSS research in geodesy and geodynamics. Understanding the complex modern interdisciplinary research in conjunction with the Earth as a planet, involving geodetic satellite technology. Ability to solve practical problems with research concepts and technologies GNSS. Students will acquire the necessary knowledge and understanding of the integration of theory and practice. Students will acquire the theoretical basis for participation in interdisciplinary research of the Earth.

Metode poučevanja in učenja:	**Learning and teaching methods:**
Predavanja v predavalnici z uporabo sodobnih metod poučevanja, predstavitve z računalnikom, praktični primeri. Praktični pouk in vaje v računalniški učilnici, nazorna predstavitev dogajanja v slovenskem državnem omrežju GNSS postaj SIGNAL v realnem času, analize podatkov	Lectures in lecture room with the usage of modern methods of teaching, presentations, presentation of practical cases Practical exercises in computer room, presentation of principles of positioning within GNSS networks with the national GNSS network SIGNAL in real time, analysis of

omrežja SIGNAL, nastajanje in uporaba produktov omrežja SIGNAL. Vaje se izvajajo tudi individualno ali v manjših skupinah z uporabo ustrezne programske opreme.	data in SIGNAL network, production and usage of products of SIGNAL network Exercises are performed individually or in smaller groups with the usage of proper software packages.

Načini ocenjevanja:	**Delež/Weight**	**Assessment:**
Način (pisni izpit, ustno izpraševanje, naloge, projekt) Obveznost študenta je izdelava seminarske naloge, ki predstavlja samostojno raziskovalno delo študenta. Predstavljena je v okviru seminarskih vaj in izdelana v obliki znanstvenega članka.	100,00 %	Type (examination, oral, coursework, project): Student has to perform individual research, which is presented within seminar exercises and prepared in a form of scientific paper.

Reference nosilca/Lecturer's references:

CAPORALI, Alessandro, AICHHORN, C., BARLIK, Marcin, BECKER, M., FEJES, Irén, GERHATOVA, L., GHITAU, D., GRENERCZY, Gyula, HEFTY, Julia, KRAUSS, S., MEDAK, Damir, MILEV, G., MOJZES, M., MULIC, M., NARDO, A., PESEC, P., RUS, T., SIMEK, J., SLEDZINSKI, J., SOLARIC, M., STANGL, G., STOPAR, Bojan, VESPE, F., VIRAG, G. Surface kinematics in the Alpine-Carpathian-Dinaric and Balkan region inferred from a new multi-network GPS combination solution. *Tectonophysics*, ISSN 0040-1951. [Print ed.], September 2009, letn. 474, št. 1-2, str. 295–321.

WEBER, John, VRABEC, Marko, PAVLOVČIČ PREŠEREN, Polona, DIXON, Tim, JIANG, Yan, STOPAR, Bojan. GPS-derived motion of the Adriatic microplate from Istria Peninsula and Po Plain sites and geodynamic implications. *Tectonophysics*, ISSN 0040-1951. [Print ed.], mar. 2010, vol. 483, iss. 3-4, str. 214-222.

PAVLOVČIČ PREŠEREN, Polona, STOPAR, Bojan. Wavelet Neural Network employmnet for continuous GNSS orbit function construction : Application for the Assisted - GNSS principle. *Applied soft computing*, ISSN 1568-4946, 2013, letn. 13, št. 5, str. 2526–2536.

UČNI NAČRT PREDMETA/COURSE SYLLABUS

Predmet:	Gravimetrija v geodeziji
Course title:	Gravimetry in Geodesy

Študijski programi in stopnja	Študijska smer	Letnik	Semestri
Grajeno okolje, tretja stopnja, doktorski	Ni členitve (študijski program)		Letni, Zimski

Univerzitetna koda predmeta/University course code: 1081

Predavanja	Seminar	Vaje	Klinične vaje	Druge oblike študija	Samostojno delo	ECTS
20	10	10	0	85	0	5

Nosilec predmeta/Lecturer: Božo Koler

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:**
Vpis v letnik doktorskega študija.	Enrollment in doctoral study.

Vsebina:	**Content (Syllabus outline):**
MODUL 1: 1) Koncept težnostnega polja Zemlje (dejansko in normalno težnostno polje Zemlje) 2) Absolutna in relativna gravimetrična izmera 3) Gravimetrične mreže MODUL 2: 4) Anomalije težnosti -globalna, regionalna in lokalna obravnava težnostnega polja Z. 5) Fizikalni višinski sistemi in težnostno polje 6) Gravimetrija v študijah globalne in lokalne geodinamike	MODUL 1: 1) Concepts of Earth's gravity field (real and normal gravity field). 2) Absolute and relative gravity measurements. 3) Gravity networks. MODUL 2: 4) Gravity anomalies - global, regional and local structures of the Earth's garvity field. 5) Height systems and Earth's gravity field 6) Gravimetry in the study of global and local geodynamics

Temeljna literatura in viri/Readings:

1) B.Hofman Wellenhof, H. Moritz. 2005. *Physical Geodesy*. Springer (free access)
2) Guochang Xu (ed). 2010. Sciences of Geodesy I, chapters 1, 3, 10 (free access)
3) D. Turcotte, G. Schubert. 2002. *Geodynamics*, Cambridge University Press.

Cilji in kompetence:	**Objectives and competences:**
Študenti se seznanijo s težnostnim poljem Zemlje, različnimi gravimetričnimi merskimi tehnikami in spoznajo pomen gravimetrije za geodezijo in študije geodinamike. Poglobljeno poznavanje težnostnega polja Zemlje. Poznati gravimetrične merske tehnike. Poznati pomen gravimetrije za geodezijo in študije geodinamike.	Students became acquainted with the properties of the Earth' gravity field and its influence on geodetic tasks. They understand various gravimetric survey methods. Deeper understanding of Earth's gravity field. Understanding of gravimetric survey methods. Understanding of importance of gravimetry for solving problems in geodesy and geodynamics.

Predvideni študijski rezultati:	Intended learning outcomes:
Znanje in razumevanje: Razume težnostno polje Zemlje. Pozna razlike med posameznimi gravimetričnimi merskimi tehnikami. Pozna in razume pomen gravimetrije za geodezijo in študije geodinamike.	Knowledge and understanding: Understand the various gravimetric measuring methods. Understand the importance of gravity field research for solving various geodetic and geodynamic problems.

Metode poučevanja in učenja:	Learning and teaching methods:
Predavanja, seminarske vaje za utrditev vsebine predavanj, ter izdelava individualne seminarske naloge na izbrano temo.	Lectures, seminars and individual seminar on the chosen topic.

Načini ocenjevanja:	Delež/Weight	Assessment:
Seminar	60,00 %	Type (examination, oral, coursework, project): Seminar
Vaje	40,00 %	Tutorial

Reference nosilca/Lecturer's references:

1) KOLER, Božo, MEDVED, Klemen, KUHAR, Miran. The new fundamental gravimetric network of Slovenia. *Acta geod. geophys. Hung.*, 2012, letn. 47, št. 3, str. 271-286, ilustr. [COBISS.SI-ID 6010209]
2) KUHAR, Miran, BERK, Sandi, KOLER, Božo, MEDVED, Klemen, OMANG, Ove Christian Dahl, SOLHEIM, Dag. Vloga kakovostnega višinskega sistema in geoida za izvedbo GNSS-višinomerstva = The quality role of height system and geoid model in the realization of GNSS heighting. V: *40. geodetski dan, 6. in 7. maj 2011, Grand hotel Primus, Ptuj : [zbornik prispevkov]*, (Geodetski vestnik, ISSN 0351-0271, Letn. 55, št. 2, 2011). Ljubljana: Zveza geodetov Slovenije, 2011, letn. 55, št. 2, str. 226-234, ilustr. http://www.geodetski-vestnik.com/55/2/gv55-2_226-234.pdf. [COBISS.SI-ID 5578337]
tipologija 1.08 -> 1.01
3) MEDVED, Klemen, KUHAR, Miran, STOPAR, Bojan, KOLER, Božo. Izravnava opazovanj v osnovni gravimetrični mreži Republike Slovenije = Adjustment of gravimetric network of Slovenia. *Geodetski vestnik*, ISSN 0351-0271. [Tiskana izd.], 2009, letn. 53, št. 2, str. 223-237, ilustr. http://www.geodetski-vestnik.com/53/2/gv53-2_223-238.pdf. [COBISS.SI-ID 4658273]
4) RIŽNAR, Igor, KOLER, Božo, BAVEC, Miloš. Recentna aktivnost regionalnih geoloških struktur v zahodni Sloveniji = Recent activity of the regional geologic structures in western Slovenia. *Geologija*, 2007, knj. 50,1, str. 111-120. [COBISS.SI-ID 1448021]
5) KOLER, Božo. Vertical movements in Slovenia from leveling data. V: PINTER, Nicholas, GRENERCZY, Gyula, WEBER, John, STEIN, Seth, MEDAK, Damir. *The Adria microplate: GPS geodesy, tectonics and hazards*, (NATO Science Series, IV, Earth and Environmental Sciences, vol. 61). Dordrecht: Springer, cop. 2006, str. 223-236, graf. prikazi. [COBISS.SI-ID 3093089]

UČNI NAČRT PREDMETA/COURSE SYLLABUS

Predmet:	Hidrogeologija krasa in medzrnskega poroznega medija
Course title:	Hydrogeology of Karst and Intergranular Porous Media

Študijski programi in stopnja	**Študijska smer**	**Letnik**	**Semestri**
Grajeno okolje, tretja stopnja, doktorski	Ni členitve (študijski program)		Letni, Zimski

Univerzitetna koda predmeta/University course code: 1290

Predavanja	**Seminar**	**Vaje**	**Klinične vaje**	**Druge oblike študija**	**Samostojno delo**	**ECTS**
20	10	10	0	0	85	5

Nosilec predmeta/Lecturer: Mihael Brenčič

Vrsta predmeta/Course type: Izbirni predmet/Elective course

Jeziki/Languages:

Predavanja/Lectures:	Slovenščina, Angleščina
Vaje/Tutorial:	Slovenščina, Angleščina

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:	**Prerequisites:**
Poznavanje hidrogeologije in dinamike podzemnih vod na ravni 2.bolonjske stopnje oz. univerzitetne diplome.	Knowledge of hydrogeology and groundwater dynamics equivalent to 2nd Bologna degree (B.Sc.) or university degree.

Vsebina:	**Content (Syllabus outline):**
- dinamika podzemne vode v medzrnskem poroznem mediju, - dinamika podzemne vode v razpoklinskem poroznem mediju, - dinamika podzemne vode v poroznem mediju z dvojno poroznostjo, - dinamika podzemne vode v kraškem vodonosniku, - tok podzemne vode v nezasičenem mediju, - stohastična hidrogeologija, - masni transport v poroznih medijih (medzrnski in razpoklinski), - transport toplote v poroznem mediju, - fizikalna kemija podzemne vode v odvisnosti od dinamike podzemne vode, - hidrogeokemijsko in hidrodinamično modeliranje toka podzemne vode, - voda v geoloških procesih, - aplikacija metod napredne hidrogeologije pri praktičnih primerih.	- groundwater dynamics in intergranular porous media, - groundwater dynamics in fissured porous media, - groundwater dynamics in double porosity media, - groundwater dynamics in karstic aquifer, - unsaturated groundwater flow, - stochastic hydrogeology, - mass transport in porous media (intergranular and fissured media), - heat transport in porous media, - physical chemistry of groundwater in relation to groundwater dynamics, - hydrogeochemistry and hydrodynamical modeling of groundwater, - water in geological processes,- application of advanced hydrogeology methods in practical applications.

Temeljna literatura in viri/Readings:

Izbrana poglavja iz: / Selected chapters from:
Bear, J. & Verrujit, 1987: Modelling Groundwater Flow and Pollution.
Bear, J., 1979: Hydraulics of Groundwarter.
Bear, J., 1972: Dynamics of Fluids in Porous Media.

Bear, J., & Cheng A.H.D., 2010: Modeling Groundwater Flow and Contaminant Transport.
Batu, V., 2006: Applied Flow and Solute Transport Modelling in Aquifers.
Batu, V., 1998: Aquifer Hydraulics.
Fetter, C.W., 1999: Contaminant hydrogeology. Prentice Hall.
Lebbe, L.C., 1999: Hydraulic Parameter Identification.
Rushton, K.K., 2005: Groundwater Hydrology. Wiley.
Zhang, V., 2002: Stochastic Methods in Flow in Porous Media.

Periodika / Periodics: Water Resources Research, Journal of Hydrology, Ground Water, Advances in Water Resources, Hydrogeology Journal, Environmental Geology, Journal of Geophysical Research, Geofluids

Publikacije so na voljo v knjižnicah Univerze v Ljubljani in na spletu / Publications are available in University of Ljubljana libraries and/or through web applications.

Cilji in kompetence:	**Objectives and competences:**
Cilij: Študent se seznani zakonitostmi toka podzemne vode skozi medzrnske, razpoklinske in kanalske naravne porozne medije (sedimente in kamnine) ter z reaktivnim in nereaktivnim masnim transportom in toplotnim tokom skozi porozni medij. Kompetence: Sposobnost analize in simulacije toka podzemne vode v kompleksnih poroznih medijih ter aplikacija teh znanj v praksi. Sposobnost analize in simulacije širjenja toplote in reaktivnih ter nereaktivnih onesnaževal v vodonosnikih različnega tipa.	Goals: Students will obtain knowledge of groundwater flow in granular, fissured and channel porosity media (sediments and rocks) and with reactive and non-reactive mass transport and heat flow in porous media. Competences: Capacity to analyze and simulate groundwater flow in complex porous media and application of this knowledge in engineering practice. Capacity to analyze and simulate heat flow and reactive and no-reactive pollutants in aquifers of various aquifers.

Predvideni študijski rezultati:	**Intended learning outcomes:**
Znanje in razumevanje: Študenti se seznanijo z doseženo stopnjo razvoja v hidrogeološki znanosti in s problemi, tako da so sposobni opravit znanstveno raziskovalno delo pri doseganju novih znanj.	Knowledge and understanding: Students will obtain knowledge about present research problems and knowledge development in the science of hydrogeology. Based on the study they will be able to perform scientific and research work in obtaining new knowledge.

Metode poučevanja in učenja:	**Learning and teaching methods:**
Predavanja, diskusije, učenje na primerih, spoznavanje orodij, izdelava individualne seminarske naloge ter predstavitev seminarja pred kolegi.	Lectures, discussions, case studies discussions, learning tools (numerical models), seminar in written form and presentation in the class.

Načini ocenjevanja:	**Delež/Weight**	**Assessment:**
Pisni izpit	35,00 %	Written examination
Ustno izpraševanje	35,00 %	Oral examination
Naloge in projekt	30,00 %	Coursework and project

Reference nosilca/Lecturer's references:

BRENČIČ, Mihael. Hydrogeochemistry of coastal carbonate aquifer in Lucija-Portorož (Gulf of Trieste, northern Adriatic Sea, Slovenia). *Acta carsologica*, 2009, let. 38, št. 2-3, str. 179-196.
PAVLIČ, Urša, BRENČIČ, Mihael. Application of sequential trend analysis for discharge characterisation of Vipava karstic springs, Slovenia. *Acta carsologica*, 2011, letn. 40, št. 2, str. 283-291
GOSAR, Andrej, BRENČIČ, Mihael. Possible relation between the sudden sinking of river Iška and the sequence of weak earthquakes in september-october 2010 near Iška vas (Central Slovenia). *Acta carsologica*, ISSN 0583-6050, 2012, letn. 41, št. 2/3, str. 265-274, ilustr.

UČNI NAČRT PREDMETA/COURSE SYLLABUS

Predmet:	Hidrološke meritve in hidrološko modeliranje
Course title:	Hydrologic Measurements and Modelling

Študijski programi in stopnja	**Študijska smer**	**Letnik**	**Semestri**
Grajeno okolje, tretja stopnja, doktorski	Ni členitve (študijski program)		Letni, Zimski

Univerzitetna koda predmeta/University course code: 1084

Predavanja	**Seminar**	**Vaje**	**Klinične vaje**	**Druge oblike študija**	**Samostojno delo**	**ECTS**
40	40	0	0	170	0	10

Nosilec predmeta/Lecturer: Mojca Šraj

Vrsta predmeta/Course type: Izbirni predmet/Elective course

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

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:	**Prerequisites:**
Predmet sestavljata dva modula: Hidrologija povirij in Modeliranje površinskih in podzemnih voda. Študent lahko izbere vsak modul posebej ali oba skupaj. Predmet je namenjen prvenstveno diplomantom magistrskih študijev Gradbeništva in Okoljskega gradbeništva, kakor tudi magistrandom nekaterih drugih študijev, kot so geofizika, geologija ali geografija, vendar je za oba modula nujno dobro znanje hidrologije na nivoju magistrskega študijskega programa Gradbeništva, Okoljskega gradbeništva ali Geofizike.	The course constitutes of two modules: Watershed hydrology and Modelling of surface and ground waters. Student can choose either one module or both. The course is meant primarily for graduates of master studies in Civil Engineering and Environmental Civil Engineering, as well as for graduates of some other master studies, such as Geophysics, Geology, and Geography, but for both modules it is essential good knowledge of hydrology on the level of the master studies in Civil Engineering, Environmental Civil Engineering or Geophysics.

Vsebina:	**Content (Syllabus outline):**
MODUL I – HIDROLOGIJA POVIRIJ Posebnosti gozdne hidrologije in hidrologije snega. Meritve prestrezanja padavin. Meritve izhlapevanja in pronicanja vode. Meritve raztopljenih snovi (različnih hranil) v tekočih vodah. Prostorska in časovna razporeditev padavin. Regionalizacija hidroloških parametrov (pretokov, padavin). Modeliranje padavinskega odtoka v povirjih z determinističnimi modeli in modeli s porazdeljenimi parametri (5 ECTS). MODUL II - MODELIRANJE POVRŠINSKIH IN PODZEMNIH VODA. Modeliranje odtoka s porečij. Modeliranje dinamike podzemnih voda. Modeliranje transporta snovi v podzemni vodi. Modeliranje poplavnih valov. Modeliranje vpliva posegov v vodni režim. Meritve režima površinskih in podzemnih voda (5 ECTS).	MODULE I – WATERSHED HYDROLOGY Particularities of forest hydrology and snow hydrology. Measurements of precipitation interception. Measurements of evaporation and infiltration. Measurements of dissolved solids (different nutrients) in running waters. Spatial and temporal distribution of precipitation. Regionalisation of hydrologic parameters (discharges, precipitation). Run-off modelling in headwaters using deterministic models and distributed models (5 ECTS). MODULE II – MODELLING OF SURFACE AND GROUND WATERS Run-off modelling in river basins. Modelling of ground water dynamics. Modelling of solute transport in ground waters. Modelling of flood waves. Modelling of interventions into water regime. Measurements of surface and ground water regime (5 ECTS).

Temeljna literatura in viri/Readings:

Modul I
Knjižni viri (izbrana poglavja):
- Abbott, M.B., Refsgaard, J.C. (ur.) (1996). Distributed hydrological modelling. Water Science and Technology Library, Vol.22, Kluwer Academic Publishers, Dordrecht, 321 str.
- Chang, M. (2006). Forest hydrology – an introduction to water and forests. CRC Press, 474 str.
- Grayson, R., Blöschl, G. (ur.) (2000). Spatial Patterns in Catchment Hydrology – observations and modelling. Cambridge University Press, Cambridge, 404 str.
- Hosking, J.R.M., Wallis, J.R. (1997). Regional frequency analysis: an approach based on L- moments. Cambridge University Press, Cambridge, 224 str.
- Likens, G.G., Bormann, F.H. (1995). Biogeochemistry of a forested ecosystem – 2nd ed., Springer Verlag, New York, 159 str.
- McCuen, R.H. (2003). Modeling Hydrologic Change – Statistical Methods. Lewis Publishers, Boca Raton, 433 str.

Izbrani članki iz periodike in kongresnih objav.
- Bronstert, A., Carrera, J., Kabat, P., Lütkemeier, S. (2005). Coupled Models for the Hydrological Cycle - Integrating Atmosphere, Biosphere and Pedosphere, Springer Verlag, Berlin, 345 str.
- Brutsaert W. (2005). Hydrology. Cambridge University Press, Cambridge, 605 str.
- Haan, C.T. (2002). Statistical Methods in Hydrology, Iowa State Press – a Blackwell Publishing Company, Ames, Iowa, 496 str.
- Sorooshian, S., Hsu, K.-l., Coppola, E., Tomassetti, B., Verdecchia, M., Visconti, G. (2008). Hydrological Modelling and the Water Cycle - Coupling the Atmospheric and Hydrological Models, Water Science and Technology Library, Vol. 63, Springer Verlag, Berlin, 291 str.
- Izbrani članki iz periodike in kongresnih objav (predvsem IAHS Publications).

Cilji in kompetence:	**Objectives and competences:**
Analiza dinamike vodnega režima je možna le s kakovostnimi terenskimi meritvami posameznih hidroloških parametrov, kar je osnova za modeliranje procesov na nivoju povodij. Cilj obeh modulov je naučiti študenta z modernimi možnostmi hidroloških meritev ter z modernimi pristopi v hidrološkem modeliranju, kjer se uporabljajo terenski podatki raziskovalnega monitoringa in rednega monitoringa hidroloških parametrov. Pri tem je modul I usmerjen v povirne dele porečij in v hudourniška območja (prizemni del hidrološkega kroga), modul II pa v podzemne vode in celotna porečja.	Analysis of dynamics of water regime is only possible with qualitative field measurements of single hydrologic parameters that forms a basis for process modelling on the basin level. The objective of both modules is to teach a student modern possibilities of hydrologic measurements and modern approaches in hydrologic modelling, where field data of research monitoring and regular monitoring of hydrologic parameters are used. The module I is oriented into headwaters and torrential watersheds (surface part of the hydrologic circle), module II into ground water and whole river basins.

Predvideni študijski rezultati:	**Intended learning outcomes:**
Znanje in razumevanje: Študent zna izvajati raznolike hidrometrične meritve in uporabljati razpoložljive matematične modele različnih hidroloških pojavov. Študent zna pristopiti k razvoju lastnega hidrološkega modela.	Knowledge and understanding: Student knows how to execute different hydrometric measurments, and how to use existing mathematical models of different hydrologic processes. Student knows how to start developing an own hydrologic model.

Metode poučevanja in učenja:	**Learning and teaching methods:**
Konzultacije, študij strokovne literature, uporaba programskih orodij za modeliranje vplivov na vodni režim, terenske meritve v eksperimentalnih povodjih, uporaba terenske merilne opreme, uporaba podatkov monitoringa v Sloveniji.	Consultations, study of professional literature, usage of programs for modelling impacts on water regime, field measurements in experimental watersheds, usage of field measurement equipment, usage of monitoring data from Slovenia.

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

Način (pisni izpit, ustno izpraševanje, naloge, projekt) izdelava seminarske naloge ali objava v strokovni periodiki	100,00 %	Type (examination, oral, coursework, project): completion of a seminar work or Paper publication in professional periodicals

Reference nosilca/Lecturer's references:

Šraj, M., Brilly, M., Mikoš, M. (2008). Rainfall interception by two deciduous Mediterranean forests of contrasting stature in Slovenia. Agricultural and Forest Meteorology 148(1), 121-134.

Šraj, M., Dirnbek, L., & Brilly, M. (2010). The Influence of Effective Rainfall on Modelled Runoff Hydrograph. Journal of Hydrology and Hydromechanics, 58(1), 3–14.

Šraj, M., Mikoš, M., Brilly, M. (2011). Rainfall interception by deciduous mediterranean forests in Slovenia, Europe. V: DANIELS, Justin A. (ur.). Advances in environmental research, (Advances in Environmental Research, ISSN 2158-5717, 14). New York: Nova Science Publishers, 153-182.

Kjeldsen, T. R., Macdonald, N., Lang, M., Mediero, L., Albuquerque, T., Bogdanowicz, E., …, Šraj, M.,… Wilson, D. (2014). Documentary evidence of past floods in Europe and their utility in flood frequency estimation. Journal of Hydrology, 517, 963–973.

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, ISSN 0885-6087, 2014, letn. XX, št. XX, str. 1-10, ilustr., doi: 10.1002/hyp.10145. [COBISS.SI-ID 6468961]

Bezak, N, Brilly, M, Šraj, M. (2014). Flood frequency analyses, statistical trends and seasonality analyses of discharge data: a case study of the Litija station on the Sava River. Journal of Flood Risk Management, in press. DOI: 10.1111/jfr3.12118

BEZAK, Nejc, BRILLY, Mitja, ŠRAJ, Mojca. Comparison between the peaks over threshold method and the annual maximum method for flood frequency analyses. Hydrological sciences journal, ISSN 0262-6667. [Print ed.], 2014, letn. 59, št. 5, str. 959-977, ilustr., doi: 10.1080/02626667.2013.831174. [COBISS.SI-ID 6315617]

Bezak, N., Mikoš, M., Šraj, M., 2014. Trivariate Frequency Analyses of Peak Discharge, Hydrograph Volume and Suspended Sediment Concentration Data Using Copulas. Water resources management, 28/8, 2195-2212 [COBISS.SI-ID 6578273]

UČNI NAČRT PREDMETA/COURSE SYLLABUS

Predmet:	Hidrološko in geotehnično raziskovanje zemeljskih plazov
Course title:	Hydrologic and Geotechnical Research on Landslides

Študijski programi in stopnja	Študijska smer	Letnik	Semestri
Grajeno okolje, tretja stopnja, doktorski	Ni členitve (študijski program)		Letni, Zimski

Univerzitetna koda predmeta/University course code: 1085

Predavanja	Seminar	Vaje	Klinične vaje	Druge oblike študija	Samostojno delo	ECTS
30	0	10	0	0	85	5

Nosilec predmeta/Lecturer: Ana Petkovšek

Vrsta predmeta/Course type: Izbirni predmet/Elective course

Jeziki/Languages:

Predavanja/Lectures:	Slovenščina, Angleščina
Vaje/Tutorial:	Slovenščina, Angleščina

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:	Prerequisites:
Predmet sestavljata dva modula: *Hidrološko raziskovanje* in *Geotehnično raziskovanje*. Študent izbira posamezni modul ali oba modula. Predmet je prednostno namenjen diplomantov magistrskih študijskih programov *Gradbeništvo* in *Okoljsko gradbeništvo*, kakor tudi drugih magistrskih študijskih programov, kot je *Geologija* in *Geografija*, ki bi želeli poglobiti svoje znanje o terenskih in laboratorijskih raziskavah različnih oblik plazenja na naravnih in umetnih pobočjih ter nasipih. Študent naj bi imel dobro zanje hidrologije in geotehnike ter osnovna znanja računalništva.	The course constitutes of two modules: *Hydrologic research* and *Geotechnical research*. Student can choose either one module or both. The course is meant primarily for graduates of master studies in *Civil Engineering* and *Environmental Civil Engineering*, as well as for graduates of some other master studies, such as *Geology* and *Geography* that wants to deepen their knowledge in field and laboratory research on different landslide forms on natural and artificial slopes, and embankments. Students should have good knowledge in hydrology and geotechnics and basic computer competencies.

Vsebina:	Content (Syllabus outline):
MODUL I – **HIDROLOŠKO RAZISKOVANJE (5 KT)** Hidrološki sprožilni mehanizmi zemeljskih plazov. Predhodne padavine in ekstremne padavine. Meritve padavin, infiltracije padavin in izcejanje podzemnih voda iz globokih drenaž in drenažnih vodnjakov. Interpretacija meritev gladine podzemne vode v piezometrih. Vodna bilanca zemeljskih plazov. Opozorilni in alarmni sistemi. Študij primerov iz prakse in primerov dobre prakse. **MODUL II –** **GEOTEHNIČNO RAZISKOVANJE (5 KT)** Terenske meritve sukcije. Interpretacija meritev v geoloških vrtinah. Laboratorijske raziskave vzorcev plazine in drobirskih tokov. Analiza stabilnosti umetnih in naravnih pobočij. Modeliranje obremenitev	**MODULE I –** **HYDROLOGIC RESEARCH (5 ECTS)** Hydrologic triggering mechanisms of landsliding. Antecedent precipitation and extreme precipitation. Measurements of precipitation, rainfall infiltration, and groundwater ex-filtration from deep drainage works and drainage wells. Interpretation of groundwater level measurements in boreholes (piezometers). Water balance of landslides. Warning and alarm systems. Practical case studies and analyses of good practice. **MODULE II –** **GEOTECHNICAL RESEARCH (5 ECTS)** Field measurements of suction. Interpretation of measurements in geological boreholes. Laboratory research on real samples of landslide and debris-flow masses. Analyses of stability of artificial embankments

zemeljskih plazov na podporne in druge vrste stabilizacijskih objektov.	and natural slopes. Modeling of loads of landslide masses on supportive and other stabilization structures.

Temeljna literatura in viri/Readings:

Printed sources (selected contents):

- Bonnard, C., Forlati, F., Scavia, C. (Eds.) (2004). Identification and Mitigation of Large Landslide Risks in Europe – Advances in Risk Assessment. Balkema Publishers, Leiden, 317 p.
- Bromhead, E., Dixon, N., Ibsen, M.L. (Eds.) (2000). Landslides in Practice, Theory and Practice. Vol.1 & Vol.2 & Vol.3, Thomas Telford, London, 1684 p.
- Cornforth, D.H. (2005). Landslides in Practice – Investigations, Analysis, and Remedial/Preventative Options in Soils. John Wiley & Sons, Hoboken, New Jersey, 596 p.
- Hungr, O., Fell, R., Couture, R., Eberhardt, E. (Eds.) (2005). Landslide Risk Management. A.A. Balkema, Leiden, 764 p.
- Lacerda, W.A., Ehrlich, M., Fontoura, S.A.B., Sayão, A.S.F. (Eds.) (2004). Landslides: Evaluation and Stabilization. Vol.1 & Vol.2, A.A. Balkema, Leiden, 1746 p.
- Lee, E.M., Jones, D.K. (2004). Landslide Risk Assessment. Thomas Telford Publishing, London, 454 p.
- Rybář, J., Stemberk, J., Wagner, P. (Eds.) (2002). Landslides. Balkema Publishers, Lisse, 734 p.
- Sidle, R.C., Ochiai, H. (2006). Landslides – Processes, Prediction, and Land Use. Water resources monograph, No.18, American Geophysical Union, Washington, DC, 312 p.
- Sassa, K., Rouhban, B., Briceno, S., McSaveney, M., He, B. (Eds.) (2013). Landslides: Global Risk Prepardness. Springer Verlag, 386 p.
- Sassa, K., Canuti, P. (Eds.) (2009). Landslides – Disaster Risk Reduction. Springer Verlag, 649 p.

- Sassa, K., Fukuoka, H., Wang, F., Wang, G. (Eds.) (2007). Progress in Landslide Science. Springer Verlag, 378 p.

Veder, C. (1981). Landslides and Their Stabilization. Springer Verlag, New York, 247 p.

Cilji in kompetence:	**Objectives and competences:**
Analiza vzročnih mehanizmov in sprožilnih faktorjev za različne oblike plazenja (naravnih in umetnih materialov) na naravnih pobočjih ali na umetno oblikovanih brežinah (cestni nasipi, deponije, vsečne brežine) zahteva kakovostno načrtovanje in izvedbo terenskih raziskav hidroloških in geoloških parametrov, nadgrajenih z laboratorijskimi študijami lastnosti zemljin (gmot zemeljskih plazov). Načrtovanje in izvedba kakovostnih terenskih meritev in laboratorijskih analiz je pogoj za doktorsko disertacijo na tem raziskovalnem področju. Cilj modula *Hidrološko raziskovanje* je pridobiti teoretične osnove za razumevanje vpliva padavin in vode (podzemne, površinske) na stabilnost pobočij, proženje in napredovanje zemeljskih plazov. Cilj modula *Geotehniško raziskovanje* je uvedba v terensko geotehniško raziskovanje nestabilnih umetnih nasutih brežin in naravnih zemljinskih pobočij.	Analysis of causative mechanisms and releasing factors of different forms of landsliding (of natural and artificial materials) on natural slopes or on artificially formed embankments (road embankments, dumping sites, and cut embankments) requires qualitative planning and execution of field research of hydrologic and geological parameters, upgraded by laboratory studies on soil characteristics (of landslide masses). Planning and execution of qualitative field measurements and laboratory analyses is a condition for a doctoral thesis in this research field. The objective of the module on *Hydrologic research* is to gain theoretical basics for understanding of impacts of precipitation and waters (ground, surface) on slope stability, triggering and advancement of landslides. The objective of the module on *Geotechnical research* is introduction to field geotechnical research on unstable artificial soil embankments and natural soil slopes.

Predvideni študijski rezultati:	**Intended learning outcomes:**
Znanje in razumevanje: **Modul I** Študentje s študijem realnih primerov plazenja tal (zemeljskih plazov) in analizami primerov dobre prakse razvijejo občutek in pridobijo znanje za načrtovanje in izvedbo hidroloških raziskav zemeljskih plazov, posebej hidrološkega ga monitoringa. Študentje razumejo hidrološke vzroke in sprožilne faktorje plazenja tal različnih oblik, in pridobijo zmožnost načrtovanja in izvedbe hidroloških raziskav zemeljskih plazov. **Modul II**	**Knowledge and understanding:** **Module I** By studying of real landslide case studies and analyses of cases of good practice, students develop feeling and gain knowledge for planning and execution of hydrologic research on landslides, especially of hydrologic monitoring. Students understand hydrologic causes and triggering factors of different forms of landslides, and gain the capability of planning and executing hydrologic research on landslides. **Module II**

Študentje znajo načrtovati, izvesti in interpretirati rezultate geološkega vrtanja, izvesti terenske meritve sukcije zemljin v različnih tipih tal, analizirati stabilnost pobočij, in modelirati obtežbo zemeljskih gmot na različne podporne objekte.	Students know how to plan, execute, and interpret research in geological boreholes, to execute field measurements of soil suction in different soil types, to analyze slope stability, and to model loads of landslides masses on different stabilization structures.

Metode poučevanja in učenja:	**Learning and teaching methods:**
Konzultacije, strokovna literatura, študij primerov dobre prakse, terenske meritve na aktivnem zemeljskem plazu (modul I), laboratorijsko delo v geotehničnem laboratoriju (modul II).	Consultations, study of professional literature, study of examples of good practice, field measurements on active landslides (module I), laboratory studies in the Soil Mechanics Laboratory (module II).

Načini ocenjevanja:	**Delež/Weight**	**Assessment:**
Raziskovalna seminarska naloga na izbrano temo.	80,00 %	Seminar research seminar on the selected topic
Ustni zagovor seminarske naloge.	20,00 %	Oral examination form the research seminar.

Reference nosilca/Lecturer's references:

1. Petkovšek, A., Fazarinc, R., Kočevar, M., Maček, M., Mikoš, M., 201 The Stogovce landslide in SW Slovenia triggered during the September 2010 extreme rainfall event. *Landslides*, 8/4, 499-506, [COBISS.SI-ID 5380449]
2. Maček, M., Majes, B., Petkovšek, A., 2011. 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 geotechnica Slovenica*, 8/2, 67-79, [COBISS.SI-ID 5668193]
3. Petkovšek, A., Maček, M., Pavšič, P., Bohar, F., 2010. Fines characterization through the methylene blue and sand equivalent test: comparison with other experimental techniques and application of criteria to the aggregate quality assessment. *Bulletin of engineering geology and the environment*, 69/4, 561-574, [COBISS.SI-ID 4766305]
4. Mikoš, M., Petkovšek, A., Majes, B., 2009. Mechanisms of landslides in over-consolidated clays and flysch : Activity scale and targeted region : national. *Landslides*, 6/4, 367-371, doi: 10.1007/s10346-009-0171-6. [COBISS.SI-ID 4752481]

UČNI NAČRT PREDMETA/COURSE SYLLABUS

Predmet:	Hidrološko in geotehnično raziskovanje zemeljskih plazov
Course title:	Hydrologic and Geotechnical Research on Landslides

Študijski programi in stopnja	**Študijska smer**	**Letnik**	**Semestri**
Grajeno okolje, tretja stopnja, doktorski	Ni členitve (študijski program)		Letni, Zimski

Univerzitetna koda predmeta/University course code: 1086

Predavanja	**Seminar**	**Vaje**	**Klinične vaje**	**Druge oblike študija**	**Samostojno delo**	**ECTS**
60	0	20	0	0	170	10

Nosilec predmeta/Lecturer: Ana Petkovšek

Vrsta predmeta/Course type: Izbirni predmet/Elective course

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

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:	**Prerequisites:**
Predmet sestavljata dva modula: *Hidrološko raziskovanje* in *Geotehnično raziskovanje*. Študent izbira posamezni modul ali oba modula. Predmet je prednostno namenjen diplomantov magistrskih študijskih programov *Gradbeništvo* in *Okoljsko gradbeništvo*, kakor tudi drugih magistrskih študijskih programov, kot je *Geologija* in *Geografija*, ki bi želeli poglobiti svoje znanje o terenskih in laboratorijskih raziskavah različnih oblik plazenja na naravnih in umetnih pobočjih ter nasipih. Študent naj bi imel dobro zanje hidrologije in geotehnike ter osnovna znanja računalništva.	The course constitutes of two modules: *Hydrologic research* and *Geotechnical research*. Student can choose either one module or both. The course is meant primarily for graduates of master studies in *Civil Engineering* and *Environmental Civil Engineering*, as well as for graduates of some other master studies, such as *Geology* and *Geography* that wants to deepen their knowledge in field and laboratory research on different landslide forms on natural and artificial slopes, and embankments. Students should have good knowledge in hydrology and geotechnics and basic computer competencies.

Vsebina:	**Content (Syllabus outline):**
MODUL I – **HIDROLOŠKO RAZISKOVANJE (5 KT)** Hidrološki sprožilni mehanizmi zemeljskih plazov. Predhodne padavine in ekstremne padavine. Meritve padavin, infiltracije padavin in izcejanje podzemnih voda iz globokih drenaž in drenažnih vodnjakov. Interpretacija meritev gladine podzemne vode v piezometrih. Vodna bilanca zemeljskih plazov. Opozorilni in alarmni sistemi. Študij primerov iz prakse in primerov dobre prakse. **MODUL II –** **GEOTEHNIČNO RAZISKOVANJE (5 KT)** Terenske meritve sukcije. Interpretacija meritev v geoloških vrtinah. Laboratorijske raziskave vzorcev plazine in drobirskih tokov. Analiza stabilnosti umetnih in naravnih pobočij. Modeliranje obremenitev	**MODULE I –** **HYDROLOGIC RESEARCH (5 ECTS)** Hydrologic triggering mechanisms of landsliding. Antecedent precipitation and extreme precipitation. Measurements of precipitation, rainfall infiltration, and groundwater ex-filtration from deep drainage works and drainage wells. Interpretation of groundwater level measurements in boreholes (piezometers). Water balance of landslides. Warning and alarm systems. Practical case studies and analyses of good practice. **MODULE II –** **GEOTECHNICAL RESEARCH (5 ECTS)** Field measurements of suction. Interpretation of measurements in geological boreholes. Laboratory research on real samples of landslide and debris-flow masses. Analyses of stability of artificial embankments

zemeljskih plazov na podporne in druge vrste stabilizacijskih objektov.	and natural slopes. Modeling of loads of landslide masses on supportive and other stabilization structures.

Temeljna literatura in viri/Readings:

Printed sources (selected contents):

- Bonnard, C., Forlati, F., Scavia, C. (Eds.) (2004). Identification and Mitigation of Large Landslide Risks in Europe – Advances in Risk Assessment. Balkema Publishers, Leiden, 317 p.
- Bromhead, E., Dixon, N., Ibsen, M.L. (Eds.) (2000). Landslides in Practice, Theory and Practice. Vol.1 & Vol.2 & Vol.3, Thomas Telford, London, 1684 p.
- Cornforth, D.H. (2005). Landslides in Practice – Investigations, Analysis, and Remedial/Preventative Options in Soils. John Wiley & Sons, Hoboken, New Jersey, 596 p.
- Hungr, O., Fell, R., Couture, R., Eberhardt, E. (Eds.) (2005). Landslide Risk Management. A.A. Balkema, Leiden, 764 p.
- Lacerda, W.A., Ehrlich, M., Fontoura, S.A.B., Sayão, A.S.F. (Eds.) (2004). Landslides: Evaluation and Stabilization. Vol.1 & Vol.2, A.A. Balkema, Leiden, 1746 p.
- Lee, E.M., Jones, D.K. (2004). Landslide Risk Assessment. Thomas Telford Publishing, London, 454 p.
- Rybář, J., Stemberk, J., Wagner, P. (Eds.) (2002). Landslides. Balkema Publishers, Lisse, 734 p.
- Sidle, R.C., Ochiai, H. (2006). Landslides – Processes, Prediction, and Land Use. Water resources monograph, No.18, American Geophysical Union, Washington, DC, 312 p.
- Sassa, K., Rouhban, B., Briceno, S., McSaveney, M., He, B. (Eds.) (2013). Landslides: Global Risk Prepardness. Springer Verlag, 386 p.
- Sassa, K., Canuti, P. (Eds.) (2009). Landslides – Disaster Risk Reduction. Springer Verlag, 649 p.

- Sassa, K., Fukuoka, H., Wang, F., Wang, G. (Eds.) (2007). Progress in Landslide Science. Springer Verlag, 378 p.

Veder, C. (1981). Landslides and Their Stabilization. Springer Verlag, New York, 247 p.

Cilji in kompetence:	**Objectives and competences:**
Analiza vzročnih mehanizmov in sprožilnih faktorjev za različne oblike plazenja (naravnih in umetnih materialov) na naravnih pobočjih ali na umetno oblikovanih brežinah (cestni nasipi, deponije, vsečne brežine) zahteva kakovostno načrtovanje in izvedbo terenskih raziskav hidroloških in geoloških parametrov, nadgrajenih z laboratorijskimi študijami lastnosti zemljin (gmot zemeljskih plazov). Načrtovanje in izvedba kakovostnih terenskih meritev in laboratorijskih analiz je pogoj za doktorsko disertacijo na tem raziskovalnem področju. Cilj modula *Hidrološko raziskovanje* je pridobiti teoretične osnove za razumevanje vpliva padavin in vode (podzemne, površinske) na stabilnost pobočij, proženje in napredovanje zemeljskih plazov. Cilj modula *Geotehniško raziskovanje* je uvedba v terensko geotehniško raziskovanje nestabilnih umetnih nasutih brežin in naravnih zemljinskih pobočij.	Analysis of causative mechanisms and releasing factors of different forms of landsliding (of natural and artificial materials) on natural slopes or on artificially formed embankments (road embankments, dumping sites, and cut embankments) requires qualitative planning and execution of field research of hydrologic and geological parameters, upgraded by laboratory studies on soil characteristics (of landslide masses). Planning and execution of qualitative field measurements and laboratory analyses is a condition for a doctoral thesis in this research field. The objective of the module on *Hydrologic research* is to gain theoretical basics for understanding of impacts of precipitation and waters (ground, surface) on slope stability, triggering and advancement of landslides. The objective of the module on *Geotechnical research* is introduction to field geotechnical research on unstable artificial soil embankments and natural soil slopes.

Predvideni študijski rezultati:	**Intended learning outcomes:**
Znanje in razumevanje: **Modul I** Študentje s študijem realnih primerov plazenja tal (zemeljskih plazov) in analizami primerov dobre prakse razvijejo občutek in pridobijo znanje za načrtovanje in izvedbo hidroloških raziskav zemeljskih plazov, posebej hidrološkega ga monitoringa. Študentje razumejo hidrološke vzroke in sprožilne faktorje plazenja tal različnih oblik, in pridobijo zmožnost načrtovanja in izvedbe hidroloških raziskav zemeljskih plazov. **Modul II**	**Knowledge and understanding:** **Module I** By studying of real landslide case studies and analyses of cases of good practice, students develop feeling and gain knowledge for planning and execution of hydrologic research on landslides, especially of hydrologic monitoring. Students understand hydrologic causes and triggering factors of different forms of landslides, and gain the capability of planning and executing hydrologic research on landslides. **Module II**

Študentje znajo načrtovati, izvesti in interpretirati rezultate geološkega vrtanja, izvesti terenske meritve sukcije zemljin v različnih tipih tal, analizirati stabilnost pobočij, in modelirati obtežbo zemeljskih gmot na različne podporne objekte.	Students know how to plan, execute, and interpret research in geological boreholes, to execute field measurements of soil suction in different soil types, to analyze slope stability, and to model loads of landslides masses on different stabilization structures.

Metode poučevanja in učenja:	**Learning and teaching methods:**
Konzultacije, strokovna literatura, študij primerov dobre prakse, terenske meritve na aktivnem zemeljskem plazu (modul I), laboratorijsko delo v geotehničnem laboratoriju (modul II).	Consultations, study of professional literature, study of examples of good practice, field measurements on active landslides (module I), laboratory studies in the Soil Mechanics Laboratory (module II).

Načini ocenjevanja:	**Delež/Weight**	**Assessment:**
Raziskovalna seminarska naloga na izbrano temo.	80,00 %	Seminar research seminar on the selected topic
Ustni zagovor seminarske naloge.	20,00 %	Oral examination form the research seminar.

Reference nosilca/Lecturer's references:

1. Petkovšek, A., Fazarinc, R., Kočevar, M., Maček, M., Mikoš, M., 201 The Stogovce landslide in SW Slovenia triggered during the September 2010 extreme rainfall event. *Landslides*, 8/4, 499-506, [COBISS.SI-ID 5380449]
2. Maček, M., Majes, B., Petkovšek, A., 2011. 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 geotechnica Slovenica*, 8/2, 67-79, [COBISS.SI-ID 5668193]
3. Petkovšek, A., Maček, M., Pavšič, P., Bohar, F., 2010. Fines characterization through the methylene blue and sand equivalent test: comparison with other experimental techniques and application of criteria to the aggregate quality assessment. *Bulletin of engineering geology and the environment*, 69/4, 561-574, [COBISS.SI-ID 4766305]
4. Mikoš, M., Petkovšek, A., Majes, B., 2009. Mechanisms of landslides in over-consolidated clays and flysch : Activity scale and targeted region : national. *Landslides*, 6/4, 367-371, doi: 10.1007/s10346-009-0171-6. [COBISS.SI-ID 4752481]

UČNI NAČRT PREDMETA/COURSE SYLLABUS

Predmet:	Izbrana poglavja s področja hidrotehničnih konstrukcij
Course title:	Selected Topics in the Field of Hydraulics Structures

Študijski programi in stopnja	Študijska smer	Letnik	Semestri
Grajeno okolje, tretja stopnja, doktorski	Ni členitve (študijski program)		Letni, Zimski

Univerzitetna koda predmeta/University course code: 1699

Predavanja	Seminar	Vaje	Klinične vaje	Druge oblike študija	Samostojno delo	ECTS
20	20	0	0	85	0	5

Nosilec predmeta/Lecturer: Andrej Kryžanowski

Vrsta predmeta/Course type: Izbirni predmet/Elective course

Jeziki/Languages:

Predavanja/Lectures:	Angleščina, Slovenščina
Vaje/Tutorial:	Angleščina, Slovenščina

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:	Prerequisites:
Predmet je namenjen predvsem študentom, ki so končali študij gradbeništva in okoljskega inženirstva, kakor tudi kandidatom, ki so končali druge študije. Za sodelovanje pri pouku je predvsem potrebno predhodno znanje inženirske hidrotehnike, mehanike ter tehnologije gradnje na nivoju magistrskega študija gradbeništva.	This course is meant primarly for graduates of master studies in Civil Engineering and Environmental Civil Engineering, as well as forgraduates of some other masterstudies. For attending this course some basic knowledge about Engineering Hydraulics, Mechanics and Constructional Technology on the master studies level of Civil Engineering and Environmental Civil Engineering is necessary.

Vsebina:	Content (Syllabus outline):
Analiza obnašanja velikih pregrad s stališča varnosti pregrad v različnih življenjskih fazah (načrtovanje, gradnja, uporaba, odstranitev objektov) Spoznavanje sodobnih tehnologij gradnje betonskih pregrad (valjani beton, masivni beton, abrazijsko odporen beton,…) Seznanjanje z mehanskih obnašanjem betonskih pregrad Presoja varnosti betonskih pregrad v različnih situacijah Načini ukrepanja za izboljšanje konstrukcijske varnosti pregrad in javne varnosti	Analysis of behaviour of large dams from the perspective of dam safety at different life stages (planning, construction, exploitation, decommission) Overview of modern construction technologies of concrete dams (roller concrete, mass concrete, abrasion resistance concrete,…) Analysis of mechanical behaviour of concrete dams Dam safety assessment in different situations A proposal of actions for improvement of construction and public safety

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
Blindt, H., (1987) Wasserbauten aus Beton, Ernst & Sohn, Berlin, 493 str.
Nonveiller, E., (1983) nasute brane, Školska knjiga, Zagreb, 359 str.
Roberson AJ, Cassidy JJ, Chaudhry MN (1997), Hydraulic Engineering, John Wiley & Sons, str. 653.

Novak P, Moffat AIB, Nalluri C, Narayanan R (1996), Hydraulic Structures, E & FN Spon, str. 599.
Douglas JF, Gasiorek JM, Swaffield JA (2001), Fluid Mechanics, Pearson Education Limited, str. 911.
Melchers RE (2002), Structural Reliability Analysis and Prediction, John Wiley & Sons, str. 437.

Cilji in kompetence:	**Objectives and competences:**
Uvajanje kandidatov v izrazito interdisciplinarno področje obravnavanja hidrotehničnih objektov Razumevanje obnašanja velikih pregrad v različnih fazah njihove življenjske dobe Izdelava ocene varnosti pregrad v primeru različnih dogodkovnih scenarijev	Introduction of candidates in highly iterdisciplinary field of hydraulic structures The understanding of the large dam behavior at their different life stages Based on this knowledge the candidates will be able to asses the dam safety under consideration

Predvideni študijski rezultati:	**Intended learning outcomes:**
Na podlagi pridobljenega znanja o velikih pregradah so kandidati sposobni analizirati obnašanje le teh v vseh fazah življenjske dobe konstrukcije ter na podlagi tega oceniti oziroma podati varnost in ukrepe za povečanje le te.	Based on knowledge on the behavior of large dams the candidates are able and qualified to analyze the structures at different life stages. Besides, they will be able to asses the safety of those structures and to give all the necessary actions to improve their safety.

Metode poučevanja in učenja:	**Learning and teaching methods:**
Konzultacije, študij strokovne in znanstvene literature, analiza praktičnih primerov.	Consultations, study of professional and scientific literature, analysis of practical problems.

Načini ocenjevanja:	**Delež/Weight**	**Assessment:**
Pisni oziroma ustni izpit Izdelava seminarske naloge Objava v različnih revijah	100,00 %	Examination, Oral exam, Seminars Paper publication in Journals

Reference nosilca/Lecturer's references:

1. KRYŽANOWSKI, Andrej, PLANINC, Igor, SCHNABL, Simon. Slip-buckling analysis of longitudinally delaminated composite columns. *Engineering structures*, ISSN 0141-0296. [Print ed.], 2014, letn. 76, str. 404-414, ilustr. [COBISS.SI-ID 6687329]
2. 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, [COBISS.SI-ID 6461281]
3. 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, [COBISS.SI-ID 6408033]
4. KRYŽANOWSKI, Andrej, MIKOŠ, Matjaž, ŠUŠTERŠIČ, Jakob, UKRAINCZYK, Velimir, PLANINC, Igor. Testing of concrete abrasion resistance in hydraulic structures on the lower Sava river. *Strojniški vestnik*, ISSN 0039-2480, apr. 2012, vol. 58, no. 4, str. 245-254. [COBISS.SI-ID 5813601]
5. KRYŽANOWSKI, Andrej, MIKOŠ, Matjaž, ŠUŠTERŠIČ, Jakob, PLANINC, Igor. Abrasion Resistance of Concrete in Hydraulic Structures. *ACI materials journal*, ISSN 0889-325X, julij-avgust 2009, letn. 106, št. 4, str. 349-356, [COBISS.SI-ID 4602209]
6. KRYŽANOWSKI, Andrej, SCHNABL, Simon, TURK, Goran, PLANINC, Igor. Exact slip-buckling analysis of two-layer composite columns. *International journal of solids and structures*, ISSN 0020-7683. [Print ed.], 2009, letn. 46, št. 14-15, str. 2929-2938, ilustr., doi: 10.1016/j.ijsolstr.2009.03.020. [COBISS.SI-ID 4572769]

UČNI NAČRT PREDMETA/COURSE SYLLABUS

Predmet:	Jekla visoke trdnosti v konstrukcijah
Course title:	Structural Application of High Strength Steels

Študijski programi in stopnja	Študijska smer	Letnik	Semestri
Grajeno okolje, tretja stopnja, doktorski	Ni členitve (študijski program)		Letni, Zimski

Univerzitetna koda predmeta/University course code: 1700

Predavanja	Seminar	Vaje	Klinične vaje	Druge oblike študija	Samostojno delo	ECTS
10	20	10	0	0	85	5

Nosilec predmeta/Lecturer: Primož Može

Vrsta predmeta/Course type: Izbirni predmet/elective course

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

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:	Prerequisites:
Opravljena izpita iz predmetov jeklene konstrukcije in nelinearne analize konstrukcij na II. stopnji študija gradbeništva na UL FGG ali osvojeno primerljivo znanje.	Courses in Steel structures and Nonlinear analysis of structures (Master programme in Civil engineering at the University of Ljubljana) or comparable knowledge.

Vsebina:	Content (Syllabus outline):
Jeklo visoke trdnosti (JVT) kot konstrukcijski material in uporaba. Pomen globalne in lokalne duktilnosti za obnašanje jeklenih konstrukcij. Zahteve za zagotavljanje lokalne in globalne duktilnosti. Spoji elementov iz JVT. Možna uporaba JVT v konstrukcijah, izpostavljenih potresnim vplivom. Posebnosti pri lokalni stabilnosti pločevin in stabilnosti elementov. Trajnostni vidik JVT.	High strength steel (HSS) as structural material and structural applicability. Importance of global and local ductility for the behaviour of steel structures. Requirements for ensuring local and global ductility. Joints of HSS elements. The applicability of HSS in structures exposed to seismic actions. Special features in the local plate buckling and global buckling. Sustainability aspect of HSS.

Temeljna literatura in viri/Readings:

P.J. Dowling, J.E. Harding, R. Bjorhovde, Constructional steel design (an international guide), Elsvier Applied Science, 1992.
International Workshop on Connections, zborniki zadnjih treh delavnic (2005, 2008, 2012), AISC-ECCS
Ziemian, R.D: Stability Design Criteria for Metal Structures, 6th Edition, 2010
C M Feldmann, B Kühn, G Sedlacek et al., 2008, Commentary and worked examples to EN 1993-1-10 "material toughness and through thickness properties" and other toughness oriented rules in EN 1993, Eurepean Commision, Joint Research Centre
M. Bruneau, C.M. Uang, A. Whittaker, Ductile design of Steel Structures, McGraw-Hill, 1998
Končna poročila projektov sofinanciranih pod okriljem Raziskovalnega sklada za premog in jeklo (Final reports of the project co-financed by Resaerch Fundation for Coal and Steel)
Članki v mednarodnih revijah (Papers in international journals)

GERVÁSIO, Helena, SANTOS, Paulo, SIMOES DA SILVA, Luis, VASSART, Olivier, HETTINGER, Anne-Laure, HUET, Valérie, MOŽE, Primož (urednik, prevajalec, tehnični urednik), SINUR, Franc (urednik), KORELC, Jože (urednik). Trajnostno vrednotenje jeklenih konstrukcij. Ljubljana: Fakulteta za gradbeništvo in geodezijo, 2014. III, 143 str., ilustr. ISBN 978-961-6884-24-2

Cilji in kompetence:	**Objectives and competences:**
Cilji: Poglobiti in razširiti osnovno znanje o odzivu jeklenih konstrukcij. Spoznati metode za napredno analizo jeklenih konstrukcij in spojev. **Kompetence:** Sposobnost aktivne uporabe pridobljenega znanja pri bodočem razvojnem in raziskovalnem delu. Sposobnost uporabe zahtevnejših programskih orodij za nelinearno analizo jeklenih konstrukcij. Sposobnost analize realnega obnašanja jeklenih konstrukcij. Sposobnost projektiranja zahtevnih jeklenih konstrukcij.	**Objectives:** To extend the basic knowledge on the behaviour of steel structures. To understand the methods for advanced analysis of steel structures and structural components. **Competences:** Capability to actively use the acquired knowledge in the future research and development. Capability to work with advanced software for nonlinear analysis of structures. Capability to analyse real behaviour of steel structures. Capability to design demanding steel structures

Predvideni študijski rezultati:	**Intended learning outcomes:**
Znanje in razumevanje: Poznavanje terminologije in pomembnosti duktilnosti (globalne in lokalne) pri jeklenih konstrukcijah. Sposobnost uporabe numeričnih metod za določitev nosilnosti jeklenih konstrukcij. Poglobljeno znanje s področja duktilnosti in stabilnosti jeklenih konstrukcij je osnova za nadaljne raziskovalno delo na področju jeklenih konstrukcij.	Knowledge and understanding: To get familiar with the terminology and to understand the importance of ductility (local and global) and stability of steel structures. The student will be able to use appropriate numerical method to determine bearing capacity of steel structures. In-depth knowledge of ductility and stability of steel structures is the basis for further research work in the field of steel structures.

Metode poučevanja in učenja:	**Learning and teaching methods:**
Predavanja, vaje, konzultacije, seminarji. Študent pripravi seminarsko nalogo, ki se nanaša na določitev mejne obtežbe jeklene konstrukcije ali konstrukcijskega sklopa. Pri tem redno hodi na konzultacije k nosilcu predmeta, kjer mora poročati o napredku in pripraviti diskusijo o posameznih problemih, ki jih rešuje.	Lectures, seminars, consultations. A student prepares the project work related to the analysis of ultimate resistance of a steel structure or a structural component. Regular consultation with the teacher and report on the progress of work are mandatory.

Načini ocenjevanja:	**Delež/Weight**	**Assessment:**
Način (pisni izpit, ustno izpraševanje, naloge, projekt): Predstavitev in zagovor seminarske naloge.	100,00 %	Type (examination, oral, coursework, project): Presentation of the project work and the oral exam.

Reference nosilca/Lecturer's references:

MOŽE, Primož, BEG, Darko. A complete study of bearing stress in single bolt connections. Journal of Constructional Steel Research, ISSN 0143-974X. [Print ed.], apr. 2014, letn. 95, str. 126-140, ilustr. [COBISS.SI-ID 6514785]
MOŽE, Primož, BEG, Darko. Investigation of high strength steel connections with several bolts in double shear. Journal of Constructional Steel Research, ISSN 0143-974X. [Print ed.], 2011, letn. 67, št. 3, str. 333-347, ilustr., doi: 10.1016/j.jcsr.2010.10.007. [COBISS.SI-ID 5173345]

MOŽE, Primož, BEG, Darko. High strength steel tension splices with one or two bolts. Journal of Constructional Steel Research, ISSN 0143-974X. [Print ed.], 2010, letn. 66, št. 8-9, str. 1000-1010, ilustr., doi: 10.1016/j.jcsr.2010.03.009. [COBISS.SI-ID 5023329]
MOŽE, Primož, BEG, Darko, LOPATIČ, Jože. Net cross-section design resistance and local ductility of elements made of high strength steel. Journal of Constructional Steel Research, ISSN 0143-974X. [Print ed.], 2007, letn. 63, št. 11, str. 1431-1441, ilustr., doi: 10.1016/j.jcsr.2007.01.009. [COBISS.SI-ID 3612001]
MOŽE, Primož, CAJOT, Luis-Guy, SINUR, Franc, REJEC, Klemen, BEG, Darko. Residual stress distribution of large steel equal leg angles. Engineering structures, ISSN 0141-0296. [Print ed.], 2014, letn. 71, št. jul., str. 35-47.
MOŽE, Primož. Ductility and resistance of bolted connections in structures made of high strength steels : doctoral thesis = Duktilnost in nosilnost vijačenih spojev v konstrukcijah narejenih, iz jekel visoke trdnosti : doktorska disertacija. Ljubljana: [P. Može], 2008.
GERVÁSIO, Helena, SANTOS, Paulo, SIMOES DA SILVA, Luis, VASSART, Olivier, HETTINGER, Anne-Laure, HUET, Valérie, MOŽE, Primož (urednik, prevajalec, tehnični urednik), SINUR, Franc (urednik), KORELC, Jože (urednik). Trajnostno vrednotenje jeklenih konstrukcij. Ljubljana: Fakulteta za gradbeništvo in geodezijo, 2014. ISBN 978-961-6884-24-2.

UČNI NAČRT PREDMETA/COURSE SYLLABUS

Predmet:	Kraški procesi in pojavi
Course title:	Karst Processes and Fractals

Študijski programi in stopnja	Študijska smer	Letnik	Semestri
Grajeno okolje, tretja stopnja, doktorski	Ni členitve (študijski program)		Letni, Zimski

Univerzitetna koda predmeta/University course code: 1291

Predavanja	Seminar	Vaje	Klinične vaje	Druge oblike študija	Samostojno delo	ECTS
20	0	20	0	85	0	5

Nosilec predmeta/Lecturer: Timotej Verbovšek

Vrsta predmeta/Course type: Izbirni predmet/Elective course

Jeziki/Languages:

Predavanja/Lectures:	Slovenščina, Angleščina
Vaje/Tutorial:	Slovenščina, Angleščina

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:	Prerequisites:
Ni posebnih pogojev.	No special prerequisites required.

Vsebina:	Content (Syllabus outline):
- Hidrogeokemični procesi v krasu ter v kraško-razpoklinskih kamninah. Procesi v vodnem okolju, zakrasevanje, nastanek in razvoj kraških kanalov - speleogeneza, masni trasport in modeliranje onesnaženja, hidrogeokemično modeliranje procesov raztapljanja, speciacije, mešanja, redoks reakcij in ostalih s programom PHREEQC. **- Hidrogeološki in hidrološki procesi** v krasu, kvantitativna analiza hidrogeoloških in hidroloških procesov in njihovih vplivov na lastnosti in razvoj kraških pojavov. Hidrogeologija kraških in kraško- razpoklinskih vodonosnikov, analize hidroloških mrež in izvirov, črpalni in sledilni poizkusi v kraških in kraško-razpoklinskih kamninah. **- Geomorfološki procesi in pojavi** v krasu, procesi oblikovanja površja in podzemnih oblik v kraških in kraško-razpoklinskih kamninah. Pogojenost kraških oblik s strukturnimi elementi. Sedimentacija v krasu. Geomorfološke analize. **- Fraktalne analize geoloških pojavov in procesov.** Definicija in opis fraktalov, njihova uporaba v geoznanosti. Primerjava in prednosti uporabe fraktalnih metod pred klasičnimi statističnimi metodami. Določanje fraktalne dimenzije geoloških objektov. Enodimenzionalne, dvodimenzionalne (box-counting, mass-dimension, ruler metoda) in tridimenzionalne metode in ekstrapolacije fraktalnih dimenzij med njimi. Problemi pri določevanju fraktalne dimenzije (vzorčenje,	**- Hydrogeochemical processes** in karst and fractured rocks. Processes in aquiatic environment, karstification, speleoinception, the formation and development of karstic channels and cave (speleogenesis), mass transport and pollutant modeling, hydrogeochemical modeling of precipitation/dissolution reactions, speciation, mixing, redox reactions and other hydrogeochemical processes with program PHREEQC. **- Hydrogeological and hydrological processes** in karst, quantitative analysis of hydrogeological and hydrological processes and their influences on the propertiesand development of karst features. Hydrogeology of karst and fractured aquifers, hydrological network and spring analyses, pumping and tracer tests in karstic and fractured rocks. **- Geomorphological processes and features** in karst, processes of development and shaping of karst surface and underground features. Influences of structural elements on karst features. Sedimentation. Geomorphological analyses. **- Fractal analyses of geological processes and features**. Definition and description of fractals, their use in geosciences. Determination of fractal dimension of geological objects. One- dimensional, two-dimensional (box-counting, mass-dimension, ruler methods) and three- dimensional methods and extrapolations of fractal dimensions. Problems with determination of fractal dimensions (sampling, truncation and censoring

okrnitveni in cenzorski efekti). Analiza časovnih podatkov. R-S analiza, variogram, potenčni spekter, Hurstov eksponent. Druge metode. **- Seminarska naloga** (samostojno reševanje izbrane tematike).	effects). Time series analysis.. R-S analysis, variogram, power spectrum, Hurst exponent. Other methods. Part of the lecture contents can be fitted to the specialized interests of the students.. **- Seminar** (independent solving and presentation of selected problem).

Temeljna literatura in viri/Readings:

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

- Appelo, C.A.J. & Postma, D., 2006: Geochemistry, groundwater and pollution. A.A. Balkema, Rotterdam; Brookfield, VT.
- Ford, D. & Williams, P., 2007: Karst geomorphology and hydrology. Wiley.
- Klimchouk, A., B., 2000: Speleogenesis, Evolution of Karst Aquifers (National speleological society.
- National Research Council Rock Fractures and Fluid Flow, 1996: Contemporary Understanding and Applications. Washington: National Academy Press.
- Turcotte, D. L., 1992: *Fractals and Chaos in Geology and Geophysics*. Cambridge University Press.
- Barton, C. & La Pointe, 1995: *Fractals in the Earth Sciences*. Springer.
- Peitgen, H-O., Jürgens, H., Saupe, D., 2004: *Chaos and Fractals. New Frontiers of Science*. Springer.

Periodika (znanstvene in strokovne revije).

Cilji in kompetence:	**Objectives and competences:**
Cilji: - Nadgraditi znanje o geologiji, hidrogeologiji, geokemiji in geomorfologiji kraških in kraško- razpoklinskih kamnin z globljim kvantitativnim razumevanjem procesov, ki oblikujejo te kamnine. - Razumeti, numerično in računalniško analizirati ter modelirati procese in pojave v kraških oz. kraško-razpoklinskih kamninah. - Osvojiti znanje o fraktalih, fraktalnih procesih in uporabnosti fraktalnih metod in o specialnih računalniških metodah za analitično in praktično delo na področju geoloških znanosti. - Primerjati fraktalne metode s klasično geometrijo in klasičnim statističnim pristopom, uporaba v geologiji krasa. **Pridobljene kompetence:** - Nadgrajeno znanje sposobnosti razumevanja kraških procesov in pojavov, njihovega analiziranja ter nadaljnje aplikacije. - Sposobnost analize kompleksnejših analiz, povezanih s prostorskimi in časovnimi podatki. - Sposobnost konceptualnega formuliranja in reševanja problemov, kritična presoja in predstavitev rezultatov	**Goals:** - To upgrade the knowledge on the geology, hydrogeology, geochemistry and geomorphology of karstic and fractured rocks by advanced understanding of processes, affecting these rocks. - To understand and to analyze numerically and by computer modeling the processes and features in karstic and fractured rocks. - To acquire the knowledge on fractals, fractal - processes, applicability of fractal methods and on the selected computer methods the analytical and practical work in the broader field of geology. - To compare the fractal methods with classical geometry and statistical approach, usage in the karst geology. **Competences:** - Ability to understand and analyze karstic processes and features, and their further applications. - Ability to perform complex analyses of spatial and temporal data and processes. - Ability to conceptually formulate and solve problems, critical judgment and presentation of results.

Predvideni študijski rezultati:	**Intended learning outcomes:**
Znanje in razumevanje: - Študent bo spoznal in nadgradil znanje in metodologijo raziskav v krasu, natančneje geomorfološke in hidrogeokemične metode kraških in kraško-razpoklinskih kamnin z globljim kvantitativnim razumevanjem procesov, ki oblikujejo te kamnine.	*Knowledge and understanding:* - Student will gain and upgrade the knowledge and methodology of research in karst, and more in detail geomorphological and hydrogeochemical methods used in karstic and fractured rocks with a deeper understanding of processes, which influence the development of these rocks.

- Poleg tega bo spoznal glavne fraktalne metode raziskovanja v širokem področju geologije in natančneje še njihovo uporabo v kraških in razpoklinskih kamninah.	- Apart from this, he/she will acquire the knowledge of fractal research methods in wider fields of geology and in more detail their application to karstic and fractured rocks.

Metode poučevanja in učenja:	**Learning and teaching methods:**
Predavanja, seminarske in laboratorijske vaje s praktičnim delom v računalniški učilnici ter izdelava seminarske naloge na izbrano temo, terensko delo.	Lectures, seminar and laboratory work on computers, preparation of exam with a selected study topics, field work.

Načini ocenjevanja:	**Delež/Weight**	**Assessment:**
Ocena vaj	20,00 %	laboratory exercises
Seminarska naloga / seminar	30,00 %	Seminar
Pisni ali ustni izpit	50,00 %	Written or oral exam score

Reference nosilca/Lecturer's references:

VERBOVŠEK, Timotej. Influences of aquifer properties on flow dimensions in dolomites. Ground water, ISSN 0017-467X, 2009, issue 5, vol. 47, str. 660-668, doi: 10.1111/j.1745-6584.2009.00577.x.
VERBOVŠEK, Timotej. BCFD - a Visual Basic program for calculation of the fractal dimension of digitized geological image data using a box-counting technique. Geological Quarterly, ISSN 1641-7291, 2009, vol. 53, no. 2, str. 241-248.
VERBOVŠEK, Timotej. Extrapolation of fractal dimensions of natural fracture networks from one to two dimensions in dolomites of Slovenia. Geosciences Journal, ISSN 1226-4806, 2009, vol. 13, no. 4, str. 343-351.

UČNI NAČRT PREDMETA/COURSE SYLLABUS

Predmet:	Lupine in membrane
Course title:	Shell and Membrane Structures

Študijski programi in stopnja	Študijska smer	Letnik	Semestri
Grajeno okolje, tretja stopnja, doktorski	Ni členitve (študijski program)		Letni, Zimski

Univerzitetna koda predmeta/University course code: 1636

Predavanja	Seminar	Vaje	Klinične vaje	Druge oblike študija	Samostojno delo	ECTS
30	0	10	0	0	85	5

Nosilec predmeta/Lecturer: Boštjan Brank

Vrsta predmeta/Course type: Izbirni predmet/Elective course

Jeziki/Languages:

Predavanja/Lectures:	Slovenščina, Angleščina
Vaje/Tutorial:	Slovenščina, Angleščina

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:	Prerequisites:
Končana 2. stopnja tehniške ali tehnološke smeri ali fizike ali matematike.	Completed 2. level in Engineering or Technology or Physics or Mathematics

Vsebina:	Content (Syllabus outline):
Linearne lupine	Linear shells
Geometrijsko točne lupine	Geometrically exact shells
Lupine z vrtajočo rotacijo	Shells with drilling rotation
3d-lupine	3d-shells and solid-shells
Končni elementi za lupine	Shell finite elements
Elastoplastičnost za lupine	Elasto-plasticity for shells
Stabilnost lupin	Shell stability
Kompozitne lupine	Composite shells
Prednapete membrane	Prestressed membranes

Temeljna literatura in viri/Readings:

IBRAHIMBEGOVIĆ, Adnan, BRANK, Boštjan, COURTOIS, Pierre. Stress resultant geometrically exact form of classical shell model and vector-like parameterization of constrained finite rotations. International journal for numerical methods in engineering, ISSN 0029-5981, 2001, vol. 52, issue 11, str. 1235-1252, ilustr. [COBISS.SI-ID 1380449]

BRANK, Boštjan, KORELC, Jože, IBRAHIMBEGOVIĆ, Adnan. Nonlinear shell problem formulation accounting for through-the-tickness stretching and its finite element implementation. Computers & Structures, ISSN 0045-7949. [Print ed.], 2002, vol. 80, n. 9/10, str. 699-717, ilustr. [COBISS.SI-ID1656929]

BRANK, Boštjan. Assessment of 4-node EAS-ANS shell elements for large deformation analysis. Computational mechanics, ISSN 0178-7675, 2008, letn. 42, št. 1, str. 39-51, ilustr. http://www.springerlink.com/content/l5661k6817320676/fulltext.pdf, doi: 10.1007/s00466-007-0233-3. [COBISS.SI-ID3863905]

DUJC, Jaka, BRANK, Boštjan. Stress resultant plasticity for shells revisited. Computer Methods in Applied Mechanics and Engineering, ISSN 0045-7825. [Print ed.], nov. 2012, letn. 247/248, str. 146-165, ilustr. http://drugg.fgg.uni-lj.si/4424/, doi: 10.1016/j.cma.2012.07.012. [COBISS.SI-ID 5921121]

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

Pridobiti osnovno znanje in kompetence s področij: linearne analize lupin, geometrijsko nelinearne analize lupin, elasto-plastične analize lupin, uklona lupin, modelov lupin višjega reda, končnih elementov za lupine in prednapetih membran.	To get introductory knowledge and competences in the fields of: linear shell analysis, geometrically nonlinear shell analysis, elasto-plastic shell analysis, shell buckling, higher-order shell models, shell finite elements, and pre-stressed membranes.

Predvideni študijski rezultati:	**Intended learning outcomes:**
Razumevanje: karakterističnega obnašanja lupinastih konstrukcij, pomembnosti nelinearne analize pri napovedi obnašanja lupin, pomembnosti problema uklona pri lupinah, uporabnosti modelov lupin višjega reda, obnašanja lupinastih končnih elementov, elasto-plastičnih formulacij za lupine.	Understanding of: characteristic behavior of shell structures, importance of nonlinear analysis for shell behavior prediction, importance of shell buckling problem, usability of higher-order shell finite element formulations, limitations of shell finite elements,elasto-plastic shell formulations.

Metode poučevanja in učenja:	**Learning and teaching methods:**
Predavanja bodo v klasični učilnici. Vaje bodo v računalniški učilnici	Leactures will be in a standard classroom. Tutorials will be in a computer laboratory.

Načini ocenjevanja:	**Delež/Weight**	**Assessment:**
Pisni izpit	50,00 %	Examination
Projekt	50,00 %	Project

Reference nosilca/Lecturer's references:

DUJC, Jaka, BRANK, Boštjan. Stress resultant plasticity for shells revisited. Computer Methods in Applied Mechanics and Engineering, ISSN 0045-7825. [Print ed.], nov. 2012, letn. 247/248, str. 146-165, ilustr. http://drugg.fgg.uni-lj.si/4424/, doi: 10.1016/j.cma.2012.07.012. [COBISS.SI-ID 5921121]

BOHINC, Uroš, BRANK, Boštjan, IBRAHIMBEGOVIĆ, Adnan. Discretization error for the Discrete Kirchoff plate finite element approximation. Computer Methods in Applied Mechanics and Engineering, ISSN 0045-7825. [Print ed.], feb. 2014, letn. 269, str. 415-436, ilustr., doi:10.1016/j.cma.2013.11.011. [COBISS.SI-ID 6422369], [JCR, SNIP, WoS do 10. 3. 2014: št. citatov (TC): 0, čistih citatov (CI): 0, normirano št. čistih citatov (NC): 0, Scopus do 26. 12. 2013: št. citatov (TC): 0, čistih citatov (CI): 0, normirano št. čistih citatov (NC): 0]

BOHINC, Uroš, IBRAHIMBEGOVIĆ, Adnan, BRANK, Boštjan. Model adaptivity for finite element analysis of thin or thick plates based on equilibrated boundary stress resultants. Engineering computations, ISSN 0264-4401, 2009, letn. 26, št. 1/2, str. 69-99, ilustr. [COBISS.SI-ID 4546401], [JCR, SNIP, WoS do 11. 3. 2014: št. citatov (TC): 2, čistih citatov (CI): 0, normirano št. čistih citatov (NC): 0, Scopus do 31. 12. 2013: št. citatov (TC): 3, čistih citatov (CI): 0, normirano št. čistih citatov (NC): 0]

UČNI NAČRT PREDMETA/COURSE SYLLABUS

Predmet:	Matematično modeliranje in turbulenca v hidravliki
Course title:	Mathematical Modelling and Turbulence in Hydraulics

Študijski programi in stopnja	Študijska smer	Letnik	Semestri
Grajeno okolje, tretja stopnja, doktorski	Ni členitve (študijski program)		Letni, Zimski

Univerzitetna koda predmeta/University course code: 1078

Predavanja	Seminar	Vaje	Klinične vaje	Druge oblike študija	Samostojno delo	ECTS
40	0	0	0	0	85	5

Nosilec predmeta/Lecturer: Matjaž Četina

Vrsta predmeta/Course type: Izbirni predmet/Elective course

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

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:	**Prerequisites:**
Ni posebnih pogojev. Predmet sestavljata dva modula: Matematično modeliranje v hidravliki (I) in Turbulenca v hidravliki (II). Študent lahko izbere vsak modul posebej ali oba skupaj.	No special requirements. The course constitutes of two modules: Mathematical modelling in hydraulics (I) and Turbulence in hydraulics (II). Students can choose either one module or both.

Vsebina:	**Content (Syllabus outline):**
Modul I »Matematično modeliranje v hidravliki« (5 ECTS) - Pomen modeliranja kot orodja pri določevanju smotrnosti človekovih posegov v okolje, prednosti in pomanjkljivosti matematičnih modelov. - Principi matematičnega modeliranja: hidrodinamični, transportno-disperzijski in biokemični moduli in način povezave v kompleksne ekološke modele. Enodimenzijski (1D), dvodimenzijski (2D) in trodimenzijski (3D) modeli; osnovne enačbe – kontinuitetna, dinamična, konvekcijsko difuzijska enačba za transport snovi, enačbe za opis biokemičnih procesov pri širjenju hraniv, kemičnih ali bioloških polutantov, naftnih derivatov itd.. Pregled numeričnih metod, modelov turbulence ter vpliva toplotne in gostotne stratifikacije, opis računalniških programov, diagrami poteka. - Podrobnejša obravnava hidrodinamičnega modula kot osnovnega gradnika kompleksnih ekoloških modelov. Posplošitev osnovnih enačb hidravlike nestalnega toka za sorodne probleme (valovi v odprtih koritih, snežni plazovi, murasti in blatni tokovi, vodni udar, hemodinamika) Robni pogoji in numerične metode reševanja (metoda karakteristik, metode končnih razlik in končnih volumnov, metoda	**Module I »Mathematical modelling in hydraulics« (5 ECTS)** - A role of modelling as a tool to predict the influence of human activities on the environment, advantages and disadvantages of mathematical models. - Principles of mathematical modelling: hydrodynamic, transport-dispersion and bio-chemical modulesand their connection into complex ecological models. One-dimensional (1D), two-dimensional (2D) and three-dimensional (3D) models; basic equations – continuity, momentum, advection-diffusion equation for transport of matter, equations of bio-chemical processes at spreading of nutrients, chemical or biological pollutants, oil slicks etc.. The review of numerical methods, turbulence models and the influence of temperature and density stratification, the description of computer codes, flow charts. - A detailed description of hydrodynamic module as a basic part of complex ecological models. The generalization of basic equations of unsteady flow hydraulics for similar problems (waves in open channels, snow avalanches, debris flows, water hammer, hemodynamics). Boundary conditions and numerical solution methods (method of characteristic, finite difference and finite volume methods, SPH method).

SPH). Verifikacija, analiza občutljivosti, umerjanje in validacija modelov. - Primeri uporabe matematičnega modeliranja za hidrotehnične probleme. **Modul II »Turbulenca v hidravliki« (5 ECTS)** - Opis pojava turbulence: osnovne značilnosti, različni pristopi k reševanju. - Kolmogorova makro in mikro merila. Vloga turbulence pri transportu in disperziji polutantov in toplote ter pri biokemičnih procesih. - Osnovne enačbe: izpeljava Reynoldsovih enačb in konvekcijsko-difuzijske enačbe za turbulentni tok, Fickov zakon. - Modeli turbulence: Boussinesquov princip, modeli z eno in z dvema enačbama, k-e model turbulence, modeli z več enačbami za posamezne turbulentne napetosti, princip neposredne simulacije večjih in modeliranja manjših vrtincev. - Disperzija v rekah: določitev koeficientov disperzije, globinsko povprečni k-e model, vpliv hrapavosti dna struge. - Turbulentna viskoznost in disperzija v jezerih in morju: določanje koeficientov, Koutitasov model za določanje koeficientov po vertikali, model Mellor-Yamada. Vpliv stratifikacije na turbulentni transport po vertikali. - Praktični primeri uporabe modelov turbulence v hidravliki.	Verification, sensitivity analysis, calibration and validation of models. - Examples of the use of mathematical models for hydraulic problems. **Module II »Turbulence in hydraulics« (5 ECTS)** - The description of turbulence phenomenon: basic characteristics, different ways of solution. - Kolmogorov's theory of micro and macro scales. The role of turbulence at transport and dispersion of pollutants and heat and at bio-chemical processes. - Basic equations: the derivation of Reynolds' equations and advection-diffusion equation of turbulent flow, Fick's law. - Turbulence models: Boussinesque's principle, models with one and two equations, k-e turbulence model, models with additional equations for individual turbulent stresses, principle of direct simulation of large eddies and modelling of small eddies. - Dispersion in rivers: the determination of dispersion coefficients, depth-averaged k-e model, the influence of river bed roughness. - Turbulent viscosity and dispersion in lakes and the sea: the determination of coefficients, Koutitas' model to determine vertical coefficients, Mellor-Yamada's model. The influence of stratification on the vertical turbulent transport. - Examples of practical applications of turbulence models in hydraulics.

Temeljna literatura in viri/Readings:

Wylie, E.B., Streeter, V.L. (1993): Fluid Transients in Systems, Prentice Hall, 463 pp.
Jørgensen, S.E., Bendoricchio, G. (2001). Fundamentals of Ecological Modelling, 3rd Ed., Elsevier, 530 pp.
Violeau, D. (2012): Fluid Mechanics and the SPH Method - Theory and Applications, Oxford University Press, 616 pp. (selected Chapters)
Rodi, W. (1993): Turbulence Models and Their Application in Hydraulics, A state-of-the-art review, A.A. Balkema, Rotterdam, 104 pp.
Rodi, W., Constatinescu, G., Stoesser, T. (2013): Large-Eddy Simulation in Hydraulics, IAHR Monograph, Taylor and Francis, 250 pp.
Electronic sources:
Cvitanović, P. et al. (2003): Chaos: Classical and quantum. Advanced graduate e-textbook. Accessible at ChaosBook.org (Niels Bohr Institute, Copenhagen), 850 pp.(selected Chapters)

Cilji in kompetence:	**Objectives and competences:**
Modul I »Matematično modeliranje v hidravliki« (5 ECTS) **Cilji:** - Poglobiti osnovno znanje hidromehanike in hidravlike s primeri nestalnega toka v odprtih koritih in v ceveh pod tlakom. - Spoznati posebnosti in načine reševanja gibanja nenewtonskih tekočin - Spoznati, kako povezati znanja mehanike tekočin in okoljskega inženirstva v kompleksne ekološke modele. **Pridobljene kompetence:** - Celovito obvladovanje procesov 1D, 2D in 3D matematičnega modeliranja, uporabe lastne in licenčne programske opreme ter kritične presoje rezultatov. - Sposobnost matematičnega modeliranja najzahtevnejših hidravličnih pojavov nestalnega toka.	**Module I »Mathematical modelling in hydraulics« (5 ECTS)** **Goals:** - To deepen basic knowledge of hydromechanics and hydraulics with cases of unsteady flow in open channels and pressure pipe flow. - To find out special properties and ways of solution of non-newtonian fluid movements. - To find out how to join knowledge from fluid mechanics and environmental engineering into complex ecological models. **Acquired competences:** - To fully control processes of 1D, 2D and 3D mathematical modelling, the use of

- Sposobnost izdelave kvantitativnih inženirskih ocen sprememb kakovosti v površinskih vodah z računalniškimi simulacijami tokov in širjenja onesnaženja. **Modul II »Turbulenca v hidravliki« (5 ECTS)** **Cilji:** - Spoznati pojav turbulence v hidravliki ter razumeti njeno vlogo pri modeliranju tokov in širjenja onesnaženja v površinskih vodah. - Spoznati najnovejše modele turbulence, vključno z osnovami teorije kaosa. **Pridobljene kompetence:** - Sposobnost razumevanja in pravilne uporabe modelov turbulence pri matematičnem modeliranju.	licensed and original computer codes and critical evaluation of results. - Ability of mathematical modelling of complex hydraulic unsteady flow phenomena. - Ability to use numerical simulations of flows and pollutant spreading to produce quantitative engineering assesments of water quality changes in surface waters. **Module II »Turbulence in hydraulics« (5 ECTS)** **Goals:** - To find out the phenomenon of turbulence in hydraulics and to understand its role in modelling of flows and pollutant spreading in surface waters. - To find out up to date turbulence models, including basic theory of chaos. **Acquired competence:** - Ability to understand and to apply turbulence models in the process of mathematical modelling.

Predvideni študijski rezultati:	**Intended learning outcomes:**
Znanje in razumevanje: - Poglobljeno razumevanje osnovnih enačb, ki opisujejo hidravliko nestalnega toka in sposobnost iskanja analogije pri sorodnih pojavih. - Dobro poznavanje numeričnih metod za učinkovito reševanje RANS enačb - Razumevanje pojava turbulence in poznavanje matematičnih modelov za njen opis. - Znati uporabljati sodobne računalniške programe za simulacije toka tekočine.	Knowledge and understanding: - Deeper understanding of basic equations to describe unsteady flow hydraulics and the ability to find analogy in similar phenomena. - Good knowledge in numerical methods for efficient solutions of RANS equations. - To understand the phenomenon of turbulence and to know mathematical models to describe it. - To be able to use up to date computer codes for flow simulations.

Metode poučevanja in učenja:	**Learning and teaching methods:**
Predavanja ter izdelava individualne seminarske naloge (za vsak modul).	Lectures and elaboration of seminar work (for each module).

Načini ocenjevanja:	**Delež/Weight**	**Assessment:**
Zagovor seminarske naloge	50,00 %	Defence of seminar work
Pisni in/ali ustni izpit, ki obsega vsebino predavanj ter študijskih virov	50,00 %	Written and/or oral exam covering the contents of lectures and literature

Reference nosilca/Lecturer's references:

1. Bombač, M., Novak, G., Rodič, P., **Četina, M.**: Numerical and physical model study of a vertical slot fishway. *Journal of Hydrology and Hydromechanics*, 2014, Vol. 62, No. 2, pp. 1-10. [COBISS.SI-ID 6513761]
2. Džebo, E., Žagar, D., Krzyk, M., **Četina, M.**, Petkovšek, G.: Different ways of defining wall shear in smoothed particle hydrodynamics simulations of a dam-break wave. *Journal of hydraulic research*, 2014, Vol. 52, No. 4, pp. 453-464. [COBISS.SI-ID 6616417]
3. Džebo, E., Žagar, D., **Četina, M.**, Petkovšek, G.: Reducing the computational time of the SPH method with a coupled 2-D/3-D approach. *Journal of Mechanical Engineering* (*Strojniški vestnik)*, 2013, Vol. 59, No. 10, pp. 575-584. [COBISS.SI-ID 6269025]
4. Krzyk, M., Klasinc, R., **Četina, M.**: Two-dimensional mathematical modelling of a dam-break wave in a narrow steep stream. *Journal of Mechanical Engineering* (*Strojniški vestnik)*, 2012, Vol. 58, No. 4, pp. 255-262. [COBISS.SI-ID 5819745]
5. Žagar, D., Sirnik, N., **Četina, M.**, Horvat, M., Kotnik, J., Ogrinc, N., Hedgecock, I. M., Cinnirella, S., De Simeone, F., Gencarelli, C. N., Pirrone, N.: Mercury in the Mediterranean. Part 2, Processes and mass balance. V: *16th*

International Conference on Heavy Metals in the Environment, 23 - 27 September, 2012, Rome, Italy. Heidelberg: Springer, 2014, Vol. 21,
No. 6, pp. 4081-4094. [COBISS.SI-ID 26981671]
6. Petkovšek, G., Džebo, E., **Četina, M.**, Žagar, D.: Application of Non-Discrete Boundaries with Friction to Smoothed Particle Hydrodynamics. *Journal of Mechanical Engineering (Strojniški vestnik)*, 2010, Vol. 56, No. 5, pp. 307-315. [COBISS.SI-ID 5094753]

UČNI NAČRT PREDMETA/COURSE SYLLABUS

Predmet:	Matematično modeliranje in turbulenca v hidravliki
Course title:	Mathematical Modelling and Turbulence in Hydraulics

Študijski programi in stopnja	Študijska smer	Letnik	Semestri
Grajeno okolje, tretja stopnja, doktorski	Ni členitve (študijski program)		Letni, Zimski

Univerzitetna koda predmeta/University course code: 1079

Predavanja	Seminar	Vaje	Klinične vaje	Druge oblike študija	Samostojno delo	ECTS
80	0	0	0	0	170	10

Nosilec predmeta/Lecturer: Matjaž Četina

Vrsta predmeta/Course type: Izbirni predmet/Elective course

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

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:	**Prerequisites:**
Ni posebnih pogojev. Predmet sestavljata dva modula: Matematično modeliranje v hidravliki (I) in Turbulenca v hidravliki (II). Študent lahko izbere vsak modul posebej ali oba skupaj.	No special requirements. The course constitutes of two modules: Mathematical modelling in hydraulics (I) and Turbulence in hydraulics (II). Students can choose either one module or both.

Vsebina:	**Content (Syllabus outline):**
Modul I »Matematično modeliranje v hidravliki« (5 ECTS) - Pomen modeliranja kot orodja pri določevanju smotrnosti človekovih posegov v okolje, prednosti in pomanjkljivosti matematičnih modelov. - Principi matematičnega modeliranja: hidrodinamični, transportno-disperzijski in biokemični moduli in način povezave v kompleksne ekološke modele. Enodimenzijski (1D), dvodimenzijski (2D) in trodimenzijski (3D) modeli; osnovne enačbe – kontinuitetna, dinamična, konvekcijsko difuzijska enačba za transport snovi, enačbe za opis biokemičnih procesov pri širjenju hraniv, kemičnih ali bioloških polutantov, naftnih derivatov itd.. Pregled numeričnih metod, modelov turbulence ter vpliva toplotne in gostotne stratifikacije, opis računalniških programov, diagrami poteka. - Podrobnejša obravnava hidrodinamičnega modula kot osnovnega gradnika kompleksnih ekoloških modelov. Posplošitev osnovnih enačb hidravlike nestalnega toka za sorodne probleme (valovi v odprtih koritih, snežni plazovi, murasti in blatni tokovi, vodni udar, hemodinamika) Robni pogoji in numerične metode reševanja (metoda karakteristik, metode končnih razlik in končnih volumnov, metoda	**Module I »Mathematical modelling in hydraulics« (5 ECTS)** - A role of modelling as a tool to predict the influence of human activities on the environment, advantages and disadvantages of mathematical models. - Principles of mathematical modelling: hydrodynamic, transport-dispersion and bio-chemical modulesand their connection into complex ecological models. One-dimensional (1D), two-dimensional (2D) and three-dimensional (3D) models; basic equations – continuity, momentum, advection-diffusion equation for transport of matter, equations of bio-chemical processes at spreading of nutrients, chemical or biological pollutants, oil slicks etc.. The review of numerical methods, turbulence models and the influence of temperature and density stratification, the description of computer codes, flow charts. - A detailed description of hydrodynamic module as a basic part of complex ecological models. The generalization of basic equations of unsteady flow hydraulics for similar problems (waves in open channels, snow avalanches, debris flows, water hammer, hemodynamics). Boundary conditions and numerical solution methods (method of characteristic, finite difference and finite volume methods, SPH method).

SPH). Verifikacija, analiza občutljivosti, umerjanje in validacija modelov. - Primeri uporabe matematičnega modeliranja za hidrotehnične probleme. **Modul II »Turbulenca v hidravliki« (5 ECTS)** - Opis pojava turbulence: osnovne značilnosti, različni pristopi k reševanju. - Kolmogorova makro in mikro merila. Vloga turbulence pri transportu in disperziji polutantov in toplote ter pri biokemičnih procesih. - Osnovne enačbe: izpeljava Reynoldsovih enačb in konvekcijsko-difuzijske enačbe za turbulentni tok, Fickov zakon. - Modeli turbulence: Boussinesquov princip, modeli z eno in z dvema enačbama, k-e model turbulence, modeli z več enačbami za posamezne turbulentne napetosti, princip neposredne simulacije večjih in modeliranja manjših vrtincev. - Disperzija v rekah: določitev koeficientov disperzije, globinsko povprečni k-e model, vpliv hrapavosti dna struge. - Turbulentna viskoznost in disperzija v jezerih in morju: določanje koeficientov, Koutitasov model za določanje koeficientov po vertikali, model Mellor-Yamada. Vpliv stratifikacije na turbulentni transport po vertikali. - Praktični primeri uporabe modelov turbulence v hidravliki.	Verification, sensitivity analysis, calibration and validation of models. - Examples of the use of mathematical models for hydraulic problems. **Module II »Turbulence in hydraulics« (5 ECTS)** - The description of turbulence phenomenon: basic characteristics, different ways of solution. - Kolmogorov's theory of micro and macro scales. The role of turbulence at transport and dispersion of pollutants and heat and at bio-chemical processes. - Basic equations: the derivation of Reynolds' equations and advection-diffusion equation of turbulent flow, Fick's law. - Turbulence models: Boussinesque's principle, models with one and two equations, k-e turbulence model, models with additional equations for individual turbulent stresses, principle of direct simulation of large eddies and modelling of small eddies. - Dispersion in rivers: the determination of dispersion coefficients, depth-averaged k-e model, the influence of river bed roughness. - Turbulent viscosity and dispersion in lakes and the sea: the determination of coefficients, Koutitas' model to determine vertical coefficients, Mellor-Yamada's model. The influence of stratification on the vertical turbulent transport. - Examples of practical applications of turbulence models in hydraulics.

Temeljna literatura in viri/Readings:

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Jørgensen, S.E., Bendoricchio, G. (2001). Fundamentals of Ecological Modelling, 3rd Ed., Elsevier, 530 pp.
Violeau, D. (2012): Fluid Mechanics and the SPH Method - Theory and Applications, Oxford University Press, 616 pp. (selected Chapters)
Rodi, W. (1993): Turbulence Models and Their Application in Hydraulics, A state-of-the-art review, A.A. Balkema, Rotterdam, 104 pp.
Rodi, W., Constatinescu, G., Stoesser, T. (2013): Large-Eddy Simulation in Hydraulics, IAHR Monograph, Taylor and Francis, 250 pp.
Electronic sources:
Cvitanović, P. et al. (2003): Chaos: Classical and quantum. Advanced graduate e-textbook. Accessible at ChaosBook.org (Niels Bohr Institute, Copenhagen), 850 pp.(selected Chapters)

Cilji in kompetence:	**Objectives and competences:**
Modul I »Matematično modeliranje v hidravliki« (5 ECTS) **Cilji:** - Poglobiti osnovno znanje hidromehanike in hidravlike s primeri nestalnega toka v odprtih koritih in v ceveh pod tlakom. - Spoznati posebnosti in načine reševanja gibanja nenewtonskih tekočin - Spoznati, kako povezati znanja mehanike tekočin in okoljskega inženirstva v kompleksne ekološke modele. **Pridobljene kompetence:** - Celovito obvladovanje procesov 1D, 2D in 3D matematičnega modeliranja, uporabe lastne in licenčne programske opreme ter kritične presoje rezultatov. - Sposobnost matematičnega modeliranja najzahtevnejših hidravličnih pojavov nestalnega toka.	**Module I »Mathematical modelling in hydraulics« (5 ECTS)** **Goals:** - To deepen basic knowledge of hydromechanics and hydraulics with cases of unsteady flow in open channels and pressure pipe flow. - To find out special properties and ways of solution of non-newtonian fluid movements. - To find out how to join knowledge from fluid mechanics and environmental engineering into complex ecological models. **Acquired competences:** - To fully control processes of 1D, 2D and 3D mathematical modelling, the use of

- Sposobnost izdelave kvantitativnih inženirskih ocen sprememb kakovosti v površinskih vodah z računalniškimi simulacijami tokov in širjenja onesnaženja. **Modul II »Turbulenca v hidravliki« (5 ECTS)** **Cilji:** - Spoznati pojav turbulence v hidravliki ter razumeti njeno vlogo pri modeliranju tokov in širjenja onesnaženja v površinskih vodah. - Spoznati najnovejše modele turbulence, vključno z osnovami teorije kaosa. **Pridobljene kompetence:** - Sposobnost razumevanja in pravilne uporabe modelov turbulence pri matematičnem modeliranju.	licensed and original computer codes and critical evaluation of results. - Ability of mathematical modelling of complex hydraulic unsteady flow phenomena. - Ability to use numerical simulations of flows and pollutant spreading to produce quantitative engineering assesments of water quality changes in surface waters. **Module II »Turbulence in hydraulics« (5 ECTS)** **Goals:** - To find out the phenomenon of turbulence in hydraulics and to understand its role in modelling of flows and pollutant spreading in surface waters. - To find out up to date turbulence models, including basic theory of chaos. **Acquired competence:** - Ability to understand and to apply turbulence models in the process of mathematical modelling.

Predvideni študijski rezultati:	**Intended learning outcomes:**
Znanje in razumevanje: - Poglobljeno razumevanje osnovnih enačb, ki opisujejo hidravliko nestalnega toka in sposobnost iskanja analogije pri sorodnih pojavih. - Dobro poznavanje numeričnih metod za učinkovito reševanje RANS enačb - Razumevanje pojava turbulence in poznavanje matematičnih modelov za njen opis. - Znati uporabljati sodobne računalniške programe za simulacije toka tekočine.	Knowledge and understanding: - Deeper understanding of basic equations to describe unsteady flow hydraulics and the ability to find analogy in similar phenomena. - Good knowledge in numerical methods for efficient solutions of RANS equations. - To understand the phenomenon of turbulence and to know mathematical models to describe it. - To be able to use up to date computer codes for flow simulations.

Metode poučevanja in učenja:	**Learning and teaching methods:**
Predavanja ter izdelava individualne seminarske naloge (za vsak modul).	Lectures and elaboration of seminar work (for each module).

Načini ocenjevanja:	**Delež/Weight**	**Assessment:**
Pisni in/ali ustni izpit, ki obsega vsebino predavanj ter študijskih virov	50,00 %	Written and/or oral exam covering the contents of lectures and literature
Zagovor seminarske naloge	50,00 %	Defence of seminar work

Reference nosilca/Lecturer's references:

1. Bombač, M., Novak, G., Rodič, P., **Četina, M.**: Numerical and physical model study of a vertical slot fishway. *Journal of Hydrology and Hydromechanics*, 2014, Vol. 62, No. 2, pp. 1-10. [COBISS.SI-ID 6513761]

2. Džebo, E., Žagar, D., Krzyk, M., **Četina, M.**, Petkovšek, G.: Different ways of defining wall shear in smoothed particle hydrodynamics simulations of a dam-break wave. *Journal of hydraulic research*, 2014, Vol. 52, No. 4, pp. 453-464. [COBISS.SI-ID 6616417]

3. Džebo, E., Žagar, D., **Četina, M.**, Petkovšek, G.: Reducing the computational time of the SPH method with a coupled 2-D/3-D approach. *Journal of Mechanical Engineering* (*Strojniški vestnik)*, 2013, Vol. 59, No. 10, pp. 575-584. [COBISS.SI-ID 6269025]

4. Krzyk, M., Klasinc, R., **Četina, M.**: Two-dimensional mathematical modelling of a dam-break wave in a narrow steep stream. *Journal of Mechanical Engineering* (*Strojniški vestnik)*, 2012, Vol. 58, No. 4, pp. 255-262. [COBISS.SI-ID 5819745]

5. Žagar, D., Sirnik, N., **Četina, M.**, Horvat, M., Kotnik, J., Ogrinc, N., Hedgecock, I. M., Cinnirella, S., De Simeone, F., Gencarelli, C. N., Pirrone, N.: Mercury in the Mediterranean. Part 2, Processes and mass balance. V: *16th*

International Conference on Heavy Metals in the Environment, 23 - 27 September, 2012, Rome, Italy. Heidelberg: Springer, 2014, Vol. 21,
No. 6, pp. 4081-4094. [COBISS.SI-ID 26981671]
6. Petkovšek, G., Džebo, E., **Četina, M.**, Žagar, D.: Application of Non-Discrete Boundaries with Friction to Smoothed Particle Hydrodynamics. *Journal of Mechanical Engineering (Strojniški vestnik)*, 2010, Vol. 56, No. 5, pp. 307-315. [COBISS.SI-ID 5094753]

UČNI NAČRT PREDMETA/COURSE SYLLABUS

Predmet:	Matematično modeliranje v prometnem inženirstvu
Course title:	Mathematical Models in Traffic Engineering

Študijski programi in stopnja	Študijska smer	Letnik	Semestri
Grajeno okolje, tretja stopnja, doktorski	Ni členitve (študijski program)		Letni, Zimski

Univerzitetna koda predmeta/University course code: 1701

Predavanja	Seminar	Vaje	Klinične vaje	Druge oblike študija	Samostojno delo	ECTS
40	40	0	0	170	0	10

Nosilec predmeta/Lecturer: Marijan Žura

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:
Ni posebnih pogojev.	No special requirements.

Vsebina:	Content (Syllabus outline):
Kramar-Fijavž: Makroskopski modeli prometnega toka Skupna struktura makroskopskih modelov, Lighthill-Whitham model, Burgerjeve enačbe, Paynov model in njegove variante Lipar:Voznodinamična analiza prometnic modeli spreminjanja hitrosti, profil vozne hitrosti, sile in pospeški na vozišču , analiza odzivnosti vozišče površine na sile na vozišču Žura: Statični in dinamični makroskopski modeli prometnih omrežij Statični modeli obremenjevanja mrež (inkrementalno, ravnovesno, stohastično, Tribut) Dinamični modeli obremenjevanja mrež (dinamično uporabniško ravnovesje,dinamično stohastično obremenjevanje) Maher: Mikroskopsko modeliranje in simulacije prometnega toka Model sledenja vozil, Model menjavanja pasov, Celični avtomati, Simulacije Žura, Maher:Odločitveni modeli v inteligentnih transportnih sistemih Kratkoročne prognoze prometnih tokov, Detekcija nevarnih situacij, Algoritmi vodenja	Kramar-Fijavž: Macroscopic traffic models Common structure of macroscopic traffic models, Lighthill-Whitham model, Burgers equations, Payn's model and it's variants Lipar: Vehicle dynamic analysis Žura: Static and dynamic macroscopic transport planning models Static assignment models (incremental, equilibrium, stochastic, Tribut) Dynamic assignment models (dynamic user equilibrium, dynamic stochastic) Maher: Microscopic models and traffic simulations, Car-following model, Lane-changing model, Cellular automata, Simulation Maher,Žura: Decision models in ITS Short term traffic forecasts, Incident detection, Traffic management algorithms, Efficiency analysis

Temeljna literatura in viri/Readings:

Helbing: Traffic and related self-driven many-particle systems, Reviews of modern phyisics
Willumsen: Modelling Transport, John Wiley & Sons, 1999.

Cilji in kompetence:	**Objectives and competences:**
Cilji: Spoznati se s teoretičnimi osnovami matematičnih modelov na različnih področjih Pridobljene kompetence Pozna teoretične osnove Zna izbrati ustrezne modele in programska orodja Zna izdelati modele za posamezne konkretne probleme Zna interpretirati rezultate modelov	To learn about theoretical backgrounds of mathematical models from different fields of traffic engineering Capability to identify the problem, to select suitable model and computer software, to build model of certain problems and to evaluate results of the model.

Predvideni študijski rezultati:	**Intended learning outcomes:**
Znanje in razumevanje: -Mikroskopskih, mezoskopskih in makroskopskih -Statičnih in dinamičnih modelov -Deterministčnih in stohastičnih prometnih modelov	Knowledge and understanding: -micro,mezo in macroscopic, -static and dynamic, -deterministic and stochastic Transport models

Metode poučevanja in učenja:	**Learning and teaching methods:**
Predavanja, računalniške vaje ter izdelave individualne seminarske naloge (za vsak sklop).	Lectures, computer exercises, preparation of term-paper ant its presentation

Načini ocenjevanja:	**Delež/Weight**	**Assessment:**
Način (pisni izpit, ustno izpraševanje, naloge, projekt) Izdelava in predstavitev seminarske naloge	50,00 %	Type (examination, oral, coursework, project): Preparation and Presentation of term-paper
Ustni ali pisni izpit	50,00 %	Oral or written examination.

Reference nosilca/Lecturer's references:

ROAD ARTERY TRAFFIC LIGHT OPTIMIZATION WITH USE OF REINFORCEMENT LEARNING
By: Marsetic, Rok; Semrov, Darja; Zura, Marijan

PROMET-TRAFFIC & TRANSPORTATION Volume: 26 Issue: 2 Pages: 101-108 Published: 2014
DIRECTIVES OF THE EUROPEAN UNION ON INTELLIGENT TRANSPORT SYSTEMS AND THEIR IMPACT ON THE REPUBLIC OF CROATIA
By: Mandzuka, Sadko; Zura, Marijan; Horvat, Bozica; et al.

PROMET-TRAFFIC & TRANSPORTATION Volume: 25 Issue: 3 Pages: 273-283 Published: 2013
ESTIMATION OF EVA MODE CHOICE MODEL PARAMETERS WITH DIFFERENT TYPES OF UTILITY FUNCTIONS
By: Maher, Tomaz; Strnad, Irena; Zura, Marijan

PROMET-TRAFFIC & TRANSPORTATION Volume: 23 Issue: 3 Pages: 169-175 Published: 2011
INFORMATION SUPPORT FOR PUBLIC AREA MANAGEMENT
By: Cerne, Tomaz; Zura, Marijan; Rakar, Albin

GEODETSKI VESTNIK Volume: 54 Issue: 1 Pages: 46-60 Published: 2010
IDENTIFICATION OF ROAD ACCIDENT HOT SPOTS USING SPATIAL STATISTICS
By: Lipar, Peter; Kostanjsek, Jure; Zura, Marijan
GEODETSKI VESTNIK Volume: 54 Issue: 1 Pages: 61-69 Published: 2010

UČNI NAČRT PREDMETA/COURSE SYLLABUS

Predmet:	Meritve in modeliranje erozije in sedimentacije
Course title:	Measurements and Modelling of Erosion and Sedimentation

Študijski programi in stopnja	Študijska smer	Letnik	Semestri
Grajeno okolje, tretja stopnja, doktorski	Ni členitve (študijski program)		Letni, Zimski

Univerzitetna koda predmeta/University course code: 1088

Predavanja	Seminar	Vaje	Klinične vaje	Druge oblike študija	Samostojno delo	ECTS
20	10	0	10	0	85	5

Nosilec predmeta/Lecturer: Matjaž Mikoš

Vrsta predmeta/Course type: Izbirni predmet/Elective course

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

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:	**Prerequisites:**
Predmet sestavljata dva modula: Modul I - Hidrometeorologija in erozija tal ter Modul II - Rečna dinamika in morfologija. Študent lahko izbere vsak modul posebej ali oba skupaj. Predmet je namenjen diplomantom magistrskih študijev Gradbeništva in Okoljskega gradbeništva, kakor tudi magistrandom drugih študijev (geologija, geografija, …). Modul I: nujno znanje predmeta Hidrologija I z univerzitetnega študijskega programa Gradbeništvo in znanje predmeta Meteorologija in hidrologija z magistrskega študijskega programa Okoljsko gradbeništvo ali Gradbeništvo oz. ustrezna primerljiva znanja. Modul II: nujno znanje predmeta Urejanje vodotokov (magistrski študijski program Okoljsko gradbeništvo ali Gradbeništvo) oz. ustrezna primerljiva znanja.	The course constitutes of two modules: Module I - *Hydrometeorology and soil erosion* and Module II - *River dynamics and morphology*. Student can choose either one module or both. The course is meant for graduates of master studies in *Civil Engineering* and *Environmental Civil Engineering*, as well as for graduates of some other master studies (*Geology, Geography*,…). Module I: it is necessary knowledge of the course on *Hydrology I* from the university studies in *Civil Engineering*, and knowledge of the course on *Meteorology and hydrology* from the master studies in *Environmental Civil Engineering* or *Civil Engineering*, or adequate knowledge. Module II: it is necessary knowledge of the course on *River Engineering* from the master studies in *Environmental Civil Engineering* or *Civil Engineering*, or adequate knowledge.

Vsebina:	**Content (Syllabus outline):**
MODUL I – HIDROMETEOROLOGIJA IN EROZIJA TAL Meritve intenzitet padavin in kinetične energije dežja. Meritve površinskega spiranja zemljin. Modeliranje površinske erozije tal (empirične in procesno utemeljene metode). Posebnosti erozije na kmetijskih površinah. Vzroki in delitev pobočnih masnih procesov. Modeliranje kamnitih in skalnatih podorov in drobirskih tokov. Zasnova in dimenzioniranje varstvenih ukrepov in objektov (5 ECTS). **MODUL II – REČNA DINAMIKA IN MORFOLOGIJA**	**MODULE I – HYDROMETEOROLOGY AND SOIL EROSION** Measurements of precipitation intensities and rain kinetic energy. Measurements of surface soil erosion. Modelling of surface soil erosion (empirical and process-based methods). Pecularities of soil erosion on agricultural land. Causes and division of slope mass processes. Modelling of stonefalls, rockfalls, and debris flows. Basic plan and design of protective measures and structures (5 ECTS). **MODULE II – RIVER DYNAMICS AND MORPHOLOGY**

Osnove hidrometričnih meritev s pregledom merilne tehnike in merilnih instrumentov. Terenske meritve pretočnih hitrosti, pretokov voda in pretočnih globin. Meritve koncentracij suspendiranih snovi, meritve zrnavosti suspendiranih snovi. Modeliranje fluvialnega transporta sedimentov (suspendiranih snovi, lebdečih plavin, rinjenih plavin). Osnove rečne morfologije. Stabilnost naravnih rečnih brežin. Prodna bilanca in ravnanje s sedimenti v povirjih, na odsekih vodotokov in na nivoju porečij. Zasnova in dimenzioniranje ureditvenih ukrepov in objektov (5 ECTS).	Principles of hydrometric measurements with an overview of measuring techniques and measuring instruments. Field measurements of flow velocities, water discharges, and water depths. Measurements of suspended solid concentrations, measurements of suspended solid granularity. Modelling of fluvial sediment transport (suspended load, bed load). Principles of river morphology. Stability of natural river banks. Sediment balance and sediment management in headwaters, in river reaches, and in river basins. Basic plan and design of protective measures and structures (5 ECTS).

Temeljna literatura in viri/Readings:

Knjižni viri (izbrana poglavja) / Printed sources (selected contents):

- Boardman, J., Poesen, J. (Eds.) (2006). Soil Erosion in Europe. John Wiley & Sons, Chichester, 855 p.
- Chien, N., Wan, Z. (1999). Mechanics of Sediment Transport. ASCE Press, Reston, 913 p.
- Dikau, R., Brunsden, D., Schrott, L., Ibsen, M-L. (1996). Landslide Recognition – Identification, Movement and Causes. John Wiley & Sons, Chichester, 251 p.
- Gray, D.H., Sotir, R.B. (1996). Biotechnical and Soil Bioengineering Slope Stabilization – A Practical Guide for Erosion Control. John Wiley & Sons, New York, 378 p.
- Julien, P.Y. (1998). Erosion and Sedimentation. Cambridge University Press, Cambridge, 380 p.
- Owens, P.N. (ur.) (2008). Sustainable Management of Sediment Resources – Sediment Management at the River Basin Scale. Elsevier, Amsterdam, 265 p.
- Owens, P.N., Collins, A.J. (Eds.) (2006). Soil erosion and sediment redistribution in river catchments. CABI Publishing, Wallingford, 328 p.
- Strangeways, I. (2007). Precipitation – Theory, Measurement and Distribution. Cambridge University Press, Cambridge, 290 p.
- Toy, T.J., Foster, G.R., Renard, K.G. (2002). Soil Erosion: Processes, Prediction, Measurements, and Control. John Wiley & Sons, New York, 338 p.
- Wohl, E. (2000). Mountain Rivers. AGU, Washington, DC, 320 p.
- Izbrani članki iz periodike in kongresnih objav / Selected papers from periodicals and congress proceedings.

Elektronski viri / Electronic sources:

- 1D sediment transport morphodynamics with applications to rivers and turbidity currents: http://cee.uiuc.edu/people/parkerg/morphodynamics_e-book.htm

Cilji in kompetence:	**Objectives and competences:**
Naravne procese erozije in sedimentacije je možno obravnavati le z dobrim poznavanjem dinamike samih procesov, s kakovostnimi terenskimi meritvami posameznih relevantnih parametrov, kar je osnova za modeliranje procesov na nivoju povodij. Cilj predmeta je v modulu I študenta seznaniti z meritvami hidrometeoroloških parametrov površinske erozije tal in modeliranjem površinske erozije tal, kakor tudi modeliranjem pobočnih procesov (kamnitih in skalnih podorov ter drobirskih tokov) ter dimenzioniranja varstvenih ukrepov in objektov. Cilj predmeta v modulu II pa je študenta seznaniti s hidrometričnimi meritvami v hudournikih in rekah ter zakonitostmi rečne morfologije in modeliranjem rečnega transporta sedimentov kot osnove za oceno prodne bilance in ravnanja s sedimenti ter dimenzioniranje ureditvenih ukrepov na vodotokih.	Natural processes of erosion and sedimentation is possible to treat only with good knowledge on dynamics of these processes, by qualitative field measurements of single relevant parameters that form a basis for process modelling on the basin level. The objective of the module I is to introduce a student to measurements of hydro-meteorological parameters of surface soil erosion and to its modelling, as well as to modelling of slope processes (stone falls, rock falls, and debris flows), and to design of protective measures and structures. The objective of the module II is to introduce a student to hydrometric measurements in torrents and rivers, and to laws of river morphology and modelling of fluvial sediment transport as a basis for assessment of sediment budget and sediment management, as well as for designing control measures in watercourses.

Predvideni študijski rezultati:	**Intended learning outcomes:**
Znanje in razumevanje:	**Knowledge and understanding:**

Modul I • Študent zna izvajati terenske meritve erozije tal. Modul II • Študent zna modelirati rečno dinamiko in kako pristopiti k razvoju lastnega modela rečne morfologije.	Module I • Student knows how to execute field measurements of soil erosion. Module II • Student knows how to model fluvial dynamics, and how to start developing an own model of river morphology.

Metode poučevanja in učenja:	**Learning and teaching methods:**
Konzultacije, študij strokovne literature, uporaba programskih orodij za modeliranje gibanja drobirskih tokov in podorov, terenske meritve v eksperimentalnih povodjih, uporaba terenske merilne opreme, uporaba podatkov monitoringa okolja v Sloveniji.	Consultations, study of professional literature, usage of programs for modelling debris flows and rock falls, field measurements in experimental watersheds, usage of field measurement equipment, usage of monitoring data from Slovenia.

Načini ocenjevanja:	**Delež/Weight**	**Assessment:**
Objava v znanstveni periodiki (modul I)	50,00 %	Paper publication in professional periodicals (module I)
Izdelava seminarske naloge (modul II)	50,00 %	Completion of a seminar work (module II)

Reference nosilca/Lecturer's references:

red. prof. dr. Matjaž Mikoš:

- Bezak, N., **Mikoš, M.**, Šraj, M., 2014. Trivariate Frequency Analyses of Peak Discharge, Hydrograph Volume and Suspended Sediment Concentration Data Using Copulas. *Water resources management*, 28/8, 21952212, doi: 10.1007/s11269014-0606-2. [COBISS.SIID 6578273]
- Babić Mladenović, M., Bekić, D., Grošelj, S., **Mikoš, M.**, Kupusović, T., Oskoruš, D., Petković, S., 2014. Towards sediment management in the Sava river basin. *Water Research and Management*, 4/1, 313, [COBISS.SI-ID 6572385]
- Lamovec, P., **Mikoš, M.**, Oštir, K., 2013. Detection of flooded areas using machine learning techniques: case study of the Ljubljana moor floods in 2010. *Disaster advances*, 6/7, 411, http://www.shankargargh.net/disaster_back_issue/disas_2013_7/1.pdf [COBISS.SIID 35792173]
- Lamovec, P., Veljanovski, T., **Mikoš, M.**, Oštir, K., 2013. Detecting flooded areas with machine learning techniques: case study of the Selška Sora river flash flood in September 2007. *Journal of applied remote sensing*, 7/1, 113, doi: 10.1117/1.JRS.7.073564 [COBISS.SIID 6253409]
- Bezak, N., Šraj, M., Mikoš, M., 2013. Pregled meritev vsebnosti suspendiranega materiala v Sloveniji in primer analize podatkov = Overview of suspended sediments measurements in Slovenia and an example of data analysis. *Gradbeni vestnik*, 62/12, 274280, [COBISS.SI-ID 6434657]
- Kryžanowski, A., **Mikoš, M.**, Šušteršič, J., Ukrainczyk, V., Planinc, I., 2012. Testing of concrete abrasion resistance in hydraulic structures on the lower Sava river. *Strojniški vestnik*, 58/4, 245254 [COBISS.SI-ID 5813601]
- **Mikoš, M.**, 2012a. Kalnost v rekah kot del erozijskosedimentacijskega kroga = Suspended loads in rivers as a part of the erosion and sedimentation cycle. *Gradbeni vestnik*, 61/6, 129136 [COBISS.SI-ID 5869409]
- **Mikoš, M.**, 2012b. Metode terenskih meritev suspendiranih sedimentov v rekah = Methods of field measurements of suspended sediment in rivers. *Gradbeni vestnik*, 61/7, 151158. [COBISS.SI-ID 5880417]
- **Mikoš, M.**, 2012c. Predlog obratovalnega hidrološkega monitoringa kalnosti na spodnji Savi = A proposal of operational hydrologic monitoring of suspendedsediment loads in the lower Sava river. *Gradbeni vestnik*, 61/8, 170176 [COBISS.SI-ID 5913953]
- Petan, S., TaveiraPinto, F., **Mikoš, M.**, PaisBarbosa, J., 2010. Modelacao da erosa do solo da bacia hidrografica do Rio Leca, coma equacao RUSLE e SIG = Modelling of soil erosion in the Leca river basin with the RUSLE and SIG equation. *Recursos hídricos*, 31/1, 99110 [COBISS.SI-ID 5043809]
- Globevnik, L., **Mikoš, M.**, 2009. Boundary conditions of morphodynamic processes in the Mura River in Slovenia. *Catena*, 79/3, 265276, doi: 10.1016/j.catena.2009.06.008 [COBISS.SIID 4704353]
- Kryžanowski, A., **Mikoš, M.**, Šušteršič, J., Planinc, I., 2009. Abrasion Resistance of Concrete in Hydraulic Structures. *ACI materials journal*, 106/4, 349-356 [COBISS.SI-ID 4602209]

UČNI NAČRT PREDMETA/COURSE SYLLABUS

Predmet:	Meritve in modeliranje erozije in sedimentacije
Course title:	Measurements and Modelling of Erosion and Sedimentation

Študijski programi in stopnja	Študijska smer	Letnik	Semestri
Grajeno okolje, tretja stopnja, doktorski	Ni členitve (študijski program)		Letni, Zimski

Univerzitetna koda predmeta/University course code: 1089

Predavanja	Seminar	Vaje	Klinične vaje	Druge oblike študija	Samostojno delo	ECTS
40	20	0	20	0	170	10

Nosilec predmeta/Lecturer: Matjaž Mikoš

Vrsta predmeta/Course type: Izbirni predmet/Elective course

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

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:	**Prerequisites:**
Predmet sestavljata dva modula: Modul I - Hidrometeorologija in erozija tal ter Modul II - Rečna dinamika in morfologija. Študent lahko izbere vsak modul posebej ali oba skupaj. Predmet je namenjen diplomantom magistrskih študijev Gradbeništva in Okoljskega gradbeništva, kakor tudi magistrandom drugih študijev (geologija, geografija, …). Modul I: nujno znanje predmeta Hidrologija I z univerzitetnega študijskega programa Gradbeništvo in znanje predmeta Meteorologija in hidrologija z magistrskega študijskega programa Okoljsko gradbeništvo ali Gradbeništvo oz. ustrezna primerljiva znanja. Modul II: nujno znanje predmeta Urejanje vodotokov (magistrski študijski program Okoljsko gradbeništvo ali Gradbeništvo) oz. ustrezna primerljiva znanja.	The course constitutes of two modules: Module I - *Hydrometeorology and soil erosion* and Module II - *River dynamics and morphology*. Student can choose either one module or both. The course is meant for graduates of master studies in *Civil Engineering* and *Environmental Civil Engineering*, as well as for graduates of some other master studies (*Geology, Geography*,…). Module I: it is necessary knowledge of the course on *Hydrology I* from the university studies in *Civil Engineering*, and knowledge of the course on *Meteorology and hydrology* from the master studies in *Environmental Civil Engineering* or *Civil Engineering*, or adequate knowledge. Module II: it is necessary knowledge of the course on *River Engineering* from the master studies in *Environmental Civil Engineering* or *Civil Engineering*, or adequate knowledge.

Vsebina:	**Content (Syllabus outline):**
MODUL I – HIDROMETEOROLOGIJA IN EROZIJA TAL Meritve intenzitet padavin in kinetične energije dežja. Meritve površinskega spiranja zemljin. Modeliranje površinske erozije tal (empirične in procesno utemeljene metode). Posebnosti erozije na kmetijskih površinah. Vzroki in delitev pobočnih masnih procesov. Modeliranje kamnitih in skalnatih podorov in drobirskih tokov. Zasnova in dimenzioniranje varstvenih ukrepov in objektov (5 ECTS). **MODUL II – REČNA DINAMIKA IN MORFOLOGIJA**	**MODULE I – HYDROMETEOROLOGY AND SOIL EROSION** Measurements of precipitation intensities and rain kinetic energy. Measurements of surface soil erosion. Modelling of surface soil erosion (empirical and process-based methods). Pecularities of soil erosion on agricultural land. Causes and division of slope mass processes. Modelling of stonefalls, rockfalls, and debris flows. Basic plan and design of protective measures and structures (5 ECTS). **MODULE II – RIVER DYNAMICS AND MORPHOLOGY**

Osnove hidrometričnih meritev s pregledom merilne tehnike in merilnih instrumentov. Terenske meritve pretočnih hitrosti, pretokov voda in pretočnih globin. Meritve koncentracij suspendiranih snovi, meritve zrnavosti suspendiranih snovi. Modeliranje fluvialnega transporta sedimentov (suspendiranih snovi, lebdečih plavin, rinjenih plavin). Osnove rečne morfologije. Stabilnost naravnih rečnih brežin. Prodna bilanca in ravnanje s sedimenti v povirjih, na odsekih vodotokov in na nivoju porečij. Zasnova in dimenzioniranje ureditvenih ukrepov in objektov (5 ECTS).	Principles of hydrometric measurements with an overview of measuring techniques and measuring instruments. Field measurements of flow velocities, water discharges, and water depths. Measurements of suspended solid concentrations, measurements of suspended solid granularity. Modelling of fluvial sediment transport (suspended load, bed load). Principles of river morphology. Stability of natural river banks. Sediment balance and sediment management in headwaters, in river reaches, and in river basins. Basic plan and design of protective measures and structures (5 ECTS).

Temeljna literatura in viri/Readings:

Knjižni viri (izbrana poglavja) / Printed sources (selected contents):

- Boardman, J., Poesen, J. (Eds.) (2006). Soil Erosion in Europe. John Wiley & Sons, Chichester, 855 p.
- Chien, N., Wan, Z. (1999). Mechanics of Sediment Transport. ASCE Press, Reston, 913 p.
- Dikau, R., Brunsden, D., Schrott, L., Ibsen, M-L. (1996). Landslide Recognition – Identification, Movement and Causes. John Wiley & Sons, Chichester, 251 p.
- Gray, D.H., Sotir, R.B. (1996). Biotechnical and Soil Bioengineering Slope Stabilization – A Practical Guide for Erosion Control. John Wiley & Sons, New York, 378 p.
- Julien, P.Y. (1998). Erosion and Sedimentation. Cambridge University Press, Cambridge, 380 p.
- Owens, P.N. (ur.) (2008). Sustainable Management of Sediment Resources – Sediment Management at the River Basin Scale. Elsevier, Amsterdam, 265 p.
- Owens, P.N., Collins, A.J. (Eds.) (2006). Soil erosion and sediment redistribution in river catchments. CABI Publishing, Wallingford, 328 p.
- Strangeways, I. (2007). Precipitation – Theory, Measurement and Distribution. Cambridge University Press, Cambridge, 290 p.
- Toy, T.J., Foster, G.R., Renard, K.G. (2002). Soil Erosion: Processes, Prediction, Measurements, and Control. John Wiley & Sons, New York, 338 p.
- Wohl, E. (2000). Mountain Rivers. AGU, Washington, DC, 320 p.
- Izbrani članki iz periodike in kongresnih objav / Selected papers from periodicals and congress proceedings.

Elektronski viri / Electronic sources:

- 1D sediment transport morphodynamics with applications to rivers and turbidity currents: http://cee.uiuc.edu/people/parkerg/morphodynamics_e-book.htm

Cilji in kompetence:	**Objectives and competences:**
Naravne procese erozije in sedimentacije je možno obravnavati le z dobrim poznavanjem dinamike samih procesov, s kakovostnimi terenskimi meritvami posameznih relevantnih parametrov, kar je osnova za modeliranje procesov na nivoju povodij. Cilj predmeta je v modulu I študenta seznaniti z meritvami hidrometeoroloških parametrov površinske erozije tal in modeliranjem površinske erozije tal, kakor tudi modeliranjem pobočnih procesov (kamnitih in skalnih podorov ter drobirskih tokov) ter dimenzioniranja varstvenih ukrepov in objektov. Cilj predmeta v modulu II pa je študenta seznaniti s hidrometričnimi meritvami v hudournikih in rekah ter zakonitostmi rečne morfologije in modeliranjem rečnega transporta sedimentov kot osnove za oceno prodne bilance in ravnanja s sedimenti ter dimenzioniranje ureditvenih ukrepov na vodotokih.	Natural processes of erosion and sedimentation is possible to treat only with good knowledge on dynamics of these processes, by qualitative field measurements of single relevant parameters that form a basis for process modelling on the basin level. The objective of the module I is to introduce a student to measurements of hydro-meteorological parameters of surface soil erosion and to its modelling, as well as to modelling of slope processes (stone falls, rock falls, and debris flows), and to design of protective measures and structures. The objective of the module II is to introduce a student to hydrometric measurements in torrents and rivers, and to laws of river morphology and modelling of fluvial sediment transport as a basis for assessment of sediment budget and sediment management, as well as for designing control measures in watercourses.

Predvideni študijski rezultati:	**Intended learning outcomes:**
Znanje in razumevanje:	**Knowledge and understanding:**

Modul I • Študent zna izvajati terenske meritve erozije tal. Modul II • Študent zna modelirati rečno dinamiko in kako pristopiti k razvoju lastnega modela rečne morfologije.	Module I • Student knows how to execute field measurements of soil erosion. Module II • Student knows how to model fluvial dynamics, and how to start developing an own model of river morphology.

Metode poučevanja in učenja:	**Learning and teaching methods:**
Konzultacije, študij strokovne literature, uporaba programskih orodij za modeliranje gibanja drobirskih tokov in podorov, terenske meritve v eksperimentalnih povodjih, uporaba terenske merilne opreme, uporaba podatkov monitoringa okolja v Sloveniji.	Consultations, study of professional literature, usage of programs for modelling debris flows and rock falls, field measurements in experimental watersheds, usage of field measurement equipment, usage of monitoring data from Slovenia.

Načini ocenjevanja:	**Delež/Weight**	**Assessment:**
Izdelava seminarske naloge (modul II)	50,00 %	Completion of a seminar work (module II)
Objava v znanstveni periodiki (modul I)	50,00 %	Paper publication in professional periodicals (module I)

Reference nosilca/Lecturer's references:

red. prof. dr. Matjaž Mikoš:

- Bezak, N., **Mikoš, M.**, Šraj, M., 2014. Trivariate Frequency Analyses of Peak Discharge, Hydrograph Volume and Suspended Sediment Concentration Data Using Copulas. *Water resources management*, 28/8, 21952212, doi: 10.1007/s11269014-0606-2. [COBISS.SIID 6578273]
- Babić Mladenović, M., Bekić, D., Grošelj, S., **Mikoš, M.**, Kupusović, T., Oskoruš, D., Petković, S., 2014. Towards sediment management in the Sava river basin. *Water Research and Management*, 4/1, 313, [COBISS.SI-ID 6572385]
- Lamovec, P., **Mikoš, M.**, Oštir, K., 2013. Detection of flooded areas using machine learning techniques: case study of the Ljubljana moor floods in 2010. *Disaster advances*, 6/7, 411, http://www.shankargargh.net/disaster_back_issue/disas_2013_7/1.pdf [COBISS.SIID 35792173]
- Lamovec, P., Veljanovski, T., **Mikoš, M.**, Oštir, K., 2013. Detecting flooded areas with machine learning techniques: case study of the Selška Sora river flash flood in September 2007. *Journal of applied remote sensing*, 7/1, 113, doi: 10.1117/1.JRS.7.073564 [COBISS.SIID 6253409]
- Bezak, N., Šraj, M., Mikoš, M., 2013. Pregled meritev vsebnosti suspendiranega materiala v Sloveniji in primer analize podatkov = Overview of suspended sediments measurements in Slovenia and an example of data analysis. *Gradbeni vestnik*, 62/12, 274280, [COBISS.SI-ID 6434657]
- Kryžanowski, A., **Mikoš, M.**, Šušteršič, J., Ukrainczyk, V., Planinc, I., 2012. Testing of concrete abrasion resistance in hydraulic structures on the lower Sava river. *Strojniški vestnik*, 58/4, 245254 [COBISS.SI-ID 5813601]
- **Mikoš, M.**, 2012a. Kalnost v rekah kot del erozijskosedimentacijskega kroga = Suspended loads in rivers as a part of the erosion and sedimentation cycle. *Gradbeni vestnik*, 61/6, 129136 [COBISS.SI-ID 5869409]
- **Mikoš, M.**, 2012b. Metode terenskih meritev suspendiranih sedimentov v rekah = Methods of field measurements of suspended sediment in rivers. *Gradbeni vestnik*, 61/7, 151158. [COBISS.SI-ID 5880417]
- **Mikoš, M.**, 2012c. Predlog obratovalnega hidrološkega monitoringa kalnosti na spodnji Savi = A proposal of operational hydrologic monitoring of suspendedsediment loads in the lower Sava river. *Gradbeni vestnik*, 61/8, 170176 [COBISS.SI-ID 5913953]
- Petan, S., TaveiraPinto, F., **Mikoš, M.**, PaisBarbosa, J., 2010. Modelacao da erosa do solo da bacia hidrografica do Rio Leca, coma equacao RUSLE e SIG = Modelling of soil erosion in the Leca river basin with the RUSLE and SIG equation. *Recursos hídricos*, 31/1, 99110 [COBISS.SI-ID 5043809]
- Globevnik, L., **Mikoš, M.**, 2009. Boundary conditions of morphodynamic processes in the Mura River in Slovenia. *Catena*, 79/3, 265276, doi: 10.1016/j.catena.2009.06.008 [COBISS.SIID 4704353],

Kryžanowski, A., **Mikoš, M.**, Šušteršič, J., Planinc, I., 2009. Abrasion Resistance of Concrete in Hydraulic Structures. *ACI materials journal*, 106/4, 349-356 [COBISS.SI-ID 4602209]

UČNI NAČRT PREDMETA/COURSE SYLLABUS

Predmet:	Metode inženirskogeoloških raziskav za zahtevne objekte
Course title:	Engineering Geology Methods for Complex Structures

Študijski programi in stopnja	Študijska smer	Letnik	Semestri
Grajeno okolje, tretja stopnja, doktorski	Ni členitve (študijski program)		Letni, Zimski

Univerzitetna koda predmeta/University course code: 1292

Predavanja	Seminar	Vaje	Klinične vaje	Druge oblike študija	Samostojno delo	ECTS
20	20	0	0	0	85	5

Nosilec predmeta/Lecturer: Karmen Fifer Bizjak

Vrsta predmeta/Course type: Izbirni predmet/Elective course

Jeziki/Languages:

Predavanja/Lectures:	Slovenščina, Angleščina
Vaje/Tutorial:	Slovenščina, Angleščina

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:	Prerequisites:
Ni posebnih pogojev	No special requirements

Vsebina:	Content (Syllabus outline):
Izvedba inženirsko geoloških raziskav za zahtevne objekte zahteva kompleksno znanje iz področja geologije, gradbeništva, strojništva, rudarstva in ekologije. Inženirsko geološke raziskave je potrebno prilagoditi specifičnim geološko geomehanskim razmeram na terenu in zahtevam gradnje novega objekta ali sanaciji poškodovanega objekta. Potrebno je podrobno poznavanje delovanja merilne in računalniške opreme ter vrednotenja rezultatov. Zanesljivost podatkov se ovrednoti s statističnimi analizami. Za monitoring objekta je potrebno poznavanje metod meritev, zakonodaje in konstrukcije objekta, na podlagi katerih se določijo potrebni parametri ukrepanja. Podatke, linijske ali točkovne, je potrebno interpretirati v inženirsko geološkem modelu, ki omogoča napovedovanje kritičnih odsekov objekta in kritičnih vrednosti deformacij. Na osnovi inženirsko geološkega modela se izvedejo numerične analize z oceno verjetnosti izračunanih parametrov. Študent pri predmetu pridobi celovito znanje vodenja izvedbe terenskih in laboratorijskih preiskav, vključno z celovito inženirsko geološko interpretacijo.	Engineering geological research for complex structures requires complex knowledge in the field of geology, civil engineering, mechanical engineering, mining and ecology. Engineering geological research is needed to adapt to the specific geological and geomechanical situation on the ground and the requirements of the new structure or rehabilitation of the damaged building. There is a need for detailed knowledge of the operation of measuring, computing equipment and the evaluation of the results. Reliability data have to be statistical analyzed. The monitoring facility has the required knowledge of legislation and design facility, to determine the critical parameters of action. All the data is necessary to interpret the engineering geological model, which allows the prediction of the critical sections of the structure and the critical value of deformation. Based on the engineering geological model is carried out by numerical analysis with the assessment of the likelihood calculated parameters. The student in the subject acquires the full knowledge of the performance management of field and laboratory tests, including comprehensive engineering geological interpretation.

Temeljna literatura in viri/Readings:

1.) G.B.Baecher, J.T.Christian, 2003. reliability and Statistics in geotechnical Engineering, Willey, USA.
2.) R.Widmann, 1995. Anchors in theory and practice, balkema, Rotterdam.
C.Detournay, 1999. FLAC and Numerical Modeling in Geomechanics, Balkema, Rotterdam.
3.) C.F.Leung, 1999. Field measurements in geomechanics. Balkema, Rotterdam. W.Powrie, 2004. Soil mechanics, concepts & applications. Spon Press.
4.) D.G.Fredlung, H.Rahardjo, 1993. Soil mechanics for unsaturated soils. John Willey & Sons.

Cilji in kompetence:	**Objectives and competences:**
Cilji: - spoznavanje metod, zakonodaje in standardov s področja raziskav zahtevnih objektov - spoznavanje metod, zakonodaje in standardov s področja monitoringa zahtevnih objektov - spoznavanje preiskav materialov, ki zahtevajo posebne postopke projektiranja - razumeti povezavo med rezultati preiskav in analizami, potrebnimi za izračun napetostno deformacijskega polja na območju objekta.	Objectives: - Knowledge about the laws and standards for research of complex structures - Knowledge about the laws and standards in the field of monitoring of complex structures - Knowledge about the investigation of materials which require special procedures design - Understand the link between the results of the tests and analysis necessary to calculate the stress- strain field of the structure.

Predvideni študijski rezultati:	**Intended learning outcomes:**
Rezultati: - študent pridobi širše znanje, ki je potrebno za vodenje zahtevnih projektov geoloških raziskav za zahtevne objekte - študent obvlada najnovejše metode laboratorijskih in terenskih raziskav, posebej raziskav volumsko občutljivih materialov - študent obvlada vrednotenje terenskih in laboratorijskih preiskav in ustrezne statistične analize - študent zna ugotoviti porušitveni model za kompleksno geološko zgradbo in izračunati napetostno deformacijskega stanje objekta z ustreznim konstitutivnim modelom.	Results: - A student obtain a wider knowledge necessary to lead geological projects for complex structures - The student has mastered the latest methods of laboratory and field research, particularly research volume of sensitive material - The student has mastered the evaluation of field and laboratory investigations and appropriate statistical analysis - A student can identify a destructive model of the complex geological structure and to calculate the stress strain condition of the facility by an appropriate constitutive model.

Metode poučevanja in učenja:	**Learning and teaching methods:**
Predavanja, individualni pogovori o dogovorjeni literaturi, ki študenta specialno zanima; seminarska vaja z izbrano tematiko iz področja določenega objekta	Course, individual conversations on selected literature connecting with student interest, seminar on chosen theme from the field of building of chosen object

Načini ocenjevanja:	**Delež/Weight**	**Assessment:**
Način (pisni izpit, ustno izpraševanje, naloge, projekt) Individualni pogovori o določeni izbrani tematiki, ki jo študent prouči s pomočjo literature Zagovor seminarske naloge	100,00 %	Type (examination, oral, coursework, project): Oral exam, seminar work, individual conversations

Reference nosilca/Lecturer's references:

1. GÁSPÁR, László, STRYK, Josef, MARCHTRENKER, Stefan, DE BEL, Régis, THØGERSEN, Finn, SEDRAN, Thierry, FIFER BIZJAK, Karmen, HELLMAN, Fredrik, ÅHNBERG, Helen, MCNALLY, Ciaran, ARM, Maria, BENCZE, Zsolt. Recycling reclaimed road material in hydraulically bound layers. Proceedings of the Institution of Civil Engineers - Transport, ISSN 0965-092X. [Print ed.], 2014., doi: 10.1680/tran.13.00056; uvrstitev: SCI, Scopus.

2. FIFER BIZJAK, Karmen, DAWSON, Andrew, HOFF, Inge, MAKKONEN, Lasse, YLHÄISI, Jussi, CARRERA, Alessandra. The impact of climate change on the European road network. Proceedings of the Institution of Civil Engineers - Transport, ISSN 0965-092X. [Print ed.], Mar. 2014, vol. 167, issue 5, str. 281-295, ilustr.; uvrstitev: SCI, Scopus.

3. THØGERSEN, Finn, GREGOIRE, Colette, STRYK, Josef, HORNYCH, Pierre, DESCANTES, Yanick, CHAZALLON, Cyrille, BLASL, Anita, BROERE, Peter, FIFER BIZJAK, Karmen, HELLMAN, Fredrik, ARM, Maria. Recycling of road materials into new unbound road layers - main practice in selected European countries. Road materials and pavement design, ISSN 1468-0629, 2013, vol. 14, issue 2, str. 438-444, ilustr.; uvrstitev: SCI, Scopus.

4. FIFER BIZJAK, Karmen, ZUPANČIČ-VALANT, Andreja. Site and laboratory investigation of the Slano blato landslide. Engineering geology, ISSN 0013-7952, may 2009, vol. 105, nos. 3-4, str. 171-185; uvrstitev: SCI, Scopus.

UČNI NAČRT PREDMETA/COURSE SYLLABUS

Predmet:	Metode izboljšanja temeljnih tal
Course title:	Ground Improvement Methods

Študijski programi in stopnja	Študijska smer	Letnik	Semestri
Grajeno okolje, tretja stopnja, doktorski	Ni členitve (študijski program)		Letni, Zimski

Univerzitetna koda predmeta/University course code: 1702

Predavanja	Seminar	Vaje	Klinične vaje	Druge oblike študija	Samostojno delo	ECTS
30	0	10	0	0	85	5

Nosilec predmeta/Lecturer: Boštjan Pulko

Vrsta predmeta/Course type: Izbirni predmet/Elective course

Jeziki/Languages:

Predavanja/Lectures:	Slovenščina, Angleščina
Vaje/Tutorial:	Slovenščina, Angleščina

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:	Prerequisites:
Končana 2. stopnja tehniške ali tehnološke smeri ali fizike.	Completed 2. level in Engineering or Technology or Physics.

Vsebina:	Content (Syllabus outline):
1. Izboljšanje tal brez veziv v nekoherentnih zemljinah ali umetnih nasipih 2. Izboljšanje tal brez veziv v koherentnih zemljinah 3. Izboljšanje tal z dodanimi materiali ali z ojačitvami (gruščnati slopi) 4. Izboljšanje tal z injiciranjem veziv 5. Strukturno ojačanje temeljnih tal/stabilizacij: a. Palična sidra b. Piloti majhnih premerov c. Mozničenje tal (piloti, vodnjaki) 6. Likvifakcija tal 7. zboljšanje tal za temeljenje konstrukcij na potresnih območjih 8. Uporaba sodobnih tehnik/metod projektiranja za izboljšanje tal	1. Ground improvement without admixtures in non-cohesive soils or fill materials 2. Ground improvement without admixtures in cohesive soils 3. Ground improvement with admixtures or inclusions (stone columns) 4. Ground improvement with grouting type admixture 5. Earth reinforcement/stabilization a. Soil nailing b. Small diameter (pin) piles c. Soil doweling (piles, shafts) 6. Soil liquefaction 7. Ground improvements for structural foundations in seismic areas 8. Use of advanced techniques/design methods for ground improvement

Temeljna literatura in viri/Readings:

1. KIRSCH, K., BELL, A. Ground Improvement, Third Edition, CRC Press, 2013, ISBN-13: 978-0415599214

2. NICHOLSON, G. Peter. Soil Improvement and Ground Modification Methods, Elsevier, 2014, ISBN-13: 000-0124080766.

3. REUBEN H. Karol. Chemical Grouting And Soil Stabilization, Revised And Expanded (3rd Edition), CRC Press, 2003, ISBN-13: 978-0824740658.

4. PETROS P. Xanthakos, LEE A. Abramson, DONALD A. Bruce. Ground control and improvement, John Wiley & Sons, 1994, ISBN 0-471-55231-3.

5. Chu, J., Varaksin, S., Klotz, U. and Menge, P. (2009). State of the Art Report: Construction Processes. 17th Intl. Conf. on Soil Mech. and Geotech. Engrg.: TC17 meeting ground Improvement, Alexandria, Egypt, 7 October 2009, 130.

Cilji in kompetence:	**Objectives and competences:**
Pridobiti znanje in kompetence na področju metod izboljšanja temeljnih tal s postopki zgoščevanja in dreniranja tal, strukturnega ojačanja tal za stabilizacijo brežin/plazov in izboljšanja tal z injektiranjem pod visokimi pritiski z razumevanjem procesa likvifakcije tal. Spoznati uporabo sodobnih metod in tehnik za projektiranje in kontrolo kvalitete izvedenih del.	To get knowledge and competences in the fields of soil improvement by methods of soil compaction and drainage, structural earth reinforcement for slope/landslide stabilization, soil improvement by means of Jet-Grouting and to understand the process of soil liquefaction. To get knowledge about the use of modern methods and techniques for the design and quality control of the soil improvement works.

Predvideni študijski rezultati:	**Intended learning outcomes:**
Na osnovi pridobljenega znanja bo študent sposoben izbrati ustrezno metodo izboljšave tal glede na sestavo/kvaliteto temeljnih tal in glede na namen/cilj izboljšave tal. Študent bo sposoben zasnovati in voditi raziskave tal in izvesti potrebne analize za projektiranje, izbrati metode kontrole kakovosti pri nadziranju izvedbe del ter izvajati kratkoročno in dolgoročno spremljavo učinkovitosti izvedenih ukrepov. Študent bo sposoben presoje varnosti tal proti likvifakciji in izbire ustrezne metode izboljšanja tal v takem primeru.	Based on gained knowledge the student will be able to select the appropriate method of ground improvement depending on the composition/quality of ground. The student will also be able to design, supervise the execution of works and to execute short and long-term monitoring of the effectiveness of the implemented measures. The student will also be able to perform safety assessment against ground liquefaction.

Metode poučevanja in učenja:	**Learning and teaching methods:**
Konzultacije, strokovna literatura, študij primerov dobre prakse, numerične analize in primerjave, izdelava seminarske naloge.	Consultations, study of professional literature, study of examples of good practice, numerical analysis and comparisons.

Načini ocenjevanja:	**Delež/Weight**	**Assessment:**
Raziskovalna seminarska naloga na izbrano temo.	80,00 %	Research seminar on the selected topic
Ustni zagovor seminarske naloge.	20,00 %	Oral examination from the research seminar.

Reference nosilca/Lecturer's references:

1. PULKO, Boštjan, MAJES, Bojan, MIKOŠ, Matjaž. Reinforced concrete shafts for the structural mitigation of large deep-seated landslides : an experience from the Macesnik and the Slano blato landslides (Slovenia). Landslides, ISSN 1612-510X. [Print ed.], 2014, letn. 11, št. 1, str. 81-91, ilustr., doi: 10.1007/s10346-012-0372-2. [COBISS.SI-ID 6097761]
2. PULKO, Boštjan, MAJES, Bojan, LOGAR, Janko. Reply to the discussion by Khabbazian, M., Meehan, C.L. and Kaliakin, V. N. on "Geosynthetic - encased stone columns: Analytical calculation model". Geotextiles and geomembranes, ISSN 0266-1144. [Print ed.], dec. 2011, letn. 29, št. 6, str. 29-32, ilustr. http://drugg.fgg.uni-lj.si/3423/, doi: 10.1016/j.geotexmem.2011.01.011. [COBISS.SI-ID 5276001]
3. 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]
4. PULKO, Boštjan, MAJES, Bojan. Analytical Method for the Analysis of Stone-Columns According to the Rowe Dilatancy Theory = Analitična metoda za analizo gruščnatih kolov z upoštevanjem Rowove teorije razmikanja. Acta geotechnica Slovenica, ISSN 1854-0171, 2006, letn. 3, št. 1, str. 36-45, ilustr. [COBISS.SI-ID 3148641]

5. MIKOŠ, Matjaž, FAZARINC, Rok, PULKO, Boštjan, PETKOVŠEK, Ana, MAJES, Bojan. Stepwise mitigation of the Macesnik landslide, N Slovenia. Natural hazards and earth system sciences, ISSN 1561-8633, 2005, 5, str. [948]-958, ilustr. [COBISS.SI-ID 2939489]
6. PULKO, Boštjan, LOGAR, Janko. Long-term observation and numerical assessment of an embankment built on stone-column improved ground. V: Proceedings of the 15th Danube - European Conference on Geotechnical Engineering, 9-11 September 2014, Vienna, Austrija = Tagungsband der 15. Donau - Europäischne Konferenz für Geotechnik, 9.-11. September 2014, Wien, Österreich. BRANDL, Heinz (ur.), ADAM, Dietmar (ur.). Geotechnics of Roads and Railways : [Conference Proceedings] = Geotechnik von Straßen und Eisenbahnen : Konferenzband. Wien: ÖIAV - Österreichischer Ingenieur- und Architekten-Verein, 2014, str. 297-302, ilustr. [COBISS.SI-ID 6742625]

UČNI NAČRT PREDMETA/COURSE SYLLABUS

Predmet:	Metode končnih elementov za konstrukcije
Course title:	Finite Element Methods for Structures

Študijski programi in stopnja	Študijska smer	Letnik	Semestri
Grajeno okolje, tretja stopnja, doktorski	Ni členitve (študijski program)		Letni, Zimski

Univerzitetna koda predmeta/University course code: 1104

Predavanja	Seminar	Vaje	Klinične vaje	Druge oblike študija	Samostojno delo	ECTS
30	0	10	0	0	85	5

Nosilec predmeta/Lecturer: Boštjan Brank

Vrsta predmeta/Course type: Izbirni predmet/Elective course

Jeziki/Languages:

Predavanja/Lectures:	Angleščina, Slovenščina
Vaje/Tutorial:	Angleščina, Slovenščina

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:	Prerequisites:
Končana 2. stopnja tehniške ali tehnološke smeri ali fizike ali matematike.	Completed 2. level in Engineering or Technology or Physics or Mathematics

Vsebina:	Content (Syllabus outline):
1. Motivacija 2. Linearni končni elementi (KE) za konstrukcije - 2d KE (nekompatibilne oblike, mešani in hibridni KE) - Diskretni Kirchhoffovi KE za plošče - Reissner-Mindlinovi KE za plošče - KE za lupine - KE za kompozitno-laminatne plošče in lupine 3. Geometrijsko nelinearni KE - KE za palice - KE za 2d telesa - KE za plošče (von Karmannova nelinearnost) - KE za lupine z velikimi rotacijami 4. Elastoplastičnost in poškodovanost - Elastoplastična palica (idealna plast., utrjevanje) - 3d elastoplastičnost - Elastoplastičnost za 2d telesa, plošče in lupine (ravninsko napetostno stanje) - Elastoviskoplastičnost za plošče - Poškodovanost za palico - Poškodovanost za 2d telesa - Mešani KE za ravninsko deformacijsko stanje	1. Motivation 2. Linear structural finite elements (FE) - 2d solid FEs (incompatible modes, mixed, hybrid FEs) - Discrete Kirchhoff FEs for plates - Reissner-Mindlin FEs for plates - Shell FEs -FEs for laminated composite plates and shells 3. Geometrically nonlinear FEs - Bar FEs - 2d solid FEs - Plate FEs (von Karmann nonlinearity) - Large rotations shell FEs 4. Elastoplasticity and damage - Elastoplastic bar (ideal plasticity, hardening) - 3d elastoplasticity - Elastoplasticity for 2d solids, plates and shells (plane stress plasticity) - Elastoviscoplasticity for plates - 1d damage model - Damage for 2d solids - Mixed FEs for plane strain plastcicity

Temeljna literatura in viri/Readings:

A. Ibrahimbegovic, Nonlinear solid mechanics. Theoretical formulations and finite element solution methods, Springer 2009.
M. A. Crisfield, Non-linear finite element analysis of solids and structures, Wiley, 1991.

J. Bonet, R.D. Wood, Nonlinear continuum mechanics for finite element analysis, Cambridge University press, 1997.

Cilji in kompetence:	**Objectives and competences:**
Izobraževalni cilji (5 KT): Naučiti se osnov nelinearne in neelastične mehanike konstrukcij in osnov nelinearne in neelastične analize konstrukcij po metodi končnih elementov. Kompetence (5 KT): Razumevanje in obvladovanje osnovnih numeričnih metod za nelinearno in neelastično analizo konstrukcij.	Objective of the course (5 ECTS): To learn basics of nonlinear and inelastic structural mechanics and basics of nonlinear and inelastic finite element analysis of structures. Competences (5 ECTS): Understanding and mastering of basic numerical tools for nonlinear and inelastic structural analysis.

Predvideni študijski rezultati:	**Intended learning outcomes:**
Razumevanje: karakterističnega obnašanja lupinastih konstrukcij, pomembnosti nelinearne analize pri napovedi obnašanja lupin, pomembnosti problema uklona pri lupinah, uporabnosti modelov lupin višjega reda, obnašanja lupinastih končnih elementov, elasto-plastičnih formulacij za lupine.	Understanding of: characteristic behavior of shell structures, importance of nonlinear analysis for shell behavior prediction, importance of shell buckling problem, usability of higher-order shell finite element formulations, limitations of shell finite elements,elasto-plastic shell formulations.

Metode poučevanja in učenja:	**Learning and teaching methods:**
Predavanja bodo v klasični učilnici. Vaje bodo v računalniški učilnici	Leactures will be in a standard classroom. Tutorials will be in a computer laboratory.

Načini ocenjevanja:	**Delež/Weight**	**Assessment:**
Pisni izpit	50,00 %	Examination
Projekt	50,00 %	Project

Reference nosilca/Lecturer's references:

JUKIĆ, Miha, BRANK, Boštjan, IBRAHIMBEGOVIĆ, Adnan. Failure analysis of reinforced concrete frames by beam finite element that combines damage, plasticity and embedded discontinuity. Engineering structures, ISSN 0141-0296. [Print ed.], sep. 2014, letn. 75, str. 507-527, ilustr., doi:10.1016/j.engstruct.2014.06.017. [COBISS.SI-ID 6637921], [JCR, SNIP, WoS do 6. 10. 2014: št. citatov (TC): 0, čistih citatov (CI): 0, normirano št. čistih citatov (NC): 0, Scopus do 28. 7. 2014: št. citatov (TC): 0, čistih citatov (CI): 0, normirano št. čistih citatov (NC): 0]

JUKIĆ, Miha, BRANK, Boštjan, IBRAHIMBEGOVIĆ, Adnan. Embedded discontinuity finite element formulation for failure analysis of planar reinforced concrete beams and frames. *Engineering structures*, ISSN 0141-0296. [Print ed.], maj 2013, letn. 50, št. 5, str. 115-125, ilustr., doi:10.1016/j.engstruct.2012.07.028. [COBISS.SI-ID 5983585], [JCR, SNIP, WoS do 8. 10. 2014: št. citatov (TC): 2, čistih citatov (CI): 1, normirano št. čistih citatov (NC): 1, Scopus do 29. 7. 2014: št. citatov (TC): 3, čistih citatov (CI): 2, normirano št. čistih citatov (NC): 2]

DUJC, Jaka, BRANK, Boštjan, IBRAHIMBEGOVIĆ, Adnan. Stress-hybrid quadrilateral finite element with embedded strong discontinuity for failure analysis of plane stress solids. *International journal for numerical methods in engineering*, ISSN 0029-5981, jun. 2013, letn. 94, št. 12, str. 1075-1098, ilustr. http://drugg.fgg.uni-lj.si/4409/, doi: 10.1002/nme.4475. [COBISS.SI-ID 6239841], [JCR, SNIP, WoS do 8. 10. 2014: št. citatov (TC): 3, čistih citatov (CI): 2, normirano št. čistih citatov (NC): 2, Scopus do 29. 7. 2014: št. citatov (TC): 3, čistih citatov (CI): 2, normirano št. čistih citatov (NC): 2]

KASSIOTIS, Christophe, IBRAHIMBEGOVIĆ, Adnan, MATTHIES, Hermann G., BRANK, Boštjan. Stable splitting scheme for general form of associated plasticity including different scales of space and time. *Computer Methods in Applied Mechanics and Engineering*, ISSN 0045-7825. [Print ed.], 2010, letn. 199, št. 21-22, str. 1254-1264, ilustr., doi: 10.1016/j.cma.2009.09.011. [COBISS.SI-ID 4816481], [JCR, SNIP, WoS do 15. 2. 2013: št. citatov (TC): 2, čistih citatov (CI): 1, normirano št. čistih citatov (NC): 1, Scopus do 17. 4. 2013: št. citatov (TC): 3, čistih citatov (CI): 2, normirano št. čistih citatov (NC): 2]

DUJC, Jaka, BRANK, Boštjan, IBRAHIMBEGOVIĆ, Adnan. Multi-scale computational model for failure analysis of metal frames that includes softening and local buckling. *Computer Methods in Applied Mechanics and Engineering*, ISSN 0045-7825. [Print ed.], 2010, letn. 199, št. 21-22, str. 1371-1385, ilustr., doi: 10.1016/j.cma.2009.09.003. [COBISS.SI-ID 4816737], [JCR, SNIP, WoS do 7. 10. 2014: št. citatov (TC): 6, čistih citatov (CI): 5, normirano št. čistih citatov (NC): 6, Scopus do 19. 8. 2014: št. citatov (TC): 10, čistih citatov (CI): 8, normirano št. čistih citatov (NC): 10]

DUJC, Jaka, BRANK, Boštjan, IBRAHIMBEGOVIĆ, Adnan. Quadrilateral Finite Element with Embedded Strong Discontinuity for Failure Analysis of Solids. *Computer modeling in engineering & sciences. CMES*, ISSN 1526-1492. Tiskana izd., 2010, letn. 69, št. 3, str. 223-260, ilustr., doi:10.3970/cmes.2010.069.223. [COBISS.SI-ID 5301345], [SNIP, WoS do 7. 10. 2014: št. citatov (TC): 4, čistih citatov (CI): 1, normirano št. čistih citatov (NC): 1, Scopus do 29. 7. 2014: št. citatov (TC): 4, čistih citatov (CI): 1, normirano št. čistih citatov (NC): 1]

DUJC, Jaka, BRANK, Boštjan, IBRAHIMBEGOVIĆ, Adnan, BRANCHERIE, Delphine. An embedded crack model for failure analysis of concrete solids. *Computers and Concrete*, ISSN 1598-8198, avgust 2010, letn. 7, št. 4, str. 331-346, ilustr. [COBISS.SI-ID 5126497], [JCR, SNIP, WoS do 7. 10. 2014: št. citatov (TC): 6, čistih citatov (CI): 3, normirano št. čistih citatov (NC): 4, Scopus do 29. 7. 2014: št. citatov (TC): 9, čistih citatov (CI): 6, normirano št. čistih citatov (NC): 8]

UČNI NAČRT PREDMETA/COURSE SYLLABUS

Predmet:	Metode končnih elementov za konstrukcije
Course title:	Finite Element Methods for Structures

Študijski programi in stopnja	Študijska smer	Letnik	Semestri
Grajeno okolje, tretja stopnja, doktorski	Ni členitve (študijski program)		Letni, Zimski

Univerzitetna koda predmeta/University course code: 1508

Predavanja	Seminar	Vaje	Klinične vaje	Druge oblike študija	Samostojno delo	ECTS
60	0	20	0	0	170	10

Nosilec predmeta/Lecturer: Boštjan Brank

Vrsta predmeta/Course type: Izbirni predmet/Elective course

Jeziki/Languages:

Predavanja/Lectures:	Angleščina, Slovenščina
Vaje/Tutorial:	Angleščina, Slovenščina

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:	Prerequisites:
Končana 2. stopnja tehniške ali tehnološke smeri ali fizike ali matematike.	Completed 2. level in Engineering or Technology or Physics or Mathematics

Vsebina:	Content (Syllabus outline):
1. Motivacija 2. Linearni končni elementi (KE) za konstrukcije - 2d KE (nekompatibilne oblike, mešani in hibridni KE) - Diskretni Kirchhoffovi KE za plošče - Reissner-Mindlinovi KE za plošče - KE za lupine - KE za kompozitno-laminatne plošče in lupine 3. Geometrijsko nelinearni KE - KE za palice - KE za 2d telesa - KE za plošče (von Karmannova nelinearnost) - KE za lupine z velikimi rotacijami 4. Elastoplastičnost in poškodovanost - Elastoplastična palica (idealna plast., utrjevanje) - 3d elastoplastičnost - Elastoplastičnost za 2d telesa, plošče in lupine (ravninsko napetostno stanje) - Elastoviskoplastičnost za plošče - Poškodovanost za palico - Poškodovanost za 2d telesa - Mešani KE za ravninsko deformacijsko stanje 5. Hiperelastičnost - Nestisljivi in skoraj nestisljivi materiali - hiperelastični materialni modeli - Formulacije z glavnimi raztezki 6. Elastična dinamika konstrukcij - Dinamika 2d teles	1. Motivation 2. Linear structural finite elements (FE) - 2d solid FEs (incompatible modes, mixed, hybrid FEs) - Discrete Kirchhoff FEs for plates - Reissner-Mindlin FEs for plates - Shell FEs -FEs for laminated composite plates and shells 3. Geometrically nonlinear FEs - Bar FEs - 2d solid FEs - Plate FEs (von Karmann nonlinearity) - Large rotations shell FEs 4. Elastoplasticity and damage - Elastoplastic bar (ideal plasticity, hardening) - 3d elastoplasticity - Elastoplasticity for 2d solids, plates and shells (plane stress plasticity) - Elastoviscoplasticity for plates - 1d damage model - Damage for 2d solids - Mixed FEs for plane strain plastcicity 5. Hyperelasticity - (Nearly) incompressible materials - Hyperelastic material models - Formulations in principal stretches 6. Structural elastodynamics - Dynamics of 2d solids

- Dinamika lupin - Integracijske sheme (Newmarkova; shema, ki ohranja energijo in vrtilno količino;) - Integracijske sheme za rotacije 7. Ocena napake diskretizacije - Ocena po Zienkiewicz-Zhu metodi - Implicitna a-posteriori ocena 8. KE za lokalizirane porušitve materiala - KE z vgrajeno nezveznostjo za nosilce - KE z vgrajeno nezveznostjo za 2d telesa	- Dynamics of shells - Integration shemes (Newmark, energy-momentum) - Integration schemes for rotations 7. Discretization error estimation - Zienkiewicz-Zhu error estimation - Implicit a-posteriori estimation 8. FEs for localized material failures - Embedded discontinuity FEs for beams - Embedded discontinuity FEs for 2d solids

Temeljna literatura in viri/Readings:

A. Ibrahimbegovic, Nonlinear solid mechanics. Theoretical formulations and finite element solution methods, Springer 2009.
M. A. Crisfield, Non-linear finite element analysis of solids and structures, Wiley, 1991.
J. Bonet, R.D. Wood, Nonlinear continuum mechanics for finite element analysis, Cambridge University press, 1997.

Cilji in kompetence:	**Objectives and competences:**
Izobraževalni cilji (10 KT): Poglobljen študij nelinearne in neelastične mehanike konstrukcij in nelinearne in neelastične analize konstrukcij po metodi končnih elementov. Kompetence (10 KT): Razumevanje in obvladovanje osnovnih in zahtevnejših numeričnih metod za nelinearno in neelastično analizo konstrukcij.	Objective of the course (10 ECTS): Advanced study of nonlinear and inelastic structural mechanics and nonlinear and inelastic finite element analysis of structures. Competences (10 ECTS): Understanding and mastering of basic and advanced numerical tools for nonlinear and inelastic structural analysis.

Predvideni študijski rezultati:	**Intended learning outcomes:**
Razumevanje: karakterističnega obnašanja lupinastih konstrukcij, pomembnosti nelinearne analize pri napovedi obnašanja lupin, pomembnosti problema uklona pri lupinah, uporabnosti modelov lupin višjega reda, obnašanja lupinastih končnih elementov, elasto-plastičnih formulacij za lupine.	Understanding of: characteristic behavior of shell structures, importance of nonlinear analysis for shell behavior prediction, importance of shell buckling problem, usability of higher-order shell finite element formulations, limitations of shell finite elements,elasto-plastic shell formulations.

Metode poučevanja in učenja:	**Learning and teaching methods:**
Predavanja bodo v klasični učilnici. Vaje bodo v računalniški učilnici	Leactures will be in a standard classroom. Tutorials will be in a computer laboratory.

Načini ocenjevanja:	**Delež/Weight**	**Assessment:**
Pisni izpit	50,00 %	Examination
Projekt	50,00 %	Project

Reference nosilca/Lecturer's references:

JUKIĆ, Miha, BRANK, Boštjan, IBRAHIMBEGOVIĆ, Adnan. Failure analysis of reinforced concrete frames by beam finite element that combines damage, plasticity and embedded discontinuity. Engineering structures, ISSN 0141-0296. [Print ed.], sep. 2014, letn. 75, str. 507-527, ilustr., doi:10.1016/j.engstruct.2014.06.017. [COBISS.SI-ID 6637921], [JCR, SNIP, WoS do 6. 10. 2014: št. citatov (TC): 0, čistih citatov (CI): 0, normirano št. čistih citatov (NC): 0, Scopus do 28. 7. 2014: št. citatov (TC): 0, čistih citatov (CI): 0, normirano št. čistih citatov (NC): 0]

JUKIĆ, Miha, BRANK, Boštjan, IBRAHIMBEGOVIĆ, Adnan. Embedded discontinuity finite element formulation for failure analysis of planar reinforced concrete beams and frames. *Engineering structures*, ISSN 0141-0296. [Print ed.], maj 2013, letn. 50, št. 5, str. 115-125, ilustr., doi:10.1016/j.engstruct.2012.07.028. [COBISS.SI-ID 5983585], [JCR, SNIP, WoS do 8. 10. 2014: št. citatov (TC): 2, čistih citatov (CI): 1, normirano št. čistih citatov (NC): 1, Scopus do 29. 7. 2014: št. citatov (TC): 3, čistih citatov (CI): 2, normirano št. čistih citatov (NC): 2]

DUJC, Jaka, BRANK, Boštjan, IBRAHIMBEGOVIĆ, Adnan. Stress-hybrid quadrilateral finite element with embedded strong discontinuity for failure analysis of plane stress solids. *International journal for numerical methods in engineering*, ISSN 0029-5981, jun. 2013, letn. 94, št. 12, str. 1075-1098, ilustr. http://drugg.fgg.uni-lj.si/4409/, doi: 10.1002/nme.4475. [COBISS.SI-ID 6239841], [JCR, SNIP, WoS do 8. 10. 2014: št. citatov (TC): 3, čistih citatov (CI): 2, normirano št. čistih citatov (NC): 2, Scopus do 29. 7. 2014: št. citatov (TC): 3, čistih citatov (CI): 2, normirano št. čistih citatov (NC): 2]

KASSIOTIS, Christophe, IBRAHIMBEGOVIĆ, Adnan, MATTHIES, Hermann G., BRANK, Boštjan. Stable splitting scheme for general form of associated plasticity including different scales of space and time. *Computer Methods in Applied Mechanics and Engineering*, ISSN 0045-7825. [Print ed.], 2010, letn. 199, št. 21-22, str. 1254-1264, ilustr., doi: 10.1016/j.cma.2009.09.011. [COBISS.SI-ID 4816481], [JCR, SNIP, WoS do 15. 2. 2013: št. citatov (TC): 2, čistih citatov (CI): 1, normirano št. čistih citatov (NC): 1, Scopus do 17. 4. 2013: št. citatov (TC): 3, čistih citatov (CI): 2, normirano št. čistih citatov (NC): 2]

DUJC, Jaka, BRANK, Boštjan, IBRAHIMBEGOVIĆ, Adnan. Multi-scale computational model for failure analysis of metal frames that includes softening and local buckling. *Computer Methods in Applied Mechanics and Engineering*, ISSN 0045-7825. [Print ed.], 2010, letn. 199, št. 21-22, str. 1371-1385, ilustr., doi: 10.1016/j.cma.2009.09.003. [COBISS.SI-ID 4816737], [JCR, SNIP, WoS do 7. 10. 2014: št. citatov (TC): 6, čistih citatov (CI): 5, normirano št. čistih citatov (NC): 6, Scopus do 19. 8. 2014: št. citatov (TC): 10, čistih citatov (CI): 8, normirano št. čistih citatov (NC): 10]

DUJC, Jaka, BRANK, Boštjan, IBRAHIMBEGOVIĆ, Adnan. Quadrilateral Finite Element with Embedded Strong Discontinuity for Failure Analysis of Solids. *Computer modeling in engineering & sciences. CMES*, ISSN 1526-1492. Tiskana izd., 2010, letn. 69, št. 3, str. 223-260, ilustr., doi:10.3970/cmes.2010.069.223. [COBISS.SI-ID 5301345], [SNIP, WoS do 7. 10. 2014: št. citatov (TC): 4, čistih citatov (CI): 1, normirano št. čistih citatov (NC): 1, Scopus do 29. 7. 2014: št. citatov (TC): 4, čistih citatov (CI): 1, normirano št. čistih citatov (NC): 1]

DUJC, Jaka, BRANK, Boštjan, IBRAHIMBEGOVIĆ, Adnan, BRANCHERIE, Delphine. An embedded crack model for failure analysis of concrete solids. *Computers and Concrete*, ISSN 1598-8198, avgust 2010, letn. 7, št. 4, str. 331-346, ilustr. [COBISS.SI-ID 5126497], [JCR, SNIP, WoS do 7. 10. 2014: št. citatov (TC): 6, čistih citatov (CI): 3, normirano št. čistih citatov (NC): 4, Scopus do 29. 7. 2014: št. citatov (TC): 9, čistih citatov (CI): 6, normirano št. čistih citatov (NC): 8]

UČNI NAČRT PREDMETA/COURSE SYLLABUS

Predmet:	Metode numeričnega modeliranja
Course title:	Computational Engineering Methods

Študijski programi in stopnja	Študijska smer	Letnik	Semestri
Grajeno okolje, tretja stopnja, doktorski	Ni členitve (študijski program)		Letni, Zimski

Univerzitetna koda predmeta/University course code: 1090

Predavanja	Seminar	Vaje	Klinične vaje	Druge oblike študija	Samostojno delo	ECTS
30	0	10	0	0	85	5

Nosilec predmeta/Lecturer: Jože Korelc

Vrsta predmeta/Course type: Izbirni predmet/Elective course

Jeziki/Languages:

Predavanja/Lectures:	Angleščina, Slovenščina
Vaje/Tutorial:	Angleščina, Slovenščina

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:	Prerequisites:
Opravljen predmet s področja matematičnih aspektov numeričnih metodah.	Course in mathematical aspects of numerical methods.

Vsebina:	Content (Syllabus outline):
1. Programska podpora numeričemu modeliranju: splošna numerična okolja, okolja za končne elemente, simbolni sistemi, objektni pristopi 2. Avtomatizacija metod numeričnega modeliranja: avtomatska generacija numeričnih programov, avtomatsko odvajanje algoritmov, simbolne metode v numeričnem modeliranju 3. Standardna formulacije končnih elementov: šibka oblika izbrane PDE, diskretizacija (linijski, 2D, osnosimetrični, plošče, lupine, in 3D elementi), rezidual, tangentna matrika 4. Alternativne metode:brezmrežne metode, metoda končnih diferenc, metoda robnih elementov, metoda končnih trakov, metoda končnih volumnov 5. Ekonomika metode končnih elementov: konvergenca, blokiranje in stabilnost končnih elementov, stabilnost in konvergenca iterativnih metod reševanja nelinearnih problemov (Newton-Raphson, metoda ločne dolžine), ekonomika linearnih solverjev 6. Metode generacije mrež končnih elementov	1. Software systems for numerical modeling in engineering: general numerical environments, finite element environments, symbolic-numeric systems, object oriented approach to numerical modeling 2. Automation of numerical software development: automatic code generation, automatic differentiation, symbolic methods in numerical modeling 3. Alternative numerical methods: finite element method, meshless method, finite difference method, finite strip method, finite volume method 4. Standard finite element formulations: weak form of chosen PDE, finite element discretization (beams, shells, 2D and 3D elements), residual, tangent matrix, explicit versus implicit solutions 5. Economics of the finite element method: convergence with mesh refinement, stability and locking, stability and convergence of the iterative solution algorithms for nonlinear problems, economics of the linear solvers (direct and iterative) 6. Methods for finite element mesh generation

Temeljna literatura in viri/Readings:

Temeljni študijski viri:
- S. N. Atluri, Methods of computer modeling in engineering & the sciences, Tech Science Press, 2005.
- M. A. Crisfield, Non-linear Finite Element Analysis of Solids and Structures Vol.1-2, John Wiley & Sons, 1991.

Elektronski viri: e-zbiraka končnih elementov: http://fgg.uni-lj.si/symech/

Cilji in kompetence:	**Objectives and competences:**
• Zna osnove vseh poglavitnih numeričnih pristopov in kompetentno izbrati za dani problem najustreznejši pristop • Zna implementirati manj zahtevne končne elemente • Podrobneje pozna lastnosti končnih elementov za trdnine	• Knowledge of the existing alternative methods and tools in computational engineering • Ability to choose the optimal numerical method for the chosen engineering problem • Ability to develop simple finite element codes using automatic coding

Predvideni študijski rezultati:	**Intended learning outcomes:**
• Spoznati se principi splošnih numeričnih okolij in sistemov za izvedbo numeričnih simulacij v tehniki, različnimi numeričnimi metodami ter podrobneje s specializiranimi okolji za metodo končnih elementov • Spoznati se z obstoječimi pristopi in naprednimi pristopi k razvoju novih numeričnih modelov • Podrobneje spoznati lastnosti metode končnih elementov	• systems for the numerical modeling and optimization in engineering • To learn about the existing competing numerical methods • To learn in detail the principles of the systems for numerical modeling using the finite element method

Metode poučevanja in učenja:	**Learning and teaching methods:**
Predavanja, seminarji, vaje v računalniški učilnici z uporabo modernih sistemov za simbolno algebro.	Lectures, seminars, computer based learning employing modern computer algebra based methods.

Načini ocenjevanja:	**Delež/Weight**	**Assessment:**
Pisni izpit	50,00 %	Writen exam
Projekt	50,00 %	Project

Reference nosilca/Lecturer's references:

MELINK, Teja, KORELC, Jože. Stability of Karhunen- Loève expansion for the simulation of Gaussian stochastic fields using Galerkin scheme. Probabilistic Engineering Mechanics, ISSN 0266-8920. [Print ed.], 2014, 37:7-15, ilustr., doi: 10.1016/j.probengmech.2014.03.006. [COBISS.SI-ID 6653793]
KORELC, Jože. Semi-analytical solution of path-independed nonlinear finite element models. Finite elem. anal. des., 2011, 47:281-287
LENGIEWICZ, Jakub, KORELC, Jože, STUPKIEWICZ, Stanislaw., Automation of finite element formulations for large deformation contact problems. Int. j. numer. methods eng., 2011, 85: 1252–1279
KORELC, Jože, ŠOLINC, Urša, WRIGGERS, Peter. An improved EAS brick element for finite deformation. Comput. mech., 2010, 46:641-659
STUPKIEWICZ, Stanislaw, LENGIEWICZ, Jakub, KORELC, Jože. Sensitivity analysis for frictional contact problems in the augmented Lagrangian formulation. Comput. methods appl. mech. eng., 2010, 199:2165-2176.
KORELC, Jože. Direct computation of critical points based on Crout's elimination and diagonal subset test function. Comput. struct.. 2010, 88:189-197.
KORELC, Jože. Automation of primal and sensitivity analysis of transient coupled problems. Comput. mech., 2009, 44:631-649.

UČNI NAČRT PREDMETA/COURSE SYLLABUS

Predmet:	Metode numeričnega modeliranja
Course title:	Computational Engineering Methods

Študijski programi in stopnja	Študijska smer	Letnik	Semestri
Grajeno okolje, tretja stopnja, doktorski	Ni členitve (študijski program)		Letni, Zimski

Univerzitetna koda predmeta/University course code: 1509

Predavanja	Seminar	Vaje	Klinične vaje	Druge oblike študija	Samostojno delo	ECTS
60	0	20	0	0	170	10

Nosilec predmeta/Lecturer: Jože Korelc

Vrsta predmeta/Course type: Izbirni predmet/Elective course

Jeziki/Languages:

Predavanja/Lectures:	Angleščina, Slovenščina
Vaje/Tutorial:	Angleščina, Slovenščina

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:	Prerequisites:
Opravljen predmet s področja matematičnih aspektov numeričnih metodah.	Course in mathematical aspects of numerical methods.

Vsebina:	Content (Syllabus outline):
1. Programska podpora numeričemu modeliranju: splošna numerična okolja, okolja za končne elemente, simbolni sistemi, objektni pristopi 2. Avtomatizacija metod numeričnega modeliranja: avtomatska generacija numeričnih programov, avtomatsko odvajanje algoritmov, simbolne metode v numeričnem modeliranju 3. Standardna formulacije končnih elementov: šibka oblika izbrane PDE, diskretizacija (linijski, 2D, osnosimetrični, plošče, lupine, in 3D elementi), rezidual, tangentna matrika 4. Alternativne metode:brezmrežne metode, metoda končnih diferenc, metoda robnih elementov, metoda končnih trakov, metoda končnih volumnov 5. Ekonomika metode končnih elementov: konvergenca, blokiranje in stabilnost končnih elementov, stabilnost in konvergenca iterativnih metod reševanja nelinearnih problemov (Newton-Raphson, metoda ločne dolžine), ekonomika linearnih solverjev 6. Metode generacije mrež končnih elementov 7. Avtomatizacija formulacije primarne in občuljivostne analize stacionarnih in tranzientnih problemov v tehniki 8. Gradientni optimizacijski problemi 9. Kontaktni problemi: implementacija kontaktnih problemov, algoritmi za iskanje kontakta med	1. Software systems for numerical modeling in engineering: general numerical environments, finite element environments, symbolic-numeric systems, object oriented approach to numerical modeling 2. Automation of numerical software development: automatic code generation, automatic differentiation, symbolic methods in numerical modeling 3. Alternative numerical methods: finite element method, meshless method, finite difference method, finite strip method, finite volume method 4. Standard finite element formulations: weak form of chosen PDE, finite element discretization (beams, shells, 2D and 3D elements), residual, tangent matrix, explicit versus implicit solutions 5. Economics of the finite element method: convergence with mesh refinement, stability and locking, stability and convergence of the iterative solution algorithms for nonlinear problems, economics of the linear solvers (direct and iterative) 6. Methods for finite element mesh generation 7. Automation of primal and sensitivity analysis of general nonlinear coupled problems in engineering 8. Formulation and gradient based solution of optimization problems

telesi, 2D in 3D kontaktni končni elementi (motoda kazenske funkcije in Lagrangeovih množiteljev) 10. Napredni končni elementi bazirani na mešanih variacijskih principih: EAS, HR, podintegracija/stabilizacija. 11. Metode formulacija in reševanja povezanih problemov (deformacijski, termalni, magnetni …): enovit, stopenjski pristop, stabilnost stopenjskih pristopov 12. Generacija semi-analitičnih rešitev mehanskih problemov z uporabo simbolnih sistemov	9. Contact problems: implementation, contact search algorithms, 2D and 3D contact finite elements, contact formulations (penalty, Lagrange, mortar,...) 10. Advanced solid elements based on mixed variational principles (EAS, HR, etc.) 11. Solution methods for coupled problems (thermo-hydro-magneto-mechanical coupling), monolithic, staggered schemes. 12. Semi-analytical solutions of engineering problems (symbolic-numeric approaches)

Temeljna literatura in viri/Readings:

Temeljni študijski viri:
- S. N. Atluri, Methods of computer modeling in engineering & the sciences, Tech Science Press, 2005.
- M. A. Crisfield, Non-linear Finite Element Analysis of Solids and Structures Vol.1-2, John Wiley & Sons, 1991.

Elektronski viri:
e-zbiraka končnih elementov: http://fgg.uni-lj.si/symech/

Cilji in kompetence:	**Objectives and competences:**
• Zna izpeljati in implementirati zahtevne konstitutivne modele in formulacije končnih elementov • Zna izpeljati občutljivostno analizo poljubnega problema in formulirati optimizacijski problem • Zna formulirati kontaktni problem • Zna izpeljati in formulirati povezan problem	• Ability to implement advanced finite element models and constitutive models for analysis oF solids and structures • Knowledge of problems in solution techniques involving contact • Knowledge of sensitivity analysis and optimization algorithms

Predvideni študijski rezultati:	**Intended learning outcomes:**
• Spoznati se principi splošnih numeričnih okolij in sistemov za izvedbo numeričnih simulacij v tehniki, različnimi numeričnimi metodami ter podrobneje s specializiranimi okolji za metodo končnih elementov • Spoznati se z obstoječimi pristopi in naprednimi pristopi k razvoju novih numeričnih modelov • Podrobneje spoznati lastnosti metode končnih elementov	• systems for the numerical modeling and optimization in engineering • To learn about the existing competing numerical methods • To learn in detail the principles of the systems for numerical modeling using the finite element method

Metode poučevanja in učenja:	**Learning and teaching methods:**
Predavanja, seminarji, vaje v računalniški učilnici z uporabo modernih sistemov za simbolno algebro.	Lectures, seminars, computer based learning employing modern computer algebra based methods.

Načini ocenjevanja:	**Delež/Weight**	**Assessment:**
Pisni izpit	50,00 %	Writen exam
Projekt	50,00 %	Project

Reference nosilca/Lecturer's references:

MELINK, Teja, KORELC, Jože. Stability of Karhunen- Loève expansion for the simulation of Gaussian stochastic fields using Galerkin scheme. Probabilistic Engineering Mechanics, ISSN 0266-8920. [Print ed.], 2014, 37:7-15, ilustr., doi: 10.1016/j.probengmech.2014.03.006. [COBISS.SI-ID 6653793]

KORELC, Jože. Semi-analytical solution of path-independed nonlinear finite element models. Finite elem. anal. des., 2011, 47:281-287

LENGIEWICZ, Jakub, KORELC, Jože, STUPKIEWICZ, Stanislaw., Automation of finite element formulations for large deformation contact problems. Int. j. numer. methods eng., 2011, 85: 1252–1279

KORELC, Jože, ŠOLINC, Urša, WRIGGERS, Peter. An improved EAS brick element for finite deformation. Comput. mech., 2010, 46:641-659
STUPKIEWICZ, Stanislaw, LENGIEWICZ, Jakub, KORELC, Jože. Sensitivity analysis for frictional contact problems in the augmented Lagrangian formulation. Comput. methods appl. mech. eng., 2010, 199:2165-2176.
KORELC, Jože. Direct computation of critical points based on Crout's elimination and diagonal subset test function. Comput. struct.. 2010, 88:189-197.
KORELC, Jože. Automation of primal and sensitivity analysis of transient coupled problems. Comput. mech., 2009, 44:631-649.

UČNI NAČRT PREDMETA/COURSE SYLLABUS

Predmet:	Modeliranje podzemnih objektov
Course title:	Modelling of Underground Structures

Študijski programi in stopnja	Študijska smer	Letnik	Semestri
Grajeno okolje, tretja stopnja, doktorski	Ni členitve (študijski program)		Letni, Zimski

Univerzitetna koda predmeta/University course code: 1091

Predavanja	Seminar	Vaje	Klinične vaje	Druge oblike študija	Samostojno delo	ECTS
20	0	20	0	0	85	5

Nosilec predmeta/Lecturer: Janko Logar

Vrsta predmeta/Course type: Izbirni predmet/Elective course

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

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:	**Prerequisites:**
Za izbiro predmeta je pogoj znanje iz vsebin numeričnih metod v inženirstvu in geotehnike v obsegu diplomanta magistrskega študija gradbeništva.	The candidate has the knowledge of numerical modelling and geotechnics obtained during Master study of Civil engineering.

Vsebina:	**Content (Syllabus outline):**
Analitične in numerične metode za analize podzemnih objektov v homogenih in izotropnih tleh ter v nehomogenih in anizotropnih tleh. Metoda končnih elementov, metoda ločenih elementov in diferenčna metoda v 3 razsežnem prostoru. Prijemi za uporabo 2D analiz pri gradnji podzemnih prostorov. Velikost modelov - vpliv robnih pogojev. Začetna napetostna stanja v kamninah. Modeliranje podpornih elementov. Modeliranje geoloških posebnosti kot so prelomi, gube. Materialni modeli za kamnine in zemljine in sicer posebej za modeliranje homogenih in izotropnih tal ter posebej za modeliranje anizotropnih tal. Modeliranje klasičnega izkopa (NATM) in strojnega izkopa (TBM, EPB). Analize stabilnosti podzemnih blokov kamnine. Vpliv podzemnih gradenj na objekte na površini. Študij na konkretnih primerih iz literature ali dobro dokumentiranih primerih iz prakse.	Analytical and numerical methods for the analyses of underground structures in homogeneous and isotropic ground conditions and in non-homogeneous and anisotropic ground conditions. Finite element method, Distinct element method and Finite difference method in 3D space. How and when to use 2D analysis for underground construction. Selection of dimensions of numerical models – influence of boundary conditions. Initial stress states in rock. Modelling of support elements. Modelling of special geological features as faults and folds. Material models for rocks and soils for homogeneous isotropic materials and for anisotropic materials. Modelling of classical (NATM) tunnelling and machine (TBM, EPB) tunnelling. Stability analysis of underground rock blocks. Influence of underground construction on surface structures. Study based on well documented case histories from literature.

Temeljna literatura in viri/Readings:

G. Beer, Numerical Simulation in Tunneling, Springer-Verlag Wien, 2003.
M. Zaman, G. Gioda, J. Booker, Modeling in geomechanics, John Wiley & Sons, Chichester UK, 2000.

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

Študent samostojno uporablja 2D in 3D numerične modele na realnih, kompleksnih primerih podzemnih konstrukcij. Glede na materiale v tleh, geometrijo podzemnega prostora ter tehnologijo gradnje zna izbrati ustrezne numerične modele, pripraviti potrebne parametre, izvesti analizo in analizirati rezultate.	Student is able to autonomously perform 2D and 3D numerical analyses of real case histories of underground constructions. She/he is able to select suitable numerical models and tools considering type of the ground, geometry of underground structure and construction technology, to asses necessary input parameters, to do analysis and to critically analyse results.

Predvideni študijski rezultati:	**Intended learning outcomes:**
Znanje in razumevanje: Razume posebnost modeliranja podzemnih objektov kot značilnega 3D problema. Zna izbrati med različnimi materialnimi modeli glede na geotehnične pogoje tal in ustrezne robne pogoje glede na tehnologijo izkopa.	Knowledge and understanding: Understanding of modelling of underground structures as typical 3D problem. Knowledge of the selection of relevant material model regarding the geotechnical ground conditions and boundary conditions with respect to the excavation method.

Metode poučevanja in učenja:	**Learning and teaching methods:**
Konzultacije, študij znanstvene in strokovne literature, študij primerov dobre prakse, numerično modeliranje podzemnih gradenj na konkretnih primerih, priprava članka.	Individual work with students, study of scientific and professional literature, study of case histories of good professional practice, practical work on numerical modelling of real examples of underground structures, writing a paper.

Načini ocenjevanja:	**Delež/Weight**	**Assessment:**
Način (pisni izpit, ustno izpraševanje, naloge, projekt) Članek/seminarska naloga z zagovorom	100,00 %	Type (examination, oral, coursework, project): Paper/seminar work with oral discussion

Reference nosilca/Lecturer's references:

KLOPČIČ, Jure, LOGAR, Janko. Effect of relative orientation of anisotropy planes to tunnel axis on the magnitude of tunnelling displacements. International journal of rock mechanics and mining sciences, ISSN 1365-1609, letn. 71, okt. 2014, str. 235-248, ilustr., doi: 10.1016/j.ijrmms.2014.02.024. [COBISS.SI-ID 6716001]

KLOPČIČ, Jure, ŽIVEC, Tina, ŽIBERT, Marko, AMBROŽIČ, Tomaž, LOGAR, Janko. Influence of the geological structure on the displacements measured ahead of the Šentvid tunnel face in small diameter exploratory tunnel = Einfluß der Geologie auf die in einem Erkundungsstollen vor der Ortsbrust des Sentvid-Tunnels gemessenen Verschiebungen. Geomechanik und Tunnelbau, ISSN 1865-7362. [Print ed.], feb. 2013, letn. 6, št. 1, str. 25-47, ilustr., doi: 10.1002/geot.201300004. [COBISS.SI-ID 6153313]

KLOPČIČ, Jure, LOGAR, Janko. Vpliv anizotropije hribinske mase na velikost in smer pomikov zaradi izkopa predora = Influence of anisotropy of rock mass on magnitude and direction of displacements due to tunnelling. Gradbeni vestnik, ISSN 0017-2774, jan. 2013, letn. 62, str. 3-14, ilustr. [COBISS.SI-ID 6151777]

KLOPČIČ, Jure, AMBROŽIČ, Tomaž, MARJETIČ, Aleš, GAMSE, Sonja, PULKO, Boštjan, LOGAR, Janko. Use of automatic target recognition system for the displacement measurements in a small diameter tunnel ahead of the face of the motorway tunnel during excavation. Sensors, ISSN 1424-8220, 2008, vol. 8, no. 12, str. 8139-8155, ilustr. http://www.mdpi.com/1424-8220/8/12/8139. [COBISS.SI-ID 4396641]

KLOPČIČ, Jure, LOGAR, Janko, AMBROŽIČ, Tomaž, ŠTIMULAK, Andrej, MARJETIČ, Aleš, BOGATIN, Sonja, MAJES, Bojan. Displacements in the exploratory tunnel ahead of the excavation face of Šentvid tunnel. Acta geotechnica Slovenica, ISSN 1854-0171, 2006, letn. 3, št. 2, str. 17-33, ilustr. [COBISS.SI-ID 3283553]

SCHUBERT, Peter, KLOPČIČ, Jure, ŠTIMULAK, Andrej, AJDIČ, Igor, LOGAR, Janko. Analysis ofCharacteristic Deformation Patterns at the Trojane Tunnel in Slovenia. Felsbau, 2005, letn. 23, št. 5, str. 25-30, graf. prikazi. [COBISS.SI-ID 2881121]

UČNI NAČRT PREDMETA/COURSE SYLLABUS

Predmet:	Modeliranje prenosa in pretvorb snovi v vodnem okolju
Course title:	Modelling Transport and Transformation of Substances in Water Systems

Študijski programi in stopnja	Študijska smer	Letnik	Semestri
Grajeno okolje, tretja stopnja, doktorski	Ni členitve (študijski program)		Letni, Zimski

Univerzitetna koda predmeta/University course code: 1092

Predavanja	Seminar	Vaje	Klinične vaje	Druge oblike študija	Samostojno delo	ECTS
30	0	10	0	0	85	5

Nosilec predmeta/Lecturer: Dušan Žagar

Vrsta predmeta/Course type: Izbirni predmet/Elective course

Jeziki/Languages:

Predavanja/Lectures:	Slovenščina, Angleščina
Vaje/Tutorial:	Slovenščina, Angleščina

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:	Prerequisites:
Ni posebnih pogojev	No special prerequisites

Vsebina:	Content (Syllabus outline):
UVODNI DEL - problematika onesnaženja vodnega okolja s snovmi in toploto ter tipi okoljskih modelov - konceptualni in numerični modeli ter večdimenzionalno modeliranje - osnove oceanografije v priobalnem pasu in na odprrtem morju (oceanografski parametri, plimovanje, razvoj in vpliv valov, vsiljevanja) - modeli cirkulacije kot osnova za modeliranje prenosa in razgradnje snovi - stacionarni in nestacionarni modeli cirkulacije, transporta in pretvorb MODUL 1: - načini reševanja A-D enačbe (Eulerjev in Lagrangeov pristop) - prenos onesnažil v raztopljeni in ne delce vezani obliki - prenos suspendiranih snovi (usedanje, resuspenzija) - izvorno ponorni člen A-D enačbe, pretvorbe snovi v vodnem okolju MODUL 2: - modeliranje v celinskih vodah in morju, gnezdenje modelov - povezovanje vodnih modelov z modeli erozije, sedimentov in zračnimi modeli - vključevanje bio-geokemičnih modelov in modulov (namenjenih procesom pretvorb) v vodne modele, modeli izvorno ponornega člena AD enačbe	INTRODUCTION: • Current issues in water pollution by chemicals and heat and the types of environmental models • Conceptual and numerical models and multidimensional modelling • Basic oceanography of coastal and open seas (oceanographic parameters, tides, formation and influence of waves, forcing factors) • Circulation models as basic tools for further transport and transformation modelling • Steady-state and non-steady state models of circulation, transport and transformations MODULE 1: • Approaches to solving A-D equation (Eulerian and Lagrangean) • Transport of pollutants in dissolved and particulate form • Transport of suspended matter (sedimentation and resuspension) • Source/sink term of the A-D equation, transformation of substances in water MODULE 2: • Modelling freshwater and sea, nesting of models • Coupling of water models with erosion-, sediment- and atmospheric models • Integrating biogeochemical models and transformations modules in the water models, models of source/sink term in the A-D equation

- druge metode modeliranja v vodnih telesih (SPH – smoothed particle hydrodynamics, MBM – mrežna Boltzmannova metoda, učenje iz podatkov) - SPH modeli večfaznega toka, transporta in pretvorb snovi MODUL 3: - povezava med opisanimi metodami modeliranja in modelnimi orodji ter uporaba kombiniranih (združenih) modelnih orodij pri reševanju problematike onesnaženja vodnega okolja - konkretni aktualni primeri in njihovo reševanje (v obliki naloge, poglobljeni samostojni študij)	• Other methods in water modelling (SPH – smoothed particle hydrodynamics, LBM – Lattice Boltzmann Method, machine learning methods) • SPH models of multiphase flow, transport and transformations MODULE 3: • Appropriate uses of the described modelling tools and methods • Using combined and/or integrated modelling tools in solving water pollution issues Case studies of recent issues and their solving (in the form of a seminar, individual study)

Temeljna literatura in viri/Readings:

- Rajar, R. (1981). Hidromehanika. Učbenik FAGG. 236 str.
- Rajar R. (1986). Hidravlika nestalnega toka, Učbenik FAGG.
- Knaus, J. (1997). Physical Oceanography (2nd ed.). Prentice Hall. 309 str.
- Martinez, PA., Harbaugh JW. (1993) Simulating Nearshore Environments. Pergamon Press Inc. 280 str.

· Fennel W., Neuman T. (2004). Introduction to the modelling of Marine Ecosystems. Elsevier. 330 str.

- Liu, G.R., Liu, M.B. (2003). Smoothed Particle Hydrodynamics: a meshfree particle method, World Scientific. 472 str. (izbrana poglavja)
- Hearn, C.J. (2008): The Dynamics of Coastal Models. Cambridge University Press. 480 str. (izbrana poglavja)

Elektronski viri: svetovni splet, baze člankov in iskalniki specializiranih elektronskih revij in baz podatkov

Cilji in kompetence:	**Objectives and competences:**
Cilji: · seznanjanje z različnimi vrstami matematičnih modelov za simulacije v vodnem okolju · razumevanje procesov v različnih tipih vodnega okolja (celinske vode, priobalni pas in odprto morje) · poglabljanje in posploševanje doseženega znanja na dodiplomskem in podiplomskem študiju (hidravlika, hidrologija, hidromehanika, termodinamika, osnovni biogeokemični procesi) ter posploševanje razumevanja enačb in procesov v vodnem okolju (hidrodinamika / cirkulacija, transport, pretvorbe snovi) **Kompetence:** študent zna uporabljati (če namerava izdelati disertacijo na tem področju pa tudi izdelati) različne vrste modelov in kombinacije modelskih orodij za simulacije procesov v različnih tipih vodnega okolja in različnih merilih	**Objectives:** • Introducing various types of mathematical models for simulating processes in water systems • Understanding processes in different water environments (freshwaters, coastal and open sea) • Expanding and generalising the knowledge obtained in undergraduate and postgraduate studies (hydraulics, fluid mechanics, thermodynamics, basic biogeochemical processes) and developing new skills in explaining equations and processes (hydrodynamics/circulation, transport, transformations) **Competences:** • The students will be able to use (and in case of making a dissertation within the field they will be also capable of developing) different types of modelling tools and their combinations in order to simulate processes in various sizes and types of water environments

Predvideni študijski rezultati:	**Intended learning outcomes:**
Znanje in razumevanje: · študent spozna in razume delovanje modelnih orodij v različnih tipih vodnega okolja · študent razume procese prenosa in pretvorb snovi v vodnih okoljih ter delovanje modelov in kombinacij modelnih orodij za ustrezne simulacije · študent razume različna merila in postopke modeliranja v vodnih okoljih	Knowledge and understanding: • The students will acquire new knowledge and understanding of the use of different modelling tools in various water environments • The students will develop an understanding of the processes of substance transport and transformations in water and the functioning of modelling tools and their combinations in simulating these processes • The students will learn to choose the appropriate modelling tool for each domain size

Metode poučevanja in učenja:	Learning and teaching methods:
Predavanja, seminarske vaje s praktičnimi primeri dela z izbranimi modeli v računalniški učilnici ter izdelava individualne seminarske naloge z izbranim modelnim orodjem.	Lectures, seminar practicals with chosen modelling tools and individual seminars on selected modelling tool(s)

Načini ocenjevanja:	Delež/Weight	Assessment:
Način (pisni izpit, ustno izpraševanje, naloge, projekt) Samostojna naloga	70,00 %	Type (examination, oral, coursework, project): Individual (seminar) work
Pisni ali ustni izpit (teoretični del)	30,00 %	Written or oral examination (theoretical part)

Reference nosilca/Lecturer's references:

1. 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. V: *16th International Conference on Heavy Metals in the Environment, 23-27 September, 2012, Rome, Italy*. Heidelberg: Springer, vol. 21, no. 6. 2014, letn. 21, št. 6, str. 4081-4094, ilustr., doi: 10.1007/s11356-013-2055-5. tipologija 1.08 -> 1.01

2. 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*, ISSN 0022-1686, 2014, letn.52, št. 4, str.453-464, ilustr., doi: 10.1080/00221686.2013.879611

3. MASLO, Aljaž, PANJAN, Jože, ŽAGAR, Dušan. Large-scale oil spill simulation using the lattice Boltzmann method, validation on the Lebanon oil spill case. *Marine pollution bulletin*, ISSN 0025-326X, jul. 2014, letn. 84, št. 1-2, str. 225-235, ilustr., doi: 10.1016/j.marpolbul.2014.05.008.

4. RAMŠAK, Vanja, MALAČIČ, Vlado, LIČER, Matjaž, KOTNIK, Jože, HORVAT, Milena, ŽAGAR, Dušan. High-resolution pollutant dispersion modelling in contaminated coastal sites. *Environmental research*, ISSN 0013-9351, avg. 2013, št. 125, str. 103-112, ilustr., doi: 10.1016/j.envres.2012.12.013

UČNI NAČRT PREDMETA/COURSE SYLLABUS

Predmet:	Na znanje oprto inženirstvo
Course title:	Knowledge Based Engineering

Študijski programi in stopnja	Študijska smer	Letnik	Semestri
Grajeno okolje, tretja stopnja, doktorski	Ni členitve (študijski program)		Letni, Zimski

Univerzitetna koda predmeta/University course code: 1096

Predavanja	Seminar	Vaje	Klinične vaje	Druge oblike študija	Samostojno delo	ECTS
20	20	0	0	0	85	5

Nosilec predmeta/Lecturer: Žiga Turk

Vrsta predmeta/Course type: Izbirni predmet/Elective course

Jeziki/Languages:

Predavanja/Lectures:	Slovenščina, Angleščina
Vaje/Tutorial:	Slovenščina, Angleščina

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:	Prerequisites:
Vsaj dva predmeta iz gradbene informatike na master nivoju	At least two construction informatics courses from master level studies

Vsebina:	Content (Syllabus outline):
• filozofske osnove predstavitve znanja • ontologije in druga orodja za semantično modeliranje inženirskih informacij • metode, tehnike in orodja arhiviranja inženirskih informacij ter poizvedovanja po njih • metode, tehnike in orodja za predstavitev inženirskega znanja • upravljanje z znanjem v gradbeni organizaciji • inženirska umetna inteligenca: na znanje oprti sistemi, genetski algoritmi, nevronske mreže, strojno učenje, inteligentni agenti • semantični splet in semantični spletni servisi	• philosophical foundations of knowledge representation • ontologies and other methods for the semantic modeling of engineering data • methods, technologies and tools for big data, information warehousing, information retrieval and data mining • methods, technologies and tools for the representation of engineering knowledge • knowledge management in an engineering organization • engineering artificial intelligence; knowledge based systems, genetic algorithms, neural networks, machine learning, intelligent agents • semantic web services and semantic web • advanced visualization, virtual and augmented reality

Temeljna literatura in viri/Readings:

- Dalkir, Kimiz. Knowledge management in theory and practice. Routledge, 2013.
- Ratner, Bruce. Statistical and machine-learning data mining: Techniques for better predictive modeling and analysis of big data. CRC Press, 2011.
- Russell, Stuart, Peter Norvig. “Artificial Intelligence. A modern approach." Artificial PrenticeHall, Egnlewood Cliffs, Third Edition (2013).
- Raphael in Smith: Fundamentals of Computer Aided Engineering, Wiley, 2003.

Cilji in kompetence:	**Objectives and competences:**
Cilji: • razumevanje principov in omejitev strojne inteligence, simbolične in statistične • razumevanje teorije in prakse, ki je povezana s semantiko inženirskih podatkov • pozna standarde, jezike in orodja za predstavitev, arhiviranje in inteligentno poizvedovanje po informacijah • pozna teorijo in orodja za upravljanje znanja v organizaciji • pozna teorijo in orodja inženirske umetne inteligence Pridobljene kompetence: - zna delati v ekipi človek-stroj - zna uporabljati strojno inteligenco pri inženirskem in raziskovalnem delu - zna načrtovati in izdelovati na znanje oprte inženirske sisteme, sisteme za upravljanje z inženirskim znanjem, arhive inženirskih podatkov ter rešitve za zajemanje in rudarjenje podatkov v njih - zna načrtovati in izdelovati sisteme za vizualizacijo inženirskih podatkov in znanja	Objectives: • understands principles and limitations of machine intelligence, both symbolic and statistical • understands the theory and practice related to the semantics of engineering data • knows standards, languages and tools for the representation, archiving and intelligent retrieval of information • knows the theory and tools for knowledge management in an organization Competences: • knows how to work in manmachine teams • knows how to use machine intelligence in engineering and research work • knows how to design and develop engineering knowledge based systems, knowledge management systems and solutions for information retrieval and data mining • knows how to design and develop visualizations of engineering information and knowledge

Predvideni študijski rezultati:	**Intended learning outcomes:**
Doseženi zgornji cilji in pridobljene zgornje kompetence.	Achieved objectives and gained competences as above.

Metode poučevanja in učenja:	**Learning and teaching methods:**
• predavanja	- lectures
• diskusije	- discussions
• samostojne raziskovalne naloge	- research assignments related to main topics
• korekture	- consulting

Načini ocenjevanja:	**Delež/Weight**	**Assessment:**
Ustni izpit	40,00 %	Oral exam
Sodelovanje	10,00 %	Participation, activity
Projektno delo	50,00 %	Project work

Reference nosilca/Lecturer's references:

TURK, Žiga. Phenomenologial foundations of conceptual product modelling in architecture, engineering and construction. Artif. intell. eng.. [Print ed.], 2001, [N.] 15, str. 83-92, ilustr. [COBISS.SI-ID 1597793]

PETRINJA, Etiel, STANKOVSKI, Vlado, TURK, Žiga. A provenance data management system for improving the product modelling process. Autom. constr.. [Print ed.], 2007, letn.
16, št. 4, str. 485-497, graf. prikazi. [COBISS.SI-ID 3436129]

KATRANUSCHKOV, Peter, SCHERER, Raimar J., TURK, Žiga. Intelligent services and tools for concurrent engineering? : an approach towards the next generation of collaboration platforms. Electronic journal of information technology in construction, 2001, vol. 6, str. 111-
128, ilustr. [COBISS.SI-ID 1663841]

DOLENC, Matevž, KLINC, Robert, TURK, Žiga. InteliGrid - Semantična grid tehnologija za podporo inženirskim virtualnim organizacijam = InteliGrid - Semantic grid technology in support of engineering virtual organisations. Gradbeni vestnik, ISSN 0017-2774, 2007, letn. 56, št. 11, str. 297-304, ilustr. [COBISS.SI-ID 3783777]

TURK, Žiga. Construction informatics: definition and ontology. Advanced engineering informatics, ISSN 1474-0346, 2006, letn. 20, št. 2, str. 187-199, graf. prikazi. [COBISS.SI-ID 3091297]

MEŽA, Sebastjan, TURK, Žiga, DOLENC, Matevž. Component based engineering of a mobile BIM-based augmented reality system. Automation in construction, ISSN 0926-5805. [Print ed.], jun. 2014, letn. 42, št. X, str. 1-12, ilustr. [COBISS.SI-ID 6537825]

KLINC, Robert, TURK, Žiga, DOLENC, Matevž. ICT enabled communication in construction 2.0. Pollack periodica, ISSN 1788-1994,April 2010, letn. 5, št. 1, str. 109-120, ilustr., doi: 10.1556/Pollack.5.2010.1.8. [COBISS.SI-ID 4986465], [št. citatov (TC): 4, čistih citatov (CI): 4, normirano št. čistih citatov (NC): 4]

KLINC, Robert, TURK, Žiga, DOLENC, Matevž. Engineering collaboration 2.0 : requirements and expectations. Journal of informationtechnology in construction, ISSN 1874-4753, 2009, letn. 14, pos. št., str. 473-488. [COBISS.SI-ID4711777], [Scopus do 17. 4. 2013: št. citatov (TC): 10, čistih citatov (CI): 8, normirano št. čistih citatov (NC): 8]

KOLER-POVH, Teja, JUŽNIČ, Primož, TURK, Žiga, TURK, Goran. Analiza znanstvenih objav v slovenskem gradbeništvu in geodezijina primeru UL FGG = Analysis of scientific publications in civil and geodetic engineering in Slovenia, in the case of the Faculty of civil andgeodetic engineering in University of Ljubljana. Geodetski vestnik, ISSN 0351-0271. [Tiskana izd.], 2011, letn. 55, št. 4, str. 764-779, ilustr. http://www.geodetski-vestnik.com/55/4/gv55-4_764-780.pdf, http://drugg.fgg.uni-lj.si/3869/. [COBISS.SI-ID 5649505], [JCR, SNIP, WoS]

UČNI NAČRT PREDMETA/COURSE SYLLABUS

Predmet:	Načrtovanje zdravih stavb
Course title:	Design of Healthy Buildings

Študijski programi in stopnja	Študijska smer	Letnik	Semestri
Grajeno okolje, tretja stopnja, doktorski	Ni členitve (študijski program)		Letni, Zimski

Univerzitetna koda predmeta/University course code: 1703

Predavanja	Seminar	Vaje	Klinične vaje	Druge oblike študija	Samostojno delo	ECTS
20	10	10	0	0	85	5

Nosilec predmeta/Lecturer: Mateja Dovjak

Vrsta predmeta/Course type: Izbirni predmet/Elective course

Jeziki/Languages:

Predavanja/Lectures:	Angleščina, Slovenščina
Vaje/Tutorial:	Angleščina, Slovenščina

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:	Prerequisites:
Ni posebnih pogojev.	No special knowledge is required.

Vsebina:	Content (Syllabus outline):
Izhodišče: značilnosti lokacije (naravne danosti, antropogeni vplivi), fiziologija človeka in termoregulacija v ekstremnih okoljih, toplotna bilanca človeškega telesa, fenomen adaptacije organizma. Zdravje *versus* udobje, storilnost, stimulirajoče razmere. **Problematika:** enostransko načrtovanja stavb; pojmovanje, vzroki in razširjenost sindroma bolnih stavb (SBS) in bolezni povezanih s stavbo (BRI). **Metodologija:** obvladovanja in preprečevanja dejavnikov tveganja za zdravje v grajenem okolju: proces ocene tveganja (štiri faze), proces obvladovanja tveganja, direktne in indirektne metode za oceno izpostavljenosti, osnovno poznavanje epidemioloških raziskav (opisne in analitične) ter epidemioloških mer pogostosti (incidenca, prevalenca) in povezanosti (razmerje obetov, relativno tveganje) med pojavi. **Potrebe, zahteve:** sanitarno tehnične in higienske zahteve za načrtovanje stavb s specifičnimi zahtevami in potrebami (zdravstvene ustanove, vzgojno-izobraževalni objekti, športni objekti, wellness, živilski objekti, letališča, stanovanjski objekti, ipd.). Celovito udobje s konceptom individualizacije, medsebojni vpliv parametrov udobja. Smernice za načrtovanje zdravih stavb s holističnim pristopom.	**Starting point:** location characteristics (natural endowments, anthropogenic influences), human physiology and thermoregulation in extreme environments, human body heat balance, phenomenon of adaptation of the organism. Health versus comfort, productivity, stimulating conditions. **Problem:** one-sided building design; understanding of main causes and prevalence of Sick Building Syndrome (SBS) and Building Related Illness (BRI). **Methodology:** control and prevention of health risk factors in the built environment: the processes of risk assessment (four phases), control of risk factors, direct and indirect methods for exposure assessment, introduction to epidemiological studies (descriptive and analytical) and epidemiological measures (incidence, prevalence, odds ratio, relative risk). **Needs, demands:** sanitary-technical and hygienic conditions for the design of buildings with specific needs and demands (health care facilities, educational facilities, sports facilities, wellness, food facilities, airports, residential buildings, etc.). Integral comfort with the concept of individualization, interactions between comfort parameters. Recommendations for the design of healthy buildings with a holistic approach.

Temeljna literatura in viri/Readings:

Basic Environmental Health / Yassi A, Kjellstrom T, de Kok T, Guidotti TL. Oxford: Oxford UniversityPress, 2001.

Zdravje in okolje: izbrana poglavja / Eržen I, Gajšek P, Hlastna Ribič C, Kukec A, Poljšak B, Zaletel Kragel L. Maribor: Univerza v Mariboru, Medicinska fakulteta, 2010.
Patofiziologija s temelji fiziologije / Bresjanac M, Rupnik M. Ljubljana: Inštitut za patološko fiziologijo, 1999.
Medicina rada i okoliša / Šarić, M, Žuškin, E. Zagreb, Medicinska naklada, 2002.
Medicina dela / Bilban M. Ljubljana, Zavod za varstvo pri delu, 2005.
Oblikovanje dela in delovnih mest / Polajnar A, Verhovnik V. Maribor, FS, 2000.
Occupational health practice / Schilling RSF. London, Butterworths, 1981.
Ergonomics, workandhealth / Pheasant S. London, MacMillan Press, 1991.
Ergonomska fiziologija / Sušnik J. Radovljica, Didakta, 1992.
Priročnik za načrtovanje in prilagajanje grajenega okolja v korist funkcionalno oviranim ljudem / Vovk M. Ljubljana, Urbanistični inštitut RS, 2000.
Sustainable architecture, bioclimatic architecture, on line teaching package. SARA – Sustainable Architecture Applied to Replicable Public Access Buildings / Krainer A, http://kske.fgg.uni-lj.si/Index_SI.htm, 2008.
Tekoča periodika/Current periodicals: Indoor & built environment, Environmental health, International journal of environmental health review, International journal of hygiene and environmental health, Indoor air, Energy & Buildings, Building & Environment.

Cilji in kompetence:	**Objectives and competences:**
Cilj predmeta je seznaniti študente z nezdravimi in neudobnimi razmerami, s sindromom bolnih stavb in boleznimi povezanimi s stavbo, ki so odraz enostranskega načrtovanja stavb (načrtovanja, pri katerem niso upoštevani vsi vplivni faktorji lokacije, stavbnega ovoja, človeka, sistemov). Študent bo osvojil znanja s področja značilnosti lokacije (naravne danosti, antropogenimi vplivi), ki vplivajo na zdravje. S ciljem izdelave smernic za načrtovanje zdravih stavb se študent seznani z metodologijo obvladovanja in preprečevanja dejavnikov tveganja za zdravje v grajenem okolju, sanitarno tehničnimi in higienskimi zahtevami za načrtovanje stavb, parametri celovitega udobja na osnovi koncepta individualizacije.	The aim of this course is to acquaint students with unhealthy and uncomfort conditions in the built environments, Sick Building Syndrome (SBS) as well as Building Related Illness (BRI) due to one-sided building design (design which does not take into account all influential factors related to location, building envelope, systems and human). Students will acquire knowledge from the field of location characteristics (natural endowments, anthropogenic influences) that affect human health. With the purpose to prepare recommendations for planning healthy buildings, student will be acquainted with the methodology of the control and prevention of health risk factors in the built environment, sanitary-technical and hygienic conditions, and parameters of integral comfort which are based on the concept of individualization.

Predvideni študijski rezultati:	**Intended learning outcomes:**
Znanje: Študent bo spoznal toplotno bilanco človeškega telesa v grajenem okolju s fenomenom adaptacije organizma. Znal bo opredeliti sanitarno tehnične in higienske zahteve za načrtovanje stavb s specifičnimi zahtevami in potrebami. Načrtovati bo znal notranje okolje na osnovi razumevanja celovitega udobja s konceptom individualizacije ter medsebojnega vpliva parametrov udobja. Sposoben bo pripraviti smernice za načrtovanje zdravih stavb s holističnim pristopom. Sposoben bo sodelovati v interdisciplinarnem timu obvladovanja in preprečevanja dejavnikov tveganja za zdravje v grajenem okolju s ciljem načrtovanja zdravih stavb. Razumevanje: Študent bo razumel pomen negativnega vpliva nepravilno zasnovane stavbe in sistemov na organizem. Razumel bo vpliv naravnih danosti in antropogenih vplivov na zasnovo stavbe v odnosu do fiziologije človeka. Razumel bo razliko med zdravimi in udobnimi razmerami, pomen stimulirajočih bivalnih in delovnih razmer.	Knowledge: Students will learn about exergy and energy balance of the human body in the built environment including the phenomenon of adaptation of the organism. They will be able to define the sanitary-technical and hygienic conditions for the design of buildings with specific needs and demands. Student will be able to design environments that are based on comprehensive understanding of comfort with the concept of individualization and interactions among parameters of comfort. They will be able to prepare recommendations for the design of healthy buildings based on the holistic approach. Students will be able to participate in an interdisciplinary team for the control and prevention of health risk factors in the built environment with the aim to design healthy buildings. Understanding: Student will understand the importance of negative impacts of improperly designed buildings and their systems on human body. Understanding the impacts of natural endowments and anthropogenic influences on building design in relation to human physiology. Students will understand the difference

	between healthy and comfort conditions, the importance of stimulating living and working conditions.

Metode poučevanja in učenja:	**Learning and teaching methods:**
Predavanja, izdelava individualnih raziskovalnih nalog, študij tekočih znanstvenih publikacij in novih tehničnih rešitev, ki temeljijo na celovitem pristopu.	Lectures, individual research work, review of current scientific studies and novel technical solutions that are based on holistic approach. Scientific paper.

Načini ocenjevanja:	**Delež/Weight**	**Assessment:**
Ustni izpit	70,00 %	Oral exam
Izdelan članek za publikacijo.	30,00 %	Paper for publication.

Reference nosilca/Lecturer's references:

1. DOVJAK, Mateja, KRAINER, Aleš, SHUKUYA, Masanori. Individualisation of personal space in hospital environment. International journal of exergy, ISSN 1742-8297. [Printed.], 2014, letn. 14, št. 2, str. 125-155, ilustr. [COBISS.SI-ID 6529121] kategorija: 1A3 (Z1); uvrstitev: SCI, Scopus, MBP; tipologijo je verificiral OSICT, IF=0.847 (2013)
2. DOVJAK, Mateja, KUKEC, Andreja, KRISTL, Živa, KOŠIR, Mitja, BILBAN, Marjan, SHUKUYA, Masanori, KRAINER, Aleš. Integral control of health hazards in hospital environment. Indoor + built environment, ISSN 1420-326X, okt. 2013, letn. 22, št. 5, str. 776-795, ilustr. [COBISS.SI-ID 5988705] kategorija: 1A1 (Z1, A', A1/2); uvrstitev: SCI, Scopus, MBP; tipologijo je verificiral OSICT, IF=1.716.
3. DOVJAK, Mateja, KUKEC, Andreja, KRAINER, Aleš. Prepoznavanje in obvladovanje dejavnikov tveganja za zdravje v bolnišničnem okolju z vidika uporabnika, stavbe in sistemov = Identification and control of health risks in hospital environment from the aspects of users, buildings and systems. Zdravstveno varstvo, ISSN 0351-0026. [Tiskana izd.], 2013, letn. 52, št. 4, str. 304-315, ilustr. [COBISS.SI-ID 6355297] kategorija: 1A4 (Z1); uvrstitev: SSCI, Scopus; tipologijo je verificiral OSICT, IF= 0.732
4. DOVJAK, Mateja, SHUKUYA, Masanori, KRAINER, Aleš. Exergy analysis of conventional and lowexergy systems for heating and cooling of near zero energy buildings. Strojniški vestnik, ISSN 0039-2480, jul.-avg. 2012, vol. 58, no. 7/8, str. 453-461, SI 91, ilustr. [COBISS.SI-ID 5879393] kategorija: 1A2 (Z1, A1/2); uvrstitev: SCI, Scopus, MBP; tipologijo je verificiral OSICT, IF= 0.883
5. DOVJAK, Mateja, SHUKUYA, Masanori, OLESEN, Bjarne W., KRAINER, Aleš. Analysis on exergy consumption patterns for space heating in Slovenian buildings. Energy policy, ISSN 0301-421 [Printed.], junij 2010, letn. 38, št. 6, str. 2998-3007, ilustr. [COBISS.SI-ID 4969825] kategorija: 1A1 (Z1, A', A1/2); uvrstitev: SSCI, SCI, Scopus, MBP; tipologijo je verificiral OSICT, IF= 2.614
6. DOVJAK, Mateja, KRAINER, Aleš, SHUKUYA, Masanori. Exergetic issues of thermoregulation physiology in different climates. International journal of exergy. ISSN 1742-8297. [Printed.], 2014, letn. x, št.x, str. x, ilustr. [COBISS.SI-ID x] in press. Uvrstitev: SCI, IF=0.847 (2013)
7. SIMONE, Angela, KOLARIK, Jakub, IWAMATSU, Toshiya, ASADA, Hideo, DOVJAK, Mateja, SCHELLEN, Lisje, SHUKUYA, Masanori, OLESEN, Bjarne W. A relation between calculated human body exergy consumption rate and subjectively assessed thermal sensation. Energy and buildings, ISSN 0378-7788. [Printed.], 2011, letn. 43, št. 1, str. 1-9, ilustr. [COBISS.SI-ID 5146977] kategorija: 1A1 (Z1, A', A1/2); uvrstitev: SCI, Scopus, MBP; tipologijo je verificiral OSICT,IF= 386
8. KOŠIR, Mitja, KRAINER, Aleš, DOVJAK, Mateja, KRISTL, Živa. Automatically controlled daylighting for visual and nonvisual effects. Lighting research & technology, ISSN 1477-1535. [Print ed.], 2011, letn. 43, št. 4, str. 439-455, ilustr., doi: 10.1177/1477153511406520. [COBISS.SI-ID 5347425] kategorija: 1A1 (Z1, A', A1/2); uvrstitev: SCI, Scopus, MBP; tipologijo je verificiral OSICT, IF 1.551

UČNI NAČRT PREDMETA/COURSE SYLLABUS

Predmet:	Načrtovanje zdravih stavb
Course title:	Design of Healthy Buildings

Študijski programi in stopnja	Študijska smer	Letnik	Semestri
Grajeno okolje, tretja stopnja, doktorski	Ni členitve (študijski program)		Letni, Zimski

Univerzitetna koda predmeta/University course code: 1704

Predavanja	Seminar	Vaje	Klinične vaje	Druge oblike študija	Samostojno delo	ECTS
40	20	20	0	0	170	10

Nosilec predmeta/Lecturer: Mateja Dovjak

Vrsta predmeta/Course type: Izbirni predmet/Elective course

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

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:	Prerequisites:
Ni posebnih pogojev.	No special knowledge is required.

Vsebina:	Content (Syllabus outline):
Izhodišče: značilnosti lokacije (naravne danosti, antropogeni vplivi), fiziologija človeka in termoregulacija v ekstremnih okoljih, toplotna bilanca človeškega telesa, fenomen adaptacije organizma. Zdravje *versus* udobje, storilnost, stimulirajoče razmere. **Problematika:** enostransko načrtovanja stavb; pojmovanje, vzroki in razširjenost sindroma bolnih stavb (SBS) in bolezni povezanih s stavbo (BRI). **Metodologija:** obvladovanja in preprečevanja dejavnikov tveganja za zdravje v grajenem okolju: proces ocene tveganja (štiri faze), proces obvladovanja tveganja, direktne in indirektne metode za oceno izpostavljenosti, osnovno poznavanje epidemioloških raziskav (opisne in analitične) ter epidemioloških mer pogostosti (incidenca, prevalenca) in povezanosti (razmerje obetov, relativno tveganje) med pojavi. **Potrebe, zahteve:** sanitarno tehnične in higienske zahteve za načrtovanje stavb s specifičnimi zahtevami in potrebami (zdravstvene ustanove, vzgojno-izobraževalni objekti, športni objekti, wellness, živilski objekti, letališča, stanovanjski objekti, ipd.). Celovito udobje s konceptom individualizacije, medsebojni vpliv parametrov udobja. Smernice za načrtovanje zdravih stavb s holističnim pristopom. V daljšem kurzu (10 KT) so dodatna poglavja: Eksergijska in energijska bilanca človeškega telesa. Razširjeno ocenjevanje in obvladovanje tveganja za zdravje v grajenem okolju.	**Starting point:** location characteristics (natural endowments, anthropogenic influences), human physiology and thermoregulation in extreme environments, human body heat balance, phenomenon of adaptation of the organism. Health versus comfort, productivity, stimulating conditions. **Problem:** one-sided building design; understanding of main causes and prevalence of Sick Building Syndrome (SBS) and Building Related Illness (BRI). **Methodology:** control and prevention of health risk factors in the built environment: the processes of risk assessment (four phases), control of risk factors, direct and indirect methods for exposure assessment, introduction to epidemiological studies (descriptive and analytical) and epidemiological measures (incidence, prevalence, odds ratio, relative risk). **Needs, demands:** sanitary-technical and hygienic conditions for the design of buildings with specific needs and demands (health care facilities, educational facilities, sports facilities, wellness, food facilities, airports, residential buildings, etc.). Integral comfort with the concept of individualization, interactions between comfort parameters. Recommendations for the design of healthy buildings with a holistic approach. The longer course (10 KT) has additional chapters: Exergy and energy balance of the human body. Expanded assessment and control of health risks related to the built environment.

Poglobljena analiza epidemioloških raziskav na področju grajenega okolja. Celovito udobje s konceptom individualizacije-poglobljena analiza medsebojnih vplivov med parametri udobja. Izbrana poglavja, ki se nanašajo na doktorsko nalogo študenta.	In-depth analysis of the epidemiological studies in built environment. Integral comfort with the concept of individualization-in-depth analysis of the mutual interactions among the parameters of comfort. Chosen chapters related to the candidate`s PhD thesis.

Temeljna literatura in viri/Readings:

Basic Environmental Health / Yassi A, Kjellstrom T, de Kok T, Guidotti TL. Oxford: Oxford UniversityPress, 2001.
Zdravje in okolje: izbrana poglavja / Eržen I, Gajšek P, Hlastna Ribič C, Kukec A, Poljšak B, Zaletel Kragel L. Maribor: Univerza v Mariboru, Medicinska fakulteta, 2010.
Patofiziologija s temelji fiziologije / Bresjanac M, Rupnik M. Ljubljana: Inštitut za patološko fiziologijo, 1999.
Medicina rada i okoliša / Šarić, M, Žuškin, E. Zagreb, Medicinska naklada, 2002.
Medicina dela / Bilban M. Ljubljana, Zavod za varstvo pri delu, 2005.
Oblikovanje dela in delovnih mest / Polajnar A, Verhovnik V. Maribor, FS, 2000.
Occupational health practice / Schilling RSF. London, Butterworths, 1981.
Ergonomics, workandhealth / Pheasant S. London, MacMillan Press, 1991.
Ergonomska fiziologija / Sušnik J. Radovljica, Didakta, 1992.
Priročnik za načrtovanje in prilagajanje grajenega okolja v korist funkcionalno oviranim ljudem / Vovk M. Ljubljana, Urbanistični inštitut RS, 2000.
Sustainable architecture, bioclimatic architecture, on line teaching package. SARA – Sustainable Architecture Applied to Replicable Public Access Buildings / Krainer A, http://kske.fgg.uni-lj.si/Index_SI.htm, 2008.
Tekoča periodika/Current periodicals: Indoor & built environment, Environmental health, International journal of environmental health review, International journal of hygiene and environmental health, Indoor air, Energy & Buildings, Building & Environment.

Cilji in kompetence:	**Objectives and competences:**
Cilj predmeta je seznaniti študente z nezdravimi in neudobnimi razmerami, s sindromom bolnih stavb in boleznimi povezanimi s stavbo, ki so odraz enostranskega načrtovanja stavb (načrtovanja, pri katerem niso upoštevani vsi vplivni faktorji lokacije, stavbnega ovoja, človeka, sistemov). Študent bo osvojil znanja s področja značilnosti lokacije (naravne danosti, antropogenimi vplivi), ki vplivajo na zdravje. S ciljem izdelave smernic za načrtovanje zdravih stavb se študent seznani z metodologijo obvladovanja in preprečevanja dejavnikov tveganja za zdravje v grajenem okolju, sanitarno tehničnimi in higienskimi zahtevami za načrtovanje stavb, parametri celovitega udobja na osnovi koncepta individualizacije.	The aim of this course is to acquaint students with unhealthy and uncomfort conditions in the built environments, Sick Building Syndrome (SBS) as well as Building Related Illness (BRI) due to one-sided building design (design which does not take into account all influential factors related to location, building envelope, systems and human). Students will acquire knowledge from the field of location characteristics (natural endowments, anthropogenic influences) that affect human health. With the purpose to prepare recommendations for planning healthy buildings, student will be acquainted with the methodology of the control and prevention of health risk factors in the built environment, sanitary-technical and hygienic conditions, and parameters of integral comfort which are based on the concept of individualization.

Predvideni študijski rezultati:	**Intended learning outcomes:**
Znanje: Študent bo spoznal toplotno bilanco človeškega telesa v grajenem okolju s fenomenom adaptacije organizma. Znal bo opredeliti sanitarno tehnične in higienske zahteve za načrtovanje stavb s specifičnimi zahtevami in potrebami. Načrtovati bo znal notranje okolje na osnovi razumevanja celovitega udobja s konceptom individualizacije ter medsebojnega vpliva parametrov udobja. Sposoben bo pripraviti smernice za načrtovanje zdravih stavb s holističnim pristopom. Sposoben bo sodelovati v interdisciplinarnem timu obvladovanja in preprečevanja dejavnikov tveganja za	Knowledge: Students will learn about exergy and energy balance of the human body in the built environment including the phenomenon of adaptation of the organism. They will be able to define the sanitary-technical and hygienic conditions for the design of buildings with specific needs and demands. Student will be able to design environments that are based on comprehensive understanding of comfort with the concept of individualization and interactions among parameters of comfort. They will be able to prepare recommendations for the design of healthy buildings

zdravje v grajenem okolju s ciljem načrtovanja zdravih stavb. Razumevanje: Študent bo razumel pomen negativnega vpliva nepravilno zasnovane stavbe in sistemov na organizem. Razumel bo vpliv naravnih danosti in antropogenih vplivov na zasnovo stavbe v odnosu do fiziologije človeka. Razumel bo razliko med zdravimi in udobnimi razmerami, pomen stimulirajočih bivalnih in delovnih razmer. **V daljšem kurzu (10 KT)** bo študent spoznal eksergijsko in energijsko bilanco človeškega telesa v grajenem okolju. Znal bo ocenit in obvladovat tveganja za zdravje v grajenem okolju. S ciljem dosega celovitega udobja bo sposoben poglobljenih analiz medsebojnih vplivov parametrov udobja.	based on the holistic approach. Students will be able to participate in an interdisciplinary team for the control and prevention of health risk factors in the built environment with the aim to design healthy buildings. Understanding: Student will understand the importance of negative impacts of improperly designed buildings and their systems on human body. Understanding the impacts of natural endowments and anthropogenic influences on building design in relation to human physiology. Students will understand the difference between healthy and comfort conditions, the importance of stimulating living and working conditions. **In the longer course (10 KT)** the students will learn about exergy and energy balance of the human body in built environment. They will be able to assess and control of health risks related to the built environment. With the purpose of integral comfort they will be able to perform in-depth analysis of the mutual interactions among the parameters of comfort.

Metode poučevanja in učenja:	**Learning and teaching methods:**
Predavanja, izdelava individualnih raziskovalnih nalog, študij tekočih znanstvenih publikacij in novih tehničnih rešitev, ki temeljijo na celovitem pristopu.	Lectures, individual research work, review of current scientific studies and novel technical solutions that are based on holistic approach. Scientific paper.

Načini ocenjevanja:	**Delež/Weight**	**Assessment:**
Ustni izpit, zagovor raziskovalnih nalog	70,00 %	Oral exam, presentation of research papers
Izdelan članek za publikacijo.	30,00 %	Paper for publication.

Reference nosilca/Lecturer's references:

1. DOVJAK, Mateja, KRAINER, Aleš, SHUKUYA, Masanori. Individualisation of personal space in hospital environment. International journal of exergy, ISSN 1742-8297. [Printed.], 2014, letn. 14, št. 2, str. 125-155, ilustr. [COBISS.SI-ID 6529121] kategorija: 1A3 (Z1); uvrstitev: SCI, Scopus, MBP; tipologijo je verificiral OSICT, IF=0.847 (2013)
2. DOVJAK, Mateja, KUKEC, Andreja, KRISTL, Živa, KOŠIR, Mitja, BILBAN, Marjan, SHUKUYA, Masanori, KRAINER, Aleš. Integral control of health hazards in hospital environment. Indoor + built environment, ISSN 1420-326X, okt. 2013, letn. 22, št. 5, str. 776-795, ilustr. [COBISS.SI-ID 5988705] kategorija: 1A1 (Z1, A', A1/2); uvrstitev: SCI, Scopus, MBP; tipologijo je verificiral OSICT, IF=1.716.
3. DOVJAK, Mateja, KUKEC, Andreja, KRAINER, Aleš. Prepoznavanje in obvladovanje dejavnikov tveganja za zdravje v bolnišničnem okolju z vidika uporabnika, stavbe in sistemov = Identification and control of health risks in hospital environment from the aspects of users, buildings and systems. Zdravstveno varstvo, ISSN 0351-0026. [Tiskana izd.], 2013, letn. 52, št. 4, str. 304-315, ilustr. [COBISS.SI-ID 6355297] kategorija: 1A4 (Z1); uvrstitev: SSCI, Scopus; tipologijo je verificiral OSICT, IF= 0.732
4. DOVJAK, Mateja, SHUKUYA, Masanori, KRAINER, Aleš. Exergy analysis of conventional and lowexergy systems for heating and cooling of near zero energy buildings. Strojniški vestnik, ISSN 0039-2480, jul.-avg. 2012, vol. 58, no. 7/8, str. 453-461, SI 91, ilustr. [COBISS.SI-ID 5879393] kategorija: 1A2 (Z1, A1/2); uvrstitev: SCI, Scopus, MBP; tipologijo je verificiral OSICT, IF= 0.883
5. DOVJAK, Mateja, SHUKUYA, Masanori, OLESEN, Bjarne W., KRAINER, Aleš. Analysis on exergy consumption patterns for space heating in Slovenian buildings. Energy policy, ISSN 0301-421 [Printed.], junij 2010, letn. 38, št. 6, str. 2998-3007, ilustr. [COBISS.SI-ID 4969825] kategorija: 1A1 (Z1, A', A1/2); uvrstitev: SSCI, SCI, Scopus, MBP; tipologijo je verificiral OSICT, IF= 2.614
6. DOVJAK, Mateja, KRAINER, Aleš, SHUKUYA, Masanori. Exergetic issues of thermoregulation physiology in different climates. International journal of exergy. ISSN 1742-8297. [Printed.], 2014, letn. x, št.x, str. x, ilustr. [COBISS.SI-ID x] in press. Uvrstitev: SCI, IF=0.847 (2013)
7. SIMONE, Angela, KOLARIK, Jakub, IWAMATSU, Toshiya, ASADA, Hideo, DOVJAK, Mateja, SCHELLEN, Lisje, SHUKUYA, Masanori, OLESEN, Bjarne W. A relation between calculated human body exergy consumption rate and subjectively assessed thermal sensation. Energy and buildings, ISSN 0378-7788. [Printed.], 2011, letn. 43,

št. 1, str. 1-9, ilustr. [COBISS.SI-ID 5146977] kategorija: 1A1 (Z1, A', A1/2); uvrstitev: SCI, Scopus, MBP; tipologijo je verificiral OSICT,IF= 386

8. KOŠIR, Mitja, KRAINER, Aleš, DOVJAK, Mateja, KRISTL, Živa. Automatically controlled daylighting for visual and nonvisual effects. Lighting research & technology, ISSN 1477-1535. [Print ed.], 2011, letn. 43, št. 4, str. 439-455, ilustr., doi: 10.1177/1477153511406520. [COBISS.SI-ID 5347425] kategorija: 1A1 (Z1, A', A1/2); uvrstitev: SCI, Scopus, MBP; tipologijo je verificiral OSICT, IF 1.551

UČNI NAČRT PREDMETA/COURSE SYLLABUS

Predmet:	Napredna petrologija magmatskih in metamorfnih kamnin
Course title:	Advanced Petrology of Igneous and Metamorphic Rocks

Študijski programi in stopnja	Študijska smer	Letnik	Semestri
Grajeno okolje, tretja stopnja, doktorski	Ni členitve (študijski program)		Letni, Zimski

Univerzitetna koda predmeta/University course code: 1293

Predavanja	Seminar	Vaje	Klinične vaje	Druge oblike študija	Samostojno delo	ECTS
40	0	20	0	65	0	5

Nosilec predmeta/Lecturer: Mirijam Vrabec

Vrsta predmeta/Course type: Izbirni predmet/Elective course

Jeziki/Languages:

Predavanja/Lectures:	Slovenščina, Angleščina
Vaje/Tutorial:	Slovenščina, Angleščina

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:	Prerequisites:
Predhodno osvojena osnovna znanja iz geologije, petrologije in mineralogije	Prior knowledge acquired in geology, petrology and mineralogy

Vsebina:	Content (Syllabus outline):
Vsebina predmeta je razdeljena na napredno petrologijo, v okviru katere se študentje poglobi znanje o petrogenezi magmatskih kamnin, njihovimi geokemičnimi in izotopskimi značilnostmi, hidrotermalnimi spremembami ter okoljem njihovega nastopanja. Vaje obsegajo makroskopsko in mikroskosko prepoznavanje različnih vrst magmatskih kamnin ter uporabo različnih diagramov in računalniških programov za njihovo klasifikacijo in modeliranje frakcionirane kristalizacije. Kemične reakcije in kemična kinetika v metamorfnih kamninah. Termodinamika mineralov in fazna ravnotežja v metamorfnih kamninah. Mineralna kemija metamorfnih kamnin. Metamorfni kristalizacijski mehanizmi. Geotermometrija in geobarometrija metamorfnih kamnin. Geokemija metamorfnih kamnin in določanje narave izvornih kamnin. Strukture in deformacije metamorfnih kamnin. Delno taljenje med visoko stopnjo metamorfoze. Fluidi in metasomatske reakcije med metamorfozo. Geodinamski pomen metamorfnih kamnin. Metamorfne kamnine v Sloveniji.	The subject is divided into advanced petrology, in which students extent their knowledge about petrogenesis of igneous rocks , their geochemical and isotopic characteristics, hydrothermal changes and the environments of their appearance. Tutorial includes macroscopic and mikroscopic identification of different types of igneous rocks and the use of various diagrams and computer programs for their classification and modeling of fractional crystallization . Chemical reactions and chemical kinetics in metamorphic rocks. Thermodynamics of minerals and phase equilibria in metamorphic rocks. Mineral chemistry of metamorphic rocks. Metamorphic crystallization mechanisms. Geotermometry and geobarometry of metamorphic rocks. Geochemistry of metamorphic rocks and identification of the protolith. Textures and deformation of metamorphic rocks. Partial melting during high degree of metamorphosis. Fluids and metasomatic reactions during metamorphosis . Geodynamical importance of metamorphic rocks. Metamorphic rocks in Slovenia.

Temeljna literatura in viri/Readings:

Izbrana poglavja iz knjig / Selected chapters from books:
1). Ernest, G., Ehlers, E.G., (1982): The interpretation of geological phase diagrams
2). Wilson, M., (1989): Igneous petrogenesis - A global tectonic approach
3). Ragland, C. P., (1989): Basic analitical Petrology
4). Bucher, K., Frey, M., (1994): Petrogenesis of metamorphic rocks
5). Shelley, d., (1983): Igneous and metamorphic rocks under the microscope
6.) F. S. Spear: Metamorphic phase equilibria and pressure-temperature-time paths. Mineralogical Society of America Monograph, 1993.
7.) K. Bucher & M. Frey: Petrogenesis of Metamorphic Rocks. Springer, 2002.
8.) R. H. Vernon & G. L. Clarke: Principles of Metamorphic petrology. Cambridge University Press, 2008.

Cilji in kompetence:	**Objectives and competences:**
Študent se seznani z naprednimi znanji petrogeneze magmatske in metamorfne petrologije, ki obsegajo njihove geokemične in izotopske značilnosti, mineralno sestavo, okolje nastopanja, hidrotermalne spremembe, kemične reakcije, fazna ravnotežija, mineralno kemijo, termobarometrijo ter napredno geokemijo metamorfnih kamnin.	Students get acquainted with the advanced knowledge in petrogesys of igneous and metamorphic petrology, covering their geochemical and isotopic characteristics, mineral composition, environments of their occurences, hydrothermal changes, chemical reactions, phase equilibria, mineral chemistry, advanced termobarometry and geochemistry of metamorphic rocks.

Predvideni študijski rezultati:	**Intended learning outcomes:**
Znanje in razumevanje: S pomočjo mikroskopske analize se študent nauči razbirati mikrostrukturne značilnosti in deformacijske mehanizme metramorfnih kamnin. S študijem »psevdosekcij« in sodobnih geotermobarometričnih kalibraciojskih modelov se usposobi za izračun in modeliranje metamorfnih pogojev, ki so jim bile kamnine izpostavljene. Spozna sestavo, značilnosti in nastanek širokega spektra metamorfnih kamnin, ki jih najdemo v Sloveniji.	Knowledge and understanding: Using microscopic analysis student learns to recognize microstructural characteristics and deformation mechanisms of metramorphic rocks. By pseudosection modeling and modern geotermobarometrical calibration models they get ready for the calculation and modeling of metamorphic conditions to which the rocks were exposed during peak of metamorphism. They learn about composition, characteristics and formation of a broad spectrum of metamorphic rocks, which are found in Slovenia.

Metode poučevanja in učenja:	**Learning and teaching methods:**
Predavanja, prikaz slikovnega gradiva (LCD projektor), mikroskopiranje, delo na računalniku (programi Thermocalc, PTExel, Perplex).	Lectures, power point presentations (LCD projector), microscopy, work on the computer (programs ThermoCalc, ptex, perplexe).

Načini ocenjevanja:	**Delež/Weight**	**Assessment:**
Način (pisni izpit, ustno izpraševanje, naloge, projekt) pisni izpit iz predavanj in vaj	100,00 %	Type (examination, oral, coursework, project): written exam based on lectures and tutorial

Reference nosilca/Lecturer's references:

1. UHER, Pavel, JANAK, Marian, KONEČNÝ, Patrik, **VRABEC, Mirijam**. Rare-element granitic pegmatite of Miocene age emplaced in UHP rocks from Visole, Pohorje Mountains (Eastern Alps, Slovenia): accessory minerals, monazite and uraninite chemical dating. *Geologica Carpathica*, ISSN 1335-0552, 2014, vol. 65, iss. 2, str. 131-146, doi: 10.2478/geoca-2014-0009.
2. VRABEC, Mirijam, JANÁK, Marian, FROITZHEIM, Nikolaus, DE HOOG, J.C.M. Phase relations during peak metamorphism and decompression of the UHP kyanite eclogites, Pohorje Mountains (Eastern Alps, Slovenia). *Lithos*, ISSN 0024-4937, 2012, vol. 144-145, str. 40-55, doi: dx.doi.org/10.1016/j.lithos.2012.04.004.
3. JANAK, Marian, CORNELL, David, FROITZHEIM, Nikolaus, HOOG, J.C.M. De, BROSKA, Igor, **VRABEC, Mirijam**, HURAI, Vratislav. Eclogite-hosting metapelites from the Pohorje Mountains (Eastern Alps): P-T evolution, zircon

geochronology and tectonic implications. *European journal of mineralogy*, 2009, vol. 21, no. 6, str. 1191-1212, doi: 10.1127/0935-1221/2009/0021-1966.

UČNI NAČRT PREDMETA/COURSE SYLLABUS

Predmet:	Napredne metode planiranja in spremljanja projektov
Course title:	Advanced Methods of Project Planning and Monitoring

Študijski programi in stopnja	Študijska smer	Letnik	Semestri
Grajeno okolje, tretja stopnja, doktorski	Ni členitve (študijski program)		Letni, Zimski

Univerzitetna koda predmeta/University course code: 1094

Predavanja	Seminar	Vaje	Klinične vaje	Druge oblike študija	Samostojno delo	ECTS
20	20	0	0	0	85	5

Nosilec predmeta/Lecturer: Jana Šelih

Vrsta predmeta/Course type: Izbirni predmet/Elective course

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

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:	Prerequisites:
Ni posebnih pogojev	No special conditions

Vsebina:	Content (Syllabus outline):
1. Kriteriji in merila za oceno terminskih planov 2. Večkriterialna optimizacija projektnih operativnih planov z vidika uporabe virov, stroškov in trajanja projekta (uporaba analitičnih in hevrističnih metod, uporaba genetskih algoritmov) 3. Planiranje kot primer odločitvenega problema 4. Prostorski terminski plani (visoke gradnje, nizke gradnje) - metode in tehnike optimizacije 5. Stohastično projektno planiranje – metoda »Monte Carlo« 6. Načini spremljanja in kontrole izvajanja projektov, napredne tehnike analiz odstopanj 7. Robustno in reaktivno planiranje (teorija omejitev, koncept kritične verige in zalog) 8. Posebnosti metod planiranja za obstoječe gradbene objekte 9. Uporaba metod odločanja v gospodarjenju z objekti	1. Criteria for the assessment of time schedules 2. Mulitcriterial optimisation of project plans from the viewpoint of resources, costs and project duration (application of analytical and heuristic methods, genetic algorithms) 3. Planning as a decision problem case 4. Space schedules (high-rise buildings, infrastructure) – optimisation methods and techniques 5. Stochastic project planning – »Monte Carlo« metohd 6. Monitoring and controlling of project execution, advanced techniques for analysis of discrepancies 7. Robust and reactive planning (theory of constraints, critical chain concept, buffer concept) 8. Specific features of planning methods applicable to existing assets 9. Application of decision methods in management of structures and buildings

Temeljna literatura in viri/Readings:

- Demeulemeester E.L., Project scheduling: a research handbook, Kluwer Ac.Publ., 2002
- Jozefowska, J., Weglarz, J. Perspectives in modern project scheduling, Springer, 2006
- Goldratt, E.M., Critical chain, The North River Press, 1997
- Baldwin, A., Bordoli, D., A Handbook for Construction Planning and Scheduling, Wiley Blackwell, 2014

Cilji in kompetence:	Objectives and competences:
CILJI	OBJECTIVES

- študent se spozna s principi in tehnikami naprednega operativnega planiranja in spremljanja projektov ter sodobnimi pristopi k razvoju novih sistemov in modelov - študent se spozna z večkriterijskimi metodami odločanja, ki so primerne za določanje optimalnega operativnega plana - študent se spozna z razlikami med planiranjem novih in obstoječih objektov ter z načeli gospodarjenja z objekti PRIDOBLJENE KOMPETENCE - pozna obstoječe znanje (state of the art) na področju planiranja in spremljanja projektov - je sposoben razvijati teoretične osnove in koncepte tehnik planiranja in spremljanja projektov - je sposoben uporabljati in nadgrajevati sodobna orodja za planiranje in spremljanje projektov ter razvijati koncepte na področju gospodarjenja z objekti	- Student gets acquinted with principles and techniques for advanced operational planning and monitoring of projects, and with advanced approach towards development of novel systems and models - students gets acquinted with multi-criteria decision methods that are suitable for determination of operational plan - student gets acquinted with differences between planning new and existing structures, and with principles of management of structures ACQUIRED COMPETENCIES • is acquinted with stateof-the-art in the field of planning and monitoring of projects • is able to develop fundamentals and concepts of techniques for project planning and monitoring • is able to use and upgrade advanced contemporary tools for planning and monitoring of projects, and to develop new concepts in the field of management of structures

Predvideni študijski rezultati:	**Intended learning outcomes:**
Znanje in razumevanje: • študent pozna načela in zna uporabljati tehnike naprednega operativnega planiranja • študent zna uporabljati sodobne večkriterijske metode odločanja v različnih primerih s področja gradbeništva • študent je sposoben nadgrajevati obstoječe metode planiranja in večkriterijske metode odločanja skladno z zahtevami obravnavanega primera	Knowledge and understanding: -The student is familiar with fundamental principles of operational planning, and is able to use techniques of operational planning -The student knows how to apply contemporary decision methods in various cases in the field of civil engineering -The student is able to develop and upgrade existing planning methods and and multi-criteria decision methods, in accordance with the requirements of the case under consideration

Metode poučevanja in učenja:	**Learning and teaching methods:**
• Predavanja in konzultacije • izdelava in predstavitev seminarske naloge	• Lectures and consultations • Preparation and presentation of seminar work

Načini ocenjevanja:	**Delež/Weight**	**Assessment:**
Ustni izpit	50,00 %	Oral exam
Seminarska naloga in zagovor	50,00 %	Seminar work and its defence

Reference nosilca/Lecturer's references:

1. KUŠAR, Matej, ŠELIH, Jana. Analysis of bridge condition on state network in Slovenia = Analiza stanja mostova na državnim cestama u Sloveniji. Građevinar, ISSN 0350-2465, 2014, letn. 66, št. 9, str. 811-822, ilustr., doi: 10.14256/JCE.1047.2014.
2. GUMILAR, Vladimir, ŽARNIĆ, Roko, ŠELIH, Jana. Increasing competitiveness of the construction sector by adopting innovative clustering. Inžinerinąe ekonomika, ISSN 1392-2785, 2011, letn. 22, št. 1, str. 41-49, ilustr.
3. SRDIČ, Aleksander, ŠELIH, Jana. Integrated quality sustainability assessment in construction - a conceptual model. Technological and economic development of economy, ISSN 2029-4913. [Print ed.], dec. 2011, letn. 17, št. 4, str. 611-626.

UČNI NAČRT PREDMETA/COURSE SYLLABUS

Predmet:	Napredne tehnologije malt in betonov
Course title:	Advanced Mortars and Concretes Technologies

Študijski programi in stopnja	Študijska smer	Letnik	Semestri
Grajeno okolje, tretja stopnja, doktorski	Ni členitve (študijski program)		Letni, Zimski

Univerzitetna koda predmeta/University course code: 1095

Predavanja	Seminar	Vaje	Klinične vaje	Druge oblike študija	Samostojno delo	ECTS
20	10	0	10	15	70	5

Nosilec predmeta/Lecturer: Violeta Bokan-Bosiljkov

Vrsta predmeta/Course type: Izbirni predmet/Elective course

Jeziki/Languages:

Predavanja/Lectures:	Slovenščina, Angleščina
Vaje/Tutorial:	Slovenščina, Angleščina

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:	Prerequisites:
Vpis na doktorski študij "Grajeno okolje" ali na druge tehnične ali naravoslovne usmeritve in usmeritve, ki vključujejo varstvo kulturne in grajene dediščine.	Enrolment in doctoral programme BUILT ENVIRONMENT or in other technical or science programmes or programmes which address protection of cultural and built heritage.

Vsebina:	Content (Syllabus outline):
• Konstrukcijski lahkoagregatni beton	• Structural lightweight Concrete
• Visokotrden beton	• High-Strength Concrete
• Visokozmogljiv beton	• High-Performance Concrete
• Samozgoščevalni beton	• Self-Compacting Concrete
• Beton s kompenziranim krčenjem	• Shrinkage-Compensating Concrete
• Mikroarmiran beton	• Fibre-Reinforced concrete
• S polimeri modificiran beton	• Concrete Containing Polymers
• Beton za zaščito pred sevanjem	• Heavyweight Concrete for Radiation Shielding
• Masivni beton	• Mass Concrete
• Valjani beton	• Roller-Compacted Concrete
• Prihajajoče tehnologije malt in betonov	• Emerging Technologies of Mortars and Concretes
• Izbrana poglavja, ki se nanašajo na doktorsko nalogo študenta	• Chosen chapters related to PhD thesis of the candidate

Temeljna literatura in viri/Readings:

1. Mehta, P.K., Monteiro, P.J.M., (2013). Concrete: Microstructure, Properties, and Materials, 4. Edition, McGraw-Hill Professional, 704 p.
2. Hewlett, P.C. (Ed.), (2004). Lea's Chemistry of Cement and Concrete, 4. izdaja, Elsevier, 1057 strani.
3. Tekoča periodika s področja vsebin predmeta/ Current periodic in area of the course content.

Cilji in kompetence:	Objectives and competences:
Cilj predmeta v obsegu 5 KT je seznaniti študenta z izbranimi novimi tehnologijami na področju malt in/ali	introduce to the student selected new technologies in the area of mortars and/or concretes and other

betonov ter ostalih materialov na bazi mineralnih veziv. Študent bo spoznal tudi relevantne metode preiskav za določitev posebnih karakteristik malt in betonov ali za oceno učinkovitosti izbranega pristopa pri sanaciji ali revitalizaciji zgodovinskih objektov.	materials based on mineral binders. Student will also learn relevant test methods for the evaluation of special properties of mortars and concretes or for efficient selection of repair or revitalization approach.

Predvideni študijski rezultati:	**Intended learning outcomes:**
Študent se bo naučil izbrati ustrezne osnovne materiale in potrebne kemijske in/ali mineralne dodatke ter določiti razmerja med njimi tako, da bo posebna mešanica betona ali malte dosegala zahtevane lastnosti v svežem in strjenem stanju. Študent bo znal izbrati relevantne metode preiskav za določitev posebnih karakteristik malt in betonov ali za oceno učinkovitosti izbranega pristopa pri sanaciji ali revitalizaciji zgodovinskih objektov.	Student will learn to select adequate basic materials and required additives and/or chemical admixtures and design of advanced mixtures in such way that particular mortar or concrete mixture will attain the required properties in fresh and hardened state. Student will bea ble to select relevant test methods for the evaluation of special properties of mortars and concretes or for efficient selection of repair or revitalization approach.

Metode poučevanja in učenja:	**Learning and teaching methods:**
Predavanja, laboratorijsko delo, vodene diskusije, konzultacije.	Lectures, laboratory work, guided discussions, consultations.

Načini ocenjevanja:	**Delež/Weight**	**Assessment:**
Laboratorijski dnevnik	30,00 %	Laboratory log
Seminar	30,00 %	seminar
Izpit	40,00 %	exam

Reference nosilca/Lecturer's references:

ŠTUKOVNIK, Petra, MARINŠEK, Marjan, MIRTIČ, Breda, **BOKAN-BOSILJKOV, Violeta**. Influence of alkali carbonate reaction on compressive strength of mortars with air lime binder. Construction & building materials, ISSN 0950-0618. [Print ed.], 2015, letn. 75, št. jan., str. 247-254, ilustr., doi: 10.1016/j.conbuildmat.2014.11.024.

ČESEN, Aleš, KOSEC, Tadeja, LEGAT, Andraž, **BOKAN-BOSILJKOV, Violeta**. Corrosion properties of different forms of carbon steel in simulated concrete pore water = Korozijske lastnosti različnih oblik jekel v simulirani porni vodi betona. Materiali in tehnologije, ISSN 1580-2949. [Tiskana izd.], jan. 2014, letn. 48, št. 1, str. 51-57, ilustr. http://mit.imt.si/Revija/.

PRINČIČ, Tina, ŠTUKOVNIK, Petra, PEJOVNIK, Stane, SCHUTTER, Geert De, **BOKAN-BOSILJKOV, Violeta**. Observations on dedolomization of carbonate concrete aggregates, implications for ACR and expansion. Cement and concrete research, ISSN 0008-8846. [Print ed.], dec. 2013, letn. 54, str. 151-160, ilustr., doi: 10.1016/j.cemconres.2013.09.005.

ŠTUKOVNIK, Petra, PRINČIČ, Tina, PEJOVNIK, Stane, **BOKAN-BOSILJKOV, Violeta**. Alkali-carbonate reaction in concrete and its implications for a high rate of long-term compressive strength increase. Construction & building materials, ISSN 0950-0618. [Print ed.], jan. 2014, letn. 50, str. 699-709, doi: 10.1016/j.conbuildmat.2013.10.007.

HOČEVAR, Andraž, KAVČIČ, Franci, **BOKAN-BOSILJKOV, Violeta**. Reološki parametri svježih betona - usporedba reometara = Rheological parameters of fresh concrete - comparison of rheometers. Građevinar, ISSN 0350-2465, 2013, letn. 65, št. 2, str. 99-109, ilustr. http://www.casopis-gradjevinar.hr/assets/Uploads/JCE_65_2013_2_1_rad-765.pdf, http://www.casopis-gradjevinar.hr/assets/Uploads/JCE_65_2013_2_1_765_EN.pdf.

URANJEK, Mojmir, BOSILJKOV, Vlatko, ŽARNIĆ, Roko, **BOKAN-BOSILJKOV, Violeta**. In situ tests and seismic assessment of a stone-masonry building. Materials and structures, ISSN 1359-5997, 2012, letn. 45, št. 6, str. 861-879, ilustr., doi: 10.1617/s11527-011-9804-z.

BOSILJKOV, Vlatko, URANJEK, Mojmir, ŽARNIĆ, Roko, **BOKAN-BOSILJKOV, Violeta**. An integrated diagnostic approach for the assessment of historic masonry structures. Journal of cultural heritage, ISSN 1296-2074, 2010, letn. 11, št. 3, str. 239-249, ilustr., doi: 10.1016/j.culher.2009.11.007.

UČNI NAČRT PREDMETA/COURSE SYLLABUS

Predmet:	Napredne tehnologije malt in betonov
Course title:	Advanced Mortars and Concretes Technologies

Študijski programi in stopnja	Študijska smer	Letnik	Semestri
Grajeno okolje, tretja stopnja, doktorski	Ni členitve (študijski program)		Letni, Zimski

Univerzitetna koda predmeta/University course code: 1706

Predavanja	Seminar	Vaje	Klinične vaje	Druge oblike študija	Samostojno delo	ECTS
40	20	0	20	30	140	10

Nosilec predmeta/Lecturer: Violeta Bokan-Bosiljkov

Vrsta predmeta/Course type: Izbirni predmet/Elective course

Jeziki/Languages:

Predavanja/Lectures:	Slovenščina, Angleščina
Vaje/Tutorial:	Slovenščina, Angleščina

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:	Prerequisites:
Vpis na doktorski študij “Grajeno okolje” ali na druge tehnične ali naravoslovne usmeritve in usmeritve, ki vključujejo varstvo kulturne in grajene dediščine.	Enrolment in doctoral programme BUILT ENVIRONMENT or in other technical or science programmes or programmes which address protection of cultural and built heritage.

Vsebina:	Content (Syllabus outline):
- Konstrukcijski lahkoagregatni beton - Visokotrden beton - Visokozmogljiv beton - Samozgoščevalni beton - Beton s kompenziranim krčenjem - Mikroarmiran beton - S polimeri modificiran beton - Beton za zaščito pred sevanjem - Masivni beton - Valjani beton - Prihajajoče tehnologije malt in betonov - Napredni materiali za sanacijo ali revitalizacijo zgodovinskih objektov - Dekorativne zidne tehnike skozi čas – dekorativni ometi - Neporušne metode preiskav za detekcijo napak, poškodb in/ali propadanja betonov in ometov - Vključevanje sekundarnih surovin (obdelanih odpadkov različnih industrij) v nekonstrukcijske in konstrukcijske betone - Reologija svežih betonov - Celovit pristop k analizi vzrokov propadanja malt in betonov z naprednimi preizkusnimi tehnikami	- Structural lightweight Concrete - High-Strength Concrete - High-Performance Concrete - Self-Compacting Concrete - Shrinkage-Compensating Concrete - Fibre-Reinforced concrete - Concrete Containing Polymers - Heavyweight Concrete for Radiation Shielding - Mass Concrete - Roller-Compacted Concrete - Emerging Technologies of Mortars and Concretes - Advanced Materials for Repair and Revitalization of Historical Buildings - Decorative wall art through time - decorative plasters - Non-destructive methods for the detection of defects, damage and / or deterioration of concrete and renders and plaster - Incorporation of secondary raw materials (treated waste of different industries) in the non-structural and structural concrete - Rheology of fresh concrete - An integrated approach to the analysis of the causes of degradation of mortars and concretes with advanced experimental techniques

- Korelacija med spremembami na nivoju mikrostrukture materiala in odzivom na nivoju fizikalnih in mehanskih lastnosti malt in betonov - Izbrana poglavja, ki se nanašajo na doktorsko nalogo študenta	- Correlation between the changes in the level of the microstructure of the material and response in the level of physical and mechanical properties of mortars and concretes - Chosen chapters related to PhD thesis of the candidate

Temeljna literatura in viri/Readings:

1. Mehta, P.K., Monteiro, P.J.M., (2013). Concrete: Microstructure, Properties, and Materials, 4. Edition, McGraw-Hill Professional, 704 p.
2. Hewlett, P.C. (Ed.), (2004). Lea's Chemistry of Cement and Concrete, 4. izdaja, Elsevier, 1057 strani.
3. Tekoča periodika s področja vsebin predmeta/ Current periodic in area of the course content.

Cilji in kompetence:	**Objectives and competences:**
Cilj predmeta v obsegu 5 KT je seznaniti študenta z izbranimi novimi tehnologijami na področju malt in/ali betonov ter ostalih materialov na bazi mineralnih veziv. Študent bo spoznal tudi relevantne metode preiskav za določitev posebnih karakteristik malt in betonov ali za oceno učinkovitosti izbranega pristopa pri sanaciji ali revitalizaciji zgodovinskih objektov. Dodatni cilji predmeta v obsegu 10 KT so: seznaniti študenta z reološkimi preiskavami svežih betonov, ki so najbolj napredna tehnika vrednotenja lastnosti svežih betonov; seznaniti študenta z možnostjo uporabe različnih neporušnih metod preiskav za ovrednotenje stanja betonskih elementov in ometov in-situ; seznaniti študenta s celovitim pristopom k analizi vzrokov propadanja malt in betonov z naprednimi preizkusnimi tehnikami, ki omogoča tudi določitev korelacije med spremembo mikrostrukture materiala in spremembo njegovih fizikalnih in/ali mehanskih lastnosti; seznaniti študenta z možnostmi in omejitvami vključevanja neinertnih sekundarnih surovin v nekonstrukcijske in konstrukcijske betone.	introduce to the student selected new technologies in the area of mortars and/or concretes and other materials based on mineral binders. Student will also learn relevant test methods for the evaluation of special properties of mortars and concretes or for efficient selection of repair or revitalization approach. Additional objectives of the ECTS 10 course are: to acquaint students with rheological tests of fresh concrete, which are the most advanced technique of fresh concrete properties evaluation; to acquaint students with the possibility to use different non-destructive test methods for the in-situ evaluation of the quality of concrete elements or mineral renders; to acquaint the student with a integral approach to the analysis of the causes of degradation of mortars and concretes with advanced experimental techniques, which at the same time allows the determination of the correlation between the change in the microstructure of the material and the changes in its physical and / or mechanical properties; acquaint students with the possibilities and limitations of incorporation of non-inert secondary raw materials in non-structural and structural concrete.

Predvideni študijski rezultati:	**Intended learning outcomes:**
Študent bo razumel fizikalno ozadje reoloških preiskav svežih betonov. Študent bo znal izbrati relevantne neporušne metode preiskav za ovrednotenje stanja betonskih elementov in ometov in-situ; Študent bo znal pojasniti vzroke propadanja malt in betonov, na podlagi rezultatov preiskav na nivoju mikrostrukture materiala ter sprememb njegovih fizikalnih in/ali mehanskih lastnosti. Študent bo razumel prednosti in pomanjkljivosti vključevanja neinertnih sekundarnih surovin v nekonstrukcijske in konstrukcijske betone.	Student will understand physical background of rheological tests of fresh concretes. Student will be able to select relevant non-destructive test methods for the in-situ evaluation of the quality of concrete elements or mineral renders. Student will be able to explain causes of degradation of mortars and concretes, based on the analyses of the microstructure of the material and the changes in its physical and / or mechanical properties. Student will understand benefits and drawbacks of incorporation of non-inert secondary raw materials in non-structural and structural concrete.

Metode poučevanja in učenja:	**Learning and teaching methods:**
Predavanja, laboratorijsko delo, vodene diskusije, konzultacije.	Lectures, laboratory work, guided discussions, consultations.

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

Izpit	40,00 %	exam
Laboratorijski dnevnik	30,00 %	Laboratory log
Seminar	30,00 %	seminar

Reference nosilca/Lecturer's references:

ŠTUKOVNIK, Petra, MARINŠEK, Marjan, MIRTIČ, Breda, **BOKAN-BOSILJKOV, Violeta**. Influence of alkali carbonate reaction on compressive strength of mortars with air lime binder. Construction & building materials, ISSN 0950-0618. [Print ed.], 2015, letn. 75, št. jan., str. 247-254, ilustr., doi: 10.1016/j.conbuildmat.2014.11.024.

ČESEN, Aleš, KOSEC, Tadeja, LEGAT, Andraž, **BOKAN-BOSILJKOV, Violeta**. Corrosion properties of different forms of carbon steel in simulated concrete pore water = Korozijske lastnosti različnih oblik jekel v simulirani porni vodi betona. Materiali in tehnologije, ISSN 1580-2949. [Tiskana izd.], jan. 2014, letn. 48, št. 1, str. 51-57, ilustr. http://mit.imt.si/Revija/.

PRINČIČ, Tina, ŠTUKOVNIK, Petra, PEJOVNIK, Stane, SCHUTTER, Geert De, **BOKAN-BOSILJKOV, Violeta**. Observations on dedolomization of carbonate concrete aggregates, implications for ACR and expansion. Cement and concrete research, ISSN 0008-8846. [Print ed.], dec. 2013, letn. 54, str. 151-160, ilustr., doi: 10.1016/j.cemconres.2013.09.005.

ŠTUKOVNIK, Petra, PRINČIČ, Tina, PEJOVNIK, Stane, **BOKAN-BOSILJKOV, Violeta**. Alkali-carbonate reaction in concrete and its implications for a high rate of long-term compressive strength increase. Construction & building materials, ISSN 0950-0618. [Print ed.], jan. 2014, letn. 50, str. 699-709, doi: 10.1016/j.conbuildmat.2013.10.007.

HOČEVAR, Andraž, KAVČIČ, Franci, **BOKAN-BOSILJKOV, Violeta**. Reološki parametri svježih betona - usporedba reometara = Rheological parameters of fresh concrete - comparison of rheometers. Građevinar, ISSN 0350-2465, 2013, letn. 65, št. 2, str. 99-109, ilustr. http://www.casopis-gradjevinar.hr/assets/Uploads/JCE_65_2013_2_1_rad-765.pdf, http://www.casopis-gradjevinar.hr/assets/Uploads/JCE_65_2013_2_1_765_EN.pdf.

URANJEK, Mojmir, BOSILJKOV, Vlatko, ŽARNIĆ, Roko, **BOKAN-BOSILJKOV, Violeta**. In situ tests and seismic assessment of a stone-masonry building. Materials and structures, ISSN 1359-5997, 2012, letn. 45, št. 6, str. 861-879, ilustr., doi: 10.1617/s11527-011-9804-z.

BOSILJKOV, Vlatko, URANJEK, Mojmir, ŽARNIĆ, Roko, **BOKAN-BOSILJKOV, Violeta**. An integrated diagnostic approach for the assessment of historic masonry structures. Journal of cultural heritage, ISSN 1296-2074, 2010, letn. 11, št. 3, str. 239-249, ilustr., doi: 10.1016/j.culher.2009.11.007.

UČNI NAČRT PREDMETA/COURSE SYLLABUS

Predmet:	Napredni konstrukcijski sklopi – NKS
Course title:	Advanced Constructional Complexes – ACC

Študijski programi in stopnja	Študijska smer	Letnik	Semestri
Grajeno okolje, tretja stopnja, doktorski	Ni členitve (študijski program)		Letni, Zimski

Univerzitetna koda predmeta/University course code: 1705

Predavanja	Seminar	Vaje	Klinične vaje	Druge oblike študija	Samostojno delo	ECTS
20	10	10	0	0	85	5

Nosilec predmeta/Lecturer: Roman Kunič

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:
Ni posebnih pogojev	No special conditions

Vsebina:	Content (Syllabus outline):
Cilj predmeta je seznaniti študente s principi inženirskega načrtovanja, oblikovanja in sistemskega pristopa k reševanju problemov in obvladovanju iterativnih postopkov razvoja od abstraktne zamisli do konkretne rešitve konstrukcijskih sklopov in obratno. Pri predmetu študent spozna postopke modeliranja in simulacije, kot tudi načine preprečevanja dejavnikov tveganja, napačne izbire ali neustrezne kombinacije materialov v poljubnem konstrukcijskem sklopu. Pri tem pa upošteva vse parametre celovitega načrtovanja in zahteve za načrtovanje stavb. PREDAVANJA: • Napredni materiali in koncipiranje razvoja naprednih konstrukcijskih sklopov, • Korelacija med kemijsko strukturo in lastnostmi, • Polimerni materiali s povišano temperaturno obstojnostjo in obstojnostjo na UV sevanje • Zaščita polimernih materialov pred pregrevanjem: termotropne in termokromne prevleke, premazi z nizko termično emisivnostjo, • Uporaba pri sanaciji stavb in za varovanje kulturne dediščine • Hranilniki toplote (PCM) • Pregled testnih metod za ugotavljanje obstojnosti materialov (pospešeni testi staranja) • Ogljični odtis, potencial globalnega segrevanja	The aim of this course is to acquaint students with the principles of engineering planning, design and systematic approach to problem solving and management of iterative development processes from abstract ideas to concrete solutions for constructional complexes and vice versa. Students learn about the procedures of modeling and simulation, as well as ways of preventing risk factors, wrong choice or inadequate combination of materials in any constructional complexes, by taking into account all the parameters of comprehensive planning and requirements for the design of buildings. LECTURES: • Advanced materials and conceptual development of advanced constructional complexes, • Correlation between chemical structure and properties • polymeric materials with high thermal stability and resistance to UV radiation • Protection against overheating of polymeric materials: thermotropic and thermochromic coatings, coatings with low thermal emissivity, • Use for the rehabilitation of buildings and for the protection of cultural heritage • Phase Changed Materials (PCM) • Review of test methods for determining the stability

	of the materials (accelerated aging tests) • Carbon footprint, global warming potential

Temeljna literatura in viri/Readings:

- Materials science for solar energy conversion systems, C. G. Granqvist (Ed), Pergamon Press, ISBN 0-08-040937-7
- Orel, Boris, Šurca Vuk Angela, Slemenik Perše Lidija : Sončni sprejemniki za pridobivanje sončne toplote : učno gradivo = Solar collectors for generation of solar heat : course notes, Ljubljana: Kemijski inštitut, 2008. 147 str., ilustr. ISBN 978-961-6104-12-8.
- Peternelj, Jože; Zvonko Jagličić, Osnove gradbene fizike, univerzitetni učbenik, UL, FGG, 2014, ISBN 978-961-6884-15-0

Elektronski viri:

- Spletna stran KSKE / Internet site: UL FGG KSKE: http://kske.fgg.uni-lj.si/

Cilji in kompetence:	**Objectives and competences:**
CILJI: • Nadgraditi osnovno znanje o naprednih materialih in naprednih konstrukcijskih sklopih, uporabnih za doseganje toplotnih, zvočnih in drugih učinkov v stavbah. • Podati pregled naprednih konstrukcijskih sklopov, njihovih fizikalno-kemijskih lastnosti v povezavi z strukturo materialov. • Nadgraditi znanje o uporabi naprednih konstrukcijskih sklopov, z namenom načrtovanja večfunkcionalnih rešitev • Podati pregled možnih rešitev v modernih (sodobnih) stavbah. • Študent s svojim znanjem in izkušnjami postane konkurenčen na trgu strokovnega, raziskovalno - razvojnega in znanstvenega področja, s poudarkom na grajenem okolju. Pridobljene kompetence: • Sposobnost koncipiranja rešitev za gradbeništvo na osnovi naprednih konstrukcijskih sklopov • Sposobnost razpoznavanja prednosti naprednih materialov in naprednih konstrukcijskih sklopov na osnovi njihovih fizikalno-kemijskih lastnost.	OBJECTIVES: • To upgrade the basic knowledge of advanced materials and advanced constructional complexes that can be applied to achieve thermal, sound and other effects in buildings. • To provide an overview of advanced constructional complexes and their physico-chemical properties in relation to the structure of materials. • to upgrade the knowledge of the use of advanced constructional complexes, in order to design multifunctional solution • To provide an overview of possible solutions in modern (contemporary) buildings. • With the knowledge and experience students become competitive in the market of professional, research & development and scientific fields, with the emphasis on the built environment. Acquired competences: • Ability to conceiving solutions for the construction based on advanced constructional complexes • ability to understand the benefits of advanced materials and advanced constructional complexes based on their physico-chemical properties

Predvideni študijski rezultati:	**Intended learning outcomes:**
ZNANJE IN RAZUMEVANJE: Razumevanje delovanja transparentnih in netransparentnih delov stavbnega ovoja, zasnova in analiza vplivov direktnega osončenja, sposobnost ocene odziva stavbe. Spretnost kreiranja in razvoja določenega konstrukcijskega sklopa od abstraktne zamisli do konkretne izvedbe in obratno. Pri tem pa ima študent sposobnost kritične presoje ocenitve položaja in vrednosti določenega elementa ali celote. Obvladovanje tehnologij in lastnosti produktov in celovitih konstrukcijskih sklopov s ciljem doseganja in izboljšanja kakovosti grajenega bivalnega in delovnega okolja. Poudarek na sintezi znanja in sistemskih pristopih, ob upoštevanju celovitega življenjskega ciklusa, vključno s celovito kritično presojo.	KNOWLEDGE AND UNDERSTANDING: Understanding the functioning of transparent and opaque constructional complexes of the building envelope, design and analysis of the effects of direct sunlight, ability to assess the response of the building. Ability to create and develop specific constructional complexes from abstract ideas to concrete implementation, and vice versa. In doing so, however, students are able to analyze and evaluate the value of specific element or constructional complexes or a building as a whole. Managing the technology and product's characteristics of advanced constructional complexes with the aim to achieve and improve the quality of the built living and working environment. The emphasis is on the synthesis of knowledge and systemic

UPORABA: Uporaba metod načrtovanja in razvoja konstrukcijskih sklopov s pomočjo novih naprednih materialov ob hkratnem spoštovanju zahtev bivanjske kulture in tradicije stavbeništva v določenem (s poudarkom na domačem) področju. Študent je sposoben upoštevati in uporabljati veljavno nacionalno in tudi evropsko zakonodajo, standarde in drugo regulativo. REFLEKSIJA: Sposobnost samostojne ocene položaja in vloge obravnavnih naprednih konstrukcijskih sklopov v sistemu 'okolje / človek / stavba' in identifikacija medsebojnih povezav. PRENOSLJIVE SPRETNOSTI: Spretnosti uporabe domače in tuje literature in drugih virov, zbiranja in interpretiranja podatkov, identifikacija in reševanje problemov, kritična analiza, sinteza, aktivno sodelovanje in delo v skupini ter sintetiziranje zanj. Študent bo razumel sposobnost identifikacije vplivnih faktorjev, ki vplivajo na kakovost, trajnost in trajnostnost različnih konstrukcijskih sklopov, tako v stacionarnem kot dinamičnem odzivu konstrukcijskega sklopa ali stavbe kot celote.	approach, taking into account the full life-cycle, including a comprehensive critical review. APPLICATION: Using the methods of planning and development of constructional complexes with the help of using new advanced materials, while respecting the requirements of living culture and building tradition in a given (with an emphasis on domestic) region. Student is able to take into account and apply the relevant national and European legislation, standards and other regulations. REFLECTION: Ability to independently evaluate the situation and the role of each considered advanced constructional complex in the system 'environment / human being / building' and identification of mutual interconnections. TRANSFERABLE SKILLS Skills of using domestic and foreign literature and other sources, collecting and interpreting data, identification of problems and problem solving, critical analysis, synthesis, active participation and group work, and synthesizes of knowledge. Student will understand the ability to identify influential factors affecting the quality, durability and sustainability of various constructional complexes, both stationary and dynamic response of constructional complex or building as a whole.

Metode poučevanja in učenja:	**Learning and teaching methods:**
Predavanja, izdelava individualnih raziskovalnih nalog, študij tekočih znanstvenih publikacij in novih tehničnih rešitev, ki temeljijo na celovitem pristopu. Priprava člankov za objavo v priznanih (SCI citiranih) publikacijah.	Lectures, individual research projects, studies of current scientific publications and new technical solutions based on an integrated design. Preparing articles for SCI cited publication.

Načini ocenjevanja:	**Delež/Weight**	**Assessment:**
Način: ustni izpit, zagovor raziskovalnih nalog in projektov.	70,00 %	Method: oral exam, presentation of research activities and projects.
Priprava vsaj enega članka za objavo v SCI citiranih publikacijah.	30,00 %	At least one article already prepared for - SCI cited publication.

Reference nosilca/Lecturer's references:

1. KUNIČ, Roman, OREL, Boris, KRAINER, Aleš. An Assessment of the Impact of Accelerated Ageing on the Service Life of Bituminous Waterproofing Sheets. *Journal of materials in civil engineering*, ISSN 0899-1561, 2011, vol. 23, no. 12, str. 1746-1754, ilustr., doi: 10.1061/(ASCE)MT.1943-5533.0000326. [COBISS.SI-ID 5509985], [JCR, SNIP, WoS do 16. 4. 2013: št. citatov (TC): 1, čistih citatov (CI): 0, normirano št. čistih citatov (NC): 0, Scopus do 28. 11. 2014: št. citatov (TC): 1, čistih citatov (CI): 0, normirano št. čistih citatov (NC): 0]
2. KUNIČ, Roman, MIHELČIČ, Mohor, OREL, Boris, SLEMENIK PERŠE, Lidija, BIZJAK, Aleš, KOVAČ, Janez, BRUNOLD, Stefan. Life expectancy prediction and application properties of novel polyurethane based thickness sensitive and thickness insensitive spectrally selective paintcoatings for solar absorbers. *Solar energy materials and solar cells*, ISSN 0927-0248. [Print ed.], 2011, letn. 95, št.11, str. 2965-2975, ilustr., doi: 10.1016/j.solmat.2011.05.014. [COBISS.SI-ID 5509729], [JCR, SNIP, WoS do 23. 9. 2014: št. citatov (TC): 9, čistih citatov (CI): 7, normirano št. čistih citatov (NC): 3, Scopus do 28. 11. 2014: št. citatov (TC): 12, čistih citatov (CI): 10, normirano št. čistih citatov (NC): 4]
3. KUNIČ, Roman, KOŽELJ, Matjaž, OREL, Boris, ŠURCA VUK, Angela, VILČNIK, Aljaž, SLEMENIK PERŠE, Lidija, MERLINI, Dušan, BRUNOLD, Stefan. Adhesion and thermal stability of thickness insesitive spectrally selective

(TISS) polyurethane-based paint coatings on copper substrates. *Solar energy materials and solar cells*, ISSN 0927-0248. [Print ed.], 2009, vol. 93, no. 5, str. 630-640. [COBISS.SI-ID 4117018], [JCR, SNIP, WoS do 10. 2. 2014: št. citatov (TC): 11, čistih citatov (CI): 8, normirano št. čistih citatov (NC): 4, Scopus do 28. 11. 2014: št. citatov (TC): 15, čistih citatov (CI): 11, normirano št. čistih citatov (NC): 5]

4. KUNIČ, Roman. Vacuum insulation panels - an assessment of the impact of accelerated ageing on service life. *Strojniški vestnik*, ISSN 0039-2480, okt. 2012, vol. 58, no. 10, str. 598-606, SI 121, ilustr., doi: 10.5545/sv-jme.2012.539. [COBISS.SI-ID 266561024]
5. KUNIČ, Roman, KUTNAR, Andreja. Accelerated ageing and global warming potential of vip thermal insulation. V: BRUNNER, Samuel (ur.), WAKILI, Karim Ghazi (ur.). *11th International Vacuum Insulation Symposium : [proceedings, Dübendorf, September 19-20, 2013]*. Dübendorf: Empa, 2013, str. 15-16. [COBISS.SI-ID 1536158916]
6. KUNIČ, Roman. Temeljenje in nasipi iz ekspandiranega poliestra. V: 10. slovenski kongres o cestah in prometu, Portorož, 20.-22. oktober 2010. *Zbornik referatov*. Ljubljana: DRC - Družba za raziskave v cestni in prometni stroki Slovenije, 2010, str. 1394-1402, ilustr. [COBISS.SI-ID 5510241]
7. KUNIČ, Roman. An assessment of the impact of accelerated ageing on the determination of the service lifetime of bitumnous waterproofing sheets. V: *Hydroizolace a vozovky na mostech : 20. jubilejní konference, Dlouhé Stráně 2009 : sborník příspěvků*. [Brno]: Akademické nakladatelství CERM, 2009, str. 124-130, ilustr. [COBISS.SI-ID 4890209]
8. JERMAN, Ivan, MIHELČIČ, Mohor, OREL, Boris, KUNIČ, Roman. Cool materials for the built environment. V: *10th IEA-SHC Task 39 Expert meeting*. Graz: 2010, str. [1], ilustr. [COBISS.SI-ID 4841242]
9. OREL, Boris, JERMAN, Ivan, KOŽELJ, Matjaž, SLEMENIK PERŠE, Lidija, KUNIČ, Roman. Materials aspects of solar paint coatings for building applications. V: KOLOKOTSA, Dionysia-Denia (ur.). *Advances in the development of cool materials for the built environment*. [S. l.]: Bentham Science Publishers, cop. 2013, str. 120-173, doi: 10.2174/978160805471811301000 9. [COBISS.SI-ID 5198618], [Scopus do 14. 10. 2013: št. citatov (TC): 0, čistih citatov (CI): 0, normirano št. čistih citatov (NC): 0]
10. BRUNOLD, Stefan, REUSCH, Florian, KUNIČ, Roman, REKSTAD, John, MEIR, Michaela, WILHELMS, Claudius. Durability tests of polymeric components. V: KÖHL, Michael (ur.). *Polymeric materials for solar thermal applications*, (Solar heating and cooling, ISSN 2194-0665), (Solar heating and cooling, ISSN 2194-8135). Weinheim: Wiley-VCL, cop. 2012, str. 319-349, ilustr. [COBISS.SI-ID 5113114]
11. KUNIČ, Roman, ROZMAN, Marko, POTOČNIK, Janez, OPRČKAL, Valentina. Ekološki osnovni bitumenski premaz IBITOL EKO = Environmentally - friendly bitumen primer IBITOL EKO. V: *Inovativni potencial Slovenije : [katalog prireditve]*. Ljubljana: Javna agencija za podjetništvo in tuje investicije, 2010, str. 34. [COBISS.SI-ID 5517409]
12. OREL, Boris, SPREIZER, Helena, KOŽELJ, Matjaž, KUNIČ, Roman, ŠURCA VUK, Angela, MERLIN, Dušan, VODLAN, Marjanca. *Report on adhesion and thermal stability of thickness insensitiv spectrally selective (TISS) paint coating*. Ljubljana: Kemijski inštitut Ljubljana Slovenija, 2008. 24 f., ilustr. [COBISS.SI-ID 4338273]
13. OREL, Boris, SPREIZER, Helena, KUNIČ, Roman. *Stabilitiy of TISS black paint coatings: temperature and humidity testing : preliminary report*. Ljubljana: Kemijski inštitut Ljubljana Slovenija, 2008. 6 f., ilustr. [COBISS.SI-ID 4338529]
14. KUNIČ, Roman. *Postopek in naprava za hidroizolacijo prebojne armature*. Ljubljana: Jure Marn, intelektualna lastnina, svetovanje in raziskave, 28.1.2011. 11 f., 2 pril. [COBISS.SI-ID 5848929]
15. KUNIČ, Roman. *Termo-izolacijska plošča, prednostno iz stiropora : patent št. 22632*. Ljubljana: Urad Republike Slovenije za intelektualno lastnino, 2009. [COBISS.SI-ID 4910433]
16. KUNIČ, Roman, OREL, Boris, KOŽELJ, Matjaž, MERLIN, Dušan, BRUNOLD, Stefan. *Modified accelerated test procedure for TISS paints : task 39 meeting 5: October 13-15, 2008, in Lisbon*. Lisbon, 2008. 27 prosojnic, Ilustr. [COBISS.SI-ID 4399457]
17. KUNIČ, Roman. *Energy Efficient Constructions - Bioclimatic Strategies & Technologies for Slovene Climate : New Advanced Thermal Insulation Materials and their Influence on Constructional Complexes : vabljeno predavanje: URBINA simpozij trajnostnih tehnologij, 12. maj 2011 v prostorih Ambasade Kraljevine Norveške v Ljubljani*. Ljubljana, 2011. 26 prosojnic. [COBISS.SI-ID 5848417]
18. KUNIČ, Roman. *Sistemi toplotnih, zvočnih in hidroizolacij; Talno ogrevanje; Ozelenjene strehe : nove zahteve po zmanjšanju porabe energije v stavbah : vabljeno predavanje na strokovnem izobraževanju Društva gradbenih inženirjev in tehnikov, 5. marec 2010 v hotelu Šport na Otočcu*. Otočec, 2011. 88 prosojnic. [COBISS.SI-ID 5848673]

UČNI NAČRT PREDMETA/COURSE SYLLABUS

Predmet:	Nelinearna analiza betonskih konstrukcij
Course title:	Nonlinear Analysis of Concrete Structures

Študijski programi in stopnja	Študijska smer	Letnik	Semestri
Grajeno okolje, tretja stopnja, doktorski	Ni členitve (študijski program)		Letni, Zimski

Univerzitetna koda predmeta/University course code: 1510

Predavanja	Seminar	Vaje	Klinične vaje	Druge oblike študija	Samostojno delo	ECTS
30	10	0	0	85	0	5

Nosilec predmeta/Lecturer: Sebastjan Bratina

Vrsta predmeta/Course type: Izbirni predmet/Elective course

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

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:	Prerequisites:
Ni posebnih pogojev	No special conditions

Vsebina:	Content (Syllabus outline):
- pregled značilnih fizikalnih pojavov pri betonskih konstrukcijah; - mehanski in reološki modeli betona, jekla za armiranje in jekla za prednapenjanje; - nelinearna analiza konstrukcij iz armiranega in prednapetega betona pri poljubni mehanski obtežbi (značilne lastnosti: pomiki, razpoke, mejna nosilnost, stabilnost, mehčanje, zdrs armature oziroma kabla, reologija); - geometrijska in materialna nelinearna analiza betonskih konstrukcij pri sočasnem vplivu mehanske in požarne obtežbe (značilne lastnosti: pomiki, požarna odpornost, temperaturne deformacije, viskozno lezenje, mehčanje, zdrs armature oziroma kabla); - kritična presoja poenostavljenih računskih postopkov za analizo betonskih konstrukcij, ki jih predpisujejo veljavni tehnični predpisi.	- Overview of typical phenomena in concrete structures; - Mechanical and rheological models of concrete, reinforcement and prestressing steel; - Nonlinear analysis of reinforced and prestressed concrete structures due to mechanical load (basic phenomena: displacements, cracking, ultimate bearing capacity, stability, softening, slip in contact between concrete and steel, rheology); - Nonlinear analysis of concrete structures due to simultaneous action of mechanical and fire load (basic phenomena: displacements, fire resistance, thermal strains, viscous creep strains, transient strains, softening, slip in contact between concrete and steel); - Critical estimation of simplified methods for analysis of concrete structures used in regulations and standards.

Temeljna literatura in viri/Readings:

Bratina S., Odziv armiranobetonskih linijskih konstrukcij na požarno obtežbo, UL FGG, Doktorska disertacija, 2003.
Krauberger N., Vpliv požara na obnašanje ojačanih betonskih linijskih konstrukcij, UL FGG, Doktorska disertacija, 2008.
A. Ghali A., Favre R., Elbadry M., Concrete structures: stresses and deformation, London: Spon Press, 2002.
Bažant Z.P., Planas J., Fracture and size effect in concrete and other quasibrittle materials, Boca Raton: CRC Press, 1998.
Harmathy T.Z., Fire safety design and concrete, London : Longman, 1993.

Rombach G.A., Finite element design of concrete structures: practical problems and their solutions, London: Telford, 2004. NFIRA, Bratina S., Planinc I., Program za nelinearno analizo linijskih betonskih konstrukcij, UL FGG, 2010. Tekoči znanstveni in strokovni članki.

Cilji in kompetence:	**Objectives and competences:**
Cilji: - nadgraditev osnovnega znanja o obnašanju betonskih konstrukcij z načeli nelinearnosti; - vpeljava osnov matematičnega in numeričnega modeliranja betonskih konstrukcij; - analiza odziva betonske konstrukcije pri poljubni obtežbi (mehanske in/ali požarne) z upoštevanjem mehanskih in reoloških lastnosti betona in jekla za armiranje in prednapenjanje, predstavitev in kritična ocena rezultatov. Pridobljene kompetence: - poznavanje terminologije in pomena pomembnejših fizikalnih količin v nelinearni analizi betonskih konstrukcij; - sposobnost izbire primernega matematičnega in numeričnega modela za nelinearno analizo betonskih konstrukcij; - sposobnost uporabe numeričnih metod za analizo mehanskega odziva betonske konstrukcije pri poljubni obtežbi (mehanske in/ali požarne) ter predstavitev in kritična ocena dobljenih rezultatov.	Goals: - Improvement of basic knowledge considering concrete structures and their nonlinear behaviour; - Introducing basic principles of mathematical and numerical modelling of concrete structures; - Analysis of mechanical response of concrete structures due to mechanical and/or fire load considering mechanical and rheological properties of concrete and reinforcement and presstressing steel, critical estimation of the results. Competences: - Knowledge about the terminology and meaning of essential parameters influencing nonlinear behaviour of concrete structures; - Capability of choosing proper mathematical and numerical model for nonlinear analysis of concrete structures; - Using suitable numerical methods for determining the mechanical response of concrete structures due to mechanical and/or fire load, critical evaluation of the results.

Predvideni študijski rezultati:	**Intended learning outcomes:**
Znanje in razumevanje: - poznavanje učinkovitih računskih metod in programskih orodij za nelinearno analizo betonskih konstrukcij v običajnih pogojih in/ali pogojih požara - razumevanje nelinearnega obnašanja betonskih konstrukcij pri poljubni obtežbi (mehanski in/ali požarni)	Knowledge and understanding: - knowledge of efficient computational methods and software for the nonlinear analysis of concrete structures in normal and/or fire conditions - understanding of the nonlinear behaviour of concrete structures due to mechanical and/or fire load

Metode poučevanja in učenja:	**Learning and teaching methods:**
Predavanja, konzultacije, izdelava individualne seminarske naloge	Lectures, consultations and individual seminar work.

Načini ocenjevanja:	**Delež/Weight**	**Assessment:**
Način (pisni izpit, ustno izpraševanje, naloge, projekt): seminarska naloga	70,00 %	Type (examination, oral, coursework, project): individual seminar work
Ustni zagovor	30,00 %	Oral examination

Reference nosilca/Lecturer's references:

KRAUBERGER Nana, BRATINA Sebastjan, SAJE Miran, SCHNABL Simon, PLANINC Igor. Inelastic buckling load of a locally weakened reinforced concrete column, Engineering Structures, letn. 34, št. 1, str. 278-288, 2012. MARKOVIČ Mojca, SAJE Miran, PLANINC Igor, BRATINA Sebastjan. On strain softening in finite element analysis of RC planar frames subjected to fire, Engineering Structures, letn. 45, str. 349-361, 2012. MARKOVIČ Mojca, KRAUBERGER Nana, SAJE Miran, PLANINC Igor, BRATINA Sebastjan, Non-linear analysis of pre-tensioned concrete planar beams, Engineering Structures, letn. 46, str. 279-293, 2013.

UČNI NAČRT PREDMETA/COURSE SYLLABUS

Predmet:	Nelinearna analiza in projektiranje potresno odpornih armiranobetonskih stavb
Course title:	Inelastic Analysis and Design of Earthquake Resistant Reinforced Concrete Buildings

Študijski programi in stopnja	**Študijska smer**	**Letnik**	**Semestri**
Grajeno okolje, tretja stopnja, doktorski	Ni členitve (študijski program)		Letni, Zimski

Univerzitetna koda predmeta/University course code: 1099

Predavanja	**Seminar**	**Vaje**	**Klinične vaje**	**Druge oblike študija**	**Samostojno delo**	**ECTS**
20	20	0	0	40	45	5

Nosilec predmeta/Lecturer: Matej Fischinger

Vrsta predmeta/Course type: izbirni predmet/Elective course

Jeziki/Languages:

Predavanja/Lectures:	Angleščina, Slovenščina
Vaje/Tutorial:	Angleščina, Slovenščina

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:	**Prerequisites:**
Znanje, ki je enakovredno tistemu pridobljenemu na I. In II. stopnji univerzitetnega študijskega programa Gradbeništvo na FGG in sicer v okviru predmetov: Betonske konstrukcije I, Betonske konstrukcije II, Osnove potresnega inženirstva, Trdnost, Statika gradbenih konstrukcij, DGK in potresno inženirstvo.	Knowledge equivalent to the knowledge obtained within the 1st and the 2nd degree of the study program "Civil Engineering" given at the Faculty of Civil and Geodetic Engineering at the University of Ljubljana; in particular within the courses: Concrete Structures I, Concrete Structures II, Basis of Earthquake Engineering, Mechanics of Solids, Structural Engineering, Structural Dynamics and Earthquake Engineering.

Vsebina:	**Content (Syllabus outline):**
V krajšem kurzu (5 KT) bodo podane potrebne temeljne vsebine za ekvivalentno nelinearno statično analizo in projektiranje osnovnih konstrukcijskih sistemov AB stavb. Poudarek bo na razumevanju nelinearnih modelov in pripravi ustreznih parametrov za njihovo uporabo. Podana bo poglobljena razlaga postopkov in zahtev v Eurokodu 8 za standardne konstrukcije armiranobetonskih stavb. Obe temi (projektiranje in nelinearno modeliranje) bosta povezani v enoviti seminarski nalogi.	The shorter (5 ETCS) course provides basic knowledge needed for the equivalent inelastic static analysis and design of typical structural systems of reinforced concrete buildings. It is focused on the understanding of the concepts of the applied inelastic models and the appropriate choice of the parameters for these models.

Temeljna literatura in viri/Readings:

Paulay, T., Priestley, M.J.N.: Design of Reinforced Concrete and Masonry Buildings for Earthquake Resistance, J. Wiley&Sons, New York, 1991, ali

Paulay, T., Bachmann, H., Moser, K.: Erdbebenbemessung von Stahlbetonhochbauten, Birkhauser Verlag, Berlin, 1990.

Fischinger, M.: Projektiranje potresno odpornih armiranobetonskih stavb, skripta. SIST EN 1998-1:2005 - Evrokod 8 - Projektiranje konstrukcij na potresnih območjih - 1. del; Eurocode 8 - Design of structures for earthquake resistance - Part 1

Cilji in kompetence:	**Objectives and competences:**
Krajša verzija bo namenjena temeljnim in splošnim vsebinam, ki bodo primerne za: /a/ študente (predvsem z drugih znanstvenih področij), ki bodo krajšo verzijo vpisali kot samostojen predmet /b/ študente, ki bodo kombinirali dva kratka kurza iz področij potresno odpornih stavb (5 KT) in mostov (5 KT)	The shorter version provides basic and general topics intended for: /a/ the students (mainly studying other scientific fields), who will enrol the course as independent unit; /b/ the students, who will combine 2 short courses in the fields of earthquake resistant buildings (5 ETCS) and earthquake resistant bridges (5 ETCS).

Predvideni študijski rezultati:	**Intended learning outcomes:**
Znanje in razumevanje: Odziv konstrukcij na močno potresno obtežbo je nelinearen. Vendar ta problem na prvih dveh stopnjah obravnavamo prevsem na ekvivalentnih linearnih modelih in z njimi povezanimi postopki projektiranja. Pri tem predmetu pa študent/ka spozna in razume zapleteno nelinearno obnašanje elementov in konstrukcij armiranobetonskih stavb pri dinamičnemu odzivu na potres. Zato je sposoben/na uporabe metodologij in programov za projektiranje, ki temeljijo na nelinearnih metodah. Pridobi tudi ustrezne kompetence za raziskovalno delo.	Knowledge and understanding: The response of structures to strong earthquake action is inelastic. However, only equivalent elastic models and related design procedures are addressed within the first two degrees of the study. Within this course, the student learns and understands the complex inelastic behaviour of RC elements and RC structures during the dynamic response to the earthquake action. Consequently he/she is competent to use the methodologies and the design software based on the inelastic methods. The course also contributes to the student's competence in the research work.

Metode poučevanja in učenja:	**Learning and teaching methods:**
Predavanja – individualna ali v majhnih skupinah + individualni študij	One to one or small group lectures + individual study

Načini ocenjevanja:	**Delež/Weight**	**Assessment:**
Seminarska naloga	50,00 %	Seminar work
Zagovor naloge z dodatnimi vprašanji	50,00 %	Presentation of the seminar + additional questions

Reference nosilca/Lecturer's references:

1. ZOUBEK, Blaž, FISCHINGER, Matej, ISAKOVIĆ, Tatjana. Estimation of the cyclic capacity of beam-to-column dowel connections in precast industrial buildings. Sprejeto v objavo v *Bulletin of earthquake engineering*, 2014. Priloženo je pismo urednika o sprejetju v objavo.
2. FISCHINGER, Matej (urednik). *Performance-based seismic engineering : vision for an earthquake resilient society*, (Geotechnical, geological, and earthquake engineering, vol. 32). Dordrecht [etc.]: Springer, cop. 2014. XXIII, 505 str., ilustr. ISBN 978-94-017-8874-8. ISBN 94-017-8874-X, doi: 10.1007/978-94-017-8875-5. [COBISS.SI-ID 2062695]
3. FISCHINGER, Matej, REJC, Klemen, ISAKOVIĆ, Tatjana. Inelastic Shear Response of RC Walls : a challenge in Performance Based Design and Assessment. V: FISCHINGER, Matej (ur.). *Performance-based seismic engineering : vision for an earthquake resilient society*, (Geotechnical, geological, and earthquake engineering, ISSN 1573-6059, vol. 32). Dordrecht [etc.]: Springer, cop. 2014, str. 347-364, ilustr. [COBISS.SI-ID 6731873]
4. ZOUBEK, Blaž, ISAKOVIĆ, Tatjana, FAHJAN, Yasin, FISCHINGER, Matej. Cyclic failure analysis of the beam-to-column dowel connections in precast industrial buildings. *Engineering structures*, ISSN 0141-0296. [Print ed.], jul. 2013, letn. 52, str. 179-191, ilustr., doi: 10.1016/j.engstruct.2013.02.028. [COBISS.SI-ID 6331233]
5. REJEC, Klemen, ISAKOVIĆ, Tatjana, FISCHINGER, Matej. Seismic shear force magnification in RC cantilever structural walls, designed according to Eurocode 8. *Bulletin of earthquake engineering*, ISSN 1570-761X, apr. 2012, letn. 10, št. 2, str. 567-586, ilustr., doi: 10.1007/s10518-011-9294-y. [COBISS.SI-ID 5503585]

6. KRAMAR, Miha, ISAKOVIĆ, Tatjana, FISCHINGER, Matej. Seismic Collapse Risk of Precast Industrial Buildings with Strong Connections. *Earthquake engineering & structural dynamics*, ISSN 0098-8847. [Print ed.], 2010, letn. 39, št. 8, str. 847-868, ilustr. http://onlinelibrary.wiley.com/doi/10.1002/eqe.970/pdf, doi: 10.1002/eqe.970. [COBISS.SI-ID 4725089]
7. FISCHINGER, Matej, KRAMAR, Miha, ISAKOVIĆ, Tatjana. Potresna sigurnost armiranobetonskih montažnih hala - eksperimentalna studija = Seismic safety of prefabricated reinforced-concrete halls - experimental study. *Građevinar*, ISSN 0350-2465, 2009, letn. 61, št. 11, str. 1031-1038, ilustr. [COBISS.SI-ID 4806753]
8. FISCHINGER, Matej, KRAMAR, Miha, ISAKOVIĆ, Tatjana. Potresna sigurnost armiranobetonskih montažnih hala - analitička studija = Seismic safety of prefabricated reinforced-concrete halls - analytical study. *Građevinar*, ISSN 0350-2465, 2009, letn. 61, št. 11, str. 1039-1045, ilustr. [COBISS.SI-ID 4807009]
9. FAJFAR, Peter, FISCHINGER, Matej, BEG, Darko. Evrokod 8 : projektiranje potresno odpornih konstrukcij. V: BEG, Darko (ur.), POGAČNIK, Andrej (ur.). *Priročnik za projektiranje gradbenih konstrukcij po evrokod standardih*. Ljubljana: Inženirska zbornica Slovenije, 2009, str. 8.1-8.241, ilustr. [COBISS.SI-ID 4746081]

UČNI NAČRT PREDMETA/COURSE SYLLABUS

Predmet:	Nelinearna analiza in projektiranje potresno odpornih armiranobetonskih stavb
Course title:	Inelastic Analysis and Design of Earthquake Resistant Reinforced Concrete Buildings

Študijski programi in stopnja	**Študijska smer**	**Letnik**	**Semestri**
Grajeno okolje, tretja stopnja, doktorski	Ni členitve (študijski program)		Letni, Zimski

Univerzitetna koda predmeta/University course code: 1281

Predavanja	**Seminar**	**Vaje**	**Klinične vaje**	**Druge oblike študija**	**Samostojno delo**	**ECTS**
40	40	0	0	80	90	10

Nosilec predmeta/Lecturer: Matej Fischinger

Vrsta predmeta/Course type: izbirni predmet/Elective course

Jeziki/Languages:

Predavanja/Lectures:	Angleščina, Slovenščina
Vaje/Tutorial:	Angleščina, Slovenščina

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:	**Prerequisites:**
Znanje, ki je enakovredno tistemu pridobljenemu na I. In II. stopnji univerzitetnega študijskega programa Gradbeništvo na FGG in sicer v okviru predmetov: Betonske konstrukcije I, Betonske konstrukcije II, Osnove potresnega inženirstva, Trdnost, Statika gradbenih konstrukcij, DGK in potresno inženirstvo.	Knowledge equivalent to the knowledge obtained within the 1st and the 2nd degree of the study program “Civil Engineering” given at the Faculty of Civil and Geodetic Engineering at the University of Ljubljana; in particular within the courses: Concrete Structures I, Concrete Structures II, Basis of Earthquake Engineering, Mechanics of Solids, Structural Engineering, Structural Dynamics and Earthquake Engineering.

Vsebina:	**Content (Syllabus outline):**
V krajšem kurzu (5 KT) bodo podane potrebne temeljne vsebine za ekvivalentno nelinearno statično analizo in projektiranje osnovnih konstrukcijskih sistemov AB stavb. Poudarek bo na razumevanju nelinearnih modelov in pripravi ustreznih parametrov za njihovo uporabo. Podana bo poglobljena razlaga postopkov in zahtev v Eurokodu 8 za standardne konstrukcije armiranobetonskih stavb. Obe temi (projektiranje in nelinearno modeliranje) bosta povezani v enoviti seminarski nalogi. V daljšem kurzu (10 KT) bodo dodana poglavja za posebne: - vrste konstrukcij (po izboru študenta) - metode nelinearne analize (račun nelinearnega časovnega odziva armiranobetonskih stavb in za to potrebni modeli) - tehnologije (potresna izolacija, potresna utrditev AB stavb)	The shorter (5 ETCS) course provides basic knowledge needed for the equivalent inelastic static analysis and design of typical structural systems of reinforced concrete buildings. It is focused on the understanding of the concepts of the applied inelastic models and the appropriate choice of the parameters for these models. The in-depth explanation of the procedures and requirements, given in the Eurocode 8 for standard reinforced building structures, is given. Both topics (inelastic modelling and design) are integrated within a single seminar work. The longer (10 ETCS) course additionally addresses special: - types of structures (according to the choice of the student) - methods of the inelastic analysis (response history analysis for reinforced concrete buildings with the particular emphasis on the inelastic models for RC structures) - technologies (seismic isolation, seismic strengthening of RC buildings)

Temeljna literatura in viri/Readings:

Paulay, T., Priestley, M.J.N.: Design of Reinforced Concrete and Masonry Buildings for Earthquake Resistance, J. Wiley&Sons, New York, 1991, ali

Paulay, T., Bachmann, H., Moser, K.: Erdbebenbemessung von Stahlbetonhochbauten, Birkhauser Verlag, Berlin, 1990.

Fischinger, M.: Projektiranje potresno odpornih armiranobetonskih stavb, skripta. SIST EN 1998-1:2005 - Evrokod 8 - Projektiranje konstrukcij na potresnih območjih - 1. del; Eurocode 8 - Design of structures for earthquake resistance - Part 1

Cilji in kompetence:	**Objectives and competences:**
Daljša verzija (10 KT) bo namenjena /a/ študentom, ki se bodo želeli specializirati na področju analize in projektiranja potresno odpornih AB stavb, npr. študentom, ki jim bodo nosilec in njegovi sodelavci mentorji in /b/ študentom, ki jih bo poleg splošnih osnov posebej zanimal dodaten poglobljen študij specialnih poglavij (npr. specialne vrste konstrukcij, nelinearnih metod ali tehnologij v potresnem inženirstvu).	The longer version (10 ETCS) is intended /a/ for the students, who will like to specialize in the field of the analysis and design of earthquake resistant buildings (i.e. for the students whose mentor will be the course coordinator) and /b/ for the students, interested in the in-depth study of the specialized topics, like special types of structures or inelastic methods and methodologies in earthquake engineering.

Predvideni študijski rezultati:	**Intended learning outcomes:**
Znanje in razumevanje: Odziv konstrukcij na močno potresno obtežbo je nelinearen. Vendar ta problem na prvih dveh stopnjah obravnavamo prevsem na ekvivalentnih linearnih modelih in z njimi povezanimi postopki projektiranja. Pri tem predmetu pa študent/ka spozna in razume zapleteno nelinearno obnašanje elementov in konstrukcij armiranobetonskih stavb pri dinamičnemu odzivu na potres. Zato je sposoben/na uporabe metodologij in programov za projektiranje, ki temeljijo na nelinearnih metodah. Pridobi tudi ustrezne kompetence za raziskovalno delo.	Knowledge and understanding: The response of structures to strong earthquake action is inelastic. However, only equivalent elastic models and related design procedures are addressed within the first two degrees of the study. Within this course, the student learns and understands the complex inelastic behaviour of RC elements and RC structures during the dynamic response to the earthquake action. Consequently he/she is competent to use the methodologies and the design software based on the inelastic methods. The course also contributes to the student's competence in the research work.

Metode poučevanja in učenja:	**Learning and teaching methods:**
Predavanja – individualna ali v majhnih skupinah + individualni študij	One to one or small group lectures + individual study

Načini ocenjevanja:	**Delež/Weight**	**Assessment:**
Seminarska naloga	50,00 %	Seminar work
Zagovor naloge z dodatnimi vprašanji	50,00 %	Presentation of the seminar + additional questions

Reference nosilca/Lecturer's references:

1. ZOUBEK, Blaž, FISCHINGER, Matej, ISAKOVIĆ, Tatjana. Estimation of the cyclic capacity of beam-to-column dowel connections in precast industrial buildings. Sprejeto v objavo v *Bulletin of earthquake engineering*, 2014. Priloženo je pismo urednika o sprejetju v objavo.
2. FISCHINGER, Matej (urednik). *Performance-based seismic engineering : vision for an earthquake resilient society*, (Geotechnical, geological, and earthquake engineering, vol. 32). Dordrecht [etc.]: Springer, cop. 2014. XXIII, 505 str., ilustr. ISBN 978-94-017-8874-8. ISBN 94-017-8874-X, doi: 10.1007/978-94-017-8875-5. [COBISS.SI-ID 2062695]
3. FISCHINGER, Matej, REJC, Klemen, ISAKOVIĆ, Tatjana. Inelastic Shear Response of RC Walls : a challenge in Performance Based Design and Assessment. V: FISCHINGER, Matej (ur.). *Performance-based seismic engineering :*

vision for an earthquake resilient society, (Geotechnical, geological, and earthquake engineering, ISSN 1573-6059, vol. 32). Dordrecht [etc.]: Springer, cop. 2014, str. 347-364, ilustr. [COBISS.SI-ID 6731873]
4. ZOUBEK, Blaž, ISAKOVIĆ, Tatjana, FAHJAN, Yasin, FISCHINGER, Matej. Cyclic failure analysis of the beam-to-column dowel connections in precast industrial buildings. *Engineering structures*, ISSN 0141-0296. [Print ed.], jul. 2013, letn. 52, str. 179-191, ilustr., doi: 10.1016/j.engstruct.2013.02.028. [COBISS.SI-ID 6331233]
5. REJEC, Klemen, ISAKOVIĆ, Tatjana, FISCHINGER, Matej. Seismic shear force magnification in RC cantilever structural walls, designed according to Eurocode 8. *Bulletin of earthquake engineering*, ISSN 1570-761X, apr. 2012, letn. 10, št. 2, str. 567-586, ilustr., doi: 10.1007/s10518-011-9294-y. [COBISS.SI-ID 5503585]
6. KRAMAR, Miha, ISAKOVIĆ, Tatjana, FISCHINGER, Matej. Seismic Collapse Risk of Precast Industrial Buildings with Strong Connections. *Earthquake engineering & structural dynamics*, ISSN 0098-8847. [Print ed.], 2010, letn. 39, št. 8, str. 847-868, ilustr. http://onlinelibrary.wiley.com/doi/10.1002/eqe.970/pdf, doi: 10.1002/eqe.970. [COBISS.SI-ID 4725089]
7. FISCHINGER, Matej, KRAMAR, Miha, ISAKOVIĆ, Tatjana. Potresna sigurnost armiranobetonskih montažnih hala - eksperimentalna studija = Seismic safety of prefabricated reinforced-concrete halls - experimental study. *Građevinar*, ISSN 0350-2465, 2009, letn. 61, št. 11, str. 1031-1038, ilustr. [COBISS.SI-ID 4806753]
8. FISCHINGER, Matej, KRAMAR, Miha, ISAKOVIĆ, Tatjana. Potresna sigurnost armiranobetonskih montažnih hala - analitička studija = Seismic safety of prefabricated reinforced-concrete halls - analytical study. *Građevinar*, ISSN 0350-2465, 2009, letn. 61, št. 11, str. 1039-1045, ilustr. [COBISS.SI-ID 4807009]
9. FAJFAR, Peter, FISCHINGER, Matej, BEG, Darko. Evrokod 8 : projektiranje potresno odpornih konstrukcij. V: BEG, Darko (ur.), POGAČNIK, Andrej (ur.). *Priročnik za projektiranje gradbenih konstrukcij po evrokod standardih*. Ljubljana: Inženirska zbornica Slovenije, 2009, str. 8.1-8.241, ilustr. [COBISS.SI-ID 4746081]

UČNI NAČRT PREDMETA/COURSE SYLLABUS

Predmet:	Nelinearna analiza kompozitnih konstrukcij
Course title:	Nonlinear Analysis of the Composite Structures

Študijski programi in stopnja	Študijska smer	Letnik	Semestri
Grajeno okolje, tretja stopnja, doktorski	Ni členitve (študijski program)		Letni, Zimski

Univerzitetna koda predmeta/University course code: 1100

Predavanja	Seminar	Vaje	Klinične vaje	Druge oblike študija	Samostojno delo	ECTS
50	0	30	0	0	170	10

Nosilec predmeta/Lecturer: Igor Planinc

Vrsta predmeta/Course type: Izbirni predmet/Elective course

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

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:	**Prerequisites:**
Ni posebnih pogojev.	No prerequisits.

Vsebina:	**Content (Syllabus outline):**
- Pregled značilnih gradbenih kompozitnih konstrukcij; - Značilne lastnosti kompozitnih gradbenih konstrukcij (mehčanje, delaminacija); - Osnove mehanike gradbenih konstrukcij (mehanika trdnih snovi in termodinamika, izotropni, ortotropni in anizotropni materialni model snovi, modeli stika med sloji, matematični modeli linijskih in ploskovnih konstrukcij, osnovni modeli porušitve kompozitnih gradbenih konstrukcij); - Nelinearna analiza gradbenih kompozitnih konstrukcij (statična in dinamična analiza, analiza različnih reoloških lastnosti posameznih slojev kompozitne konstrukcije ter požarna in stabilnostna analiza); - Kritična presoja poenostavljenih računskih metod za analizo kompozitnih konstrukcij, ki jih predpisujejo veljavni tehnični predpisi.	- Overview of typical civil engineering composite structures, - Basic properties of composite structures (e.g. softening, delaminations, etc.), - Basics of structural mechanics (mechanics of solids, thermodynamics, isotropic, ortotropic and unisotropic material models, contact models, mathematical models of linear and planar structures, basic collapse models of composite civil engineering structures), - Nonlinear analysis of civil engineering composite structures (static and dynamic analysis, analysis of rheological behaviour of certain materials being typically used in composite structures, fire and stability analysis), - Critical evaluation of simplified calculation methods for analysis of composite structures that can be found in regulations and standards.

Temeljna literatura in viri/Readings:

Kim D.-H. (1995): Composite Structures for Civil and Architectural Engineering, F & FN Spon, 490 pp.
Reddy J.N. (2004):Mechanics of Laminated Composite Plates and Shells: Theory and Analysis, CRC Press, pp. 567-721.
Recent engineering and scientific papers.

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

- Nadgraditi osnovno konstruktersko znanje z načeli projektiranja kompozitnih gradbenih konstrukcij; - V povezavi z drugimi naravoslovnimi, temeljnimi mehanskimi in strokovnimi predmeti spoznati in razumeti mehanizme interaktivnega delovanja materialov, ki sestavljajo kompozitno konstrukcijo - Vpeljati osnovna načela matematičnega in numeričnega modeliranja kompozitnih gradbenih konstrukcij; - Navajati kandidate na določitev in predstavitev problemov povezanih s kompozitnimi konstrukcijami, zajem eksperimentalnih podatkov, izbiro metode reševanja ter predstavitev in kritično oceno rezultatov.	- Improvement of basic knowledge considering composite structures and their behaviour in civil engineering practice. - Better understanding of interactive behaviour of materials in composite structures considering other natural science, basic mechanical and expert branches of instruction. - Introducing basic principles of mathematical and numerical modelling of composite civil engineering structures. - Finally, candidates should be capable of determining and presenting composite structures problems and results of properly chosen analysis as well as defining parameters that sholuld be measured during experiments.

Predvideni študijski rezultati:	**Intended learning outcomes:**
Znanje in razumevanje: - Poznavanje terminologije in pomena pomembnejših fizikalnih količin v nelinearni analizi kompozitnih konstrukcij; - Sposobnost izbire primernega matematičnega in numeričnega modela za nelinearno analizo kompozitnih gradbenih konstrukcij; - Sposobnost uporabe numeričnih metod za oceno togosti, duktilnosti in nosilnosti kompozitnih konstrukcij.	Knowledge and understanding: - Knowledge about the terminology and meaning of essential parameters influencing nonlinear behaviour of composite structures. - Capability of choosing proper mathematical and numerical model for nonlinear analysis of civil engineering composite structures. - Using suitable numerical methods for determining composite structures stiffness, ductility and their bearing capacity.

Metode poučevanja in učenja:	**Learning and teaching methods:**
Predavanja, seminar, konsultacije.	Lectures and individual seminar work.

Načini ocenjevanja:	**Delež/Weight**	**Assessment:**
Izdelava seminarske naloge	70,00 %	Individual seminar work
Uspešna ustna ali pisna branitev naloge	30,00 %	Its explanation and writing/oral examination

Reference nosilca/Lecturer's references:

SCHNABL, Simon, **PLANINC, Igor.** Inelastic buckling of two-layer composite columns with non-linear interface compliance. International journal of mechanical sciences, ISSN 0020-7403. [Print ed.], 2011, letn. 53, št. 12, str. 1077-1083.

SCHNABL, Simon, **PLANINC, Igor**. The effect of transverse shear deformation on the buckling of two-layer composite columns with interlayer slip. International journal of non-linear mechanics, ISSN 0020-7462. [Print ed.], 2011, letn. 46, št. 3, str. 543-553.

KROFLIČ, Aleš, **PLANINC, Igor**, SAJE, Miran, TURK, Goran, ČAS, Bojan. Non-linear analysis of two-layer timber beams considering interlayer slip and uplift. Engineering structures, ISSN 0141-0296. [Print ed.], junij 2010, letn. 32, št. 6, str. 1617-1630.

SCHNABL, Simon, **PLANINC, Igor**. The influence of boundary conditions and axial deformability on buckling behavior of two-layer composite columns with interlayer slip. Engineering structures, ISSN 0141-0296. [Print ed.], oktober 2010, letn. 32, št. 10, str. 3103-3111.

KROFLIČ, Aleš, **PLANINC, Igor**, SAJE, Miran, ČAS, Bojan. Analytical solution of two-layer beam including interlayer slip and uplift. Structural engineering and mechanics, ISSN 1225-4568. [Print ed.], 2010, letn. 34, št. 6, str. 667-683.

KRYŽANOWSKI, Andrej, SCHNABL, Simon, TURK, Goran, **PLANINC, Igor**. Exact slip-buckling analysis of two-layer composite columns. International journal of solids and structures, ISSN 0020-7683. [Print ed.], 2009, letn. 46, št. 14-15, str. 2929-2938.

UČNI NAČRT PREDMETA/COURSE SYLLABUS

Predmet:	Nelinearna mehanika deformabilnih teles
Course title:	Non-linear Continuum Mechanics

Študijski programi in stopnja	Študijska smer	Letnik	Semestri
Grajeno okolje, tretja stopnja, doktorski	Ni členitve (študijski program)		Letni, Zimski

Univerzitetna koda predmeta/University course code: 1102

Predavanja	Seminar	Vaje	Klinične vaje	Druge oblike študija	Samostojno delo	ECTS
45	0	15	0	65	0	5

Nosilec predmeta/Lecturer: Miran Saje

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:
Ni posebnih pogojev.	No special conditions.

Vsebina:

Kinematika. Opis prostora, časa in telesa. Koordinate. Gibanje. Lagrangev in Eulerjev opis. Pomiki, hitrosti in pospeški. Rotacija, kotna hitrost in kotni pospešek.
Deformacije. Deformacijski gradient. Deformacijske mere. Hitrost deformacij. Polarni razcep.
Napetosti. Tenzorji napetosti. Zveze med tenzorji napetosti. Izrek o ohranitve mase. Izreki o gibalni in vrtilni količini ter energiji. Lokalna oblika gibalnih enačb. Hitrosti napetosti.
Objektivnost mehanskih količin.
Šibka oblika gibalnih enačb. Linearizacija. Princip virtualnega dela. Posplošeni princip virtualnega dela. Energijski izreki.
Konstitucijske enačbe. Linearno in nelinearno elastični modeli. Plastični in viskoplastični modeli. Linearizacija in tangentna matrika.
Stabilnost. Definicija in algebrajski pogoji. Strukturna in materialna nestabilnost.
Dinamika. Nihanje in valovanje.
Diskretizacija enačb in reševanje. Metoda končnih elementov. Linearizacija. Newtonova metoda.

Vaje:
Uporaba računalniškega programa za analizo deformabilnih teles.

Content (Syllabus outline):

Lectures:
Kinematics. Description of space, time and body. Coordinates. Change of position. Motion. Lagrange's and Euler's descriptions of motion. Displacement, velocity and acceleration. Rotation, angular velocity and angular acceleration.
Strains. Deformation gradient. Strain measures. Polar decomposition. Strain rate.
Stresses. Stress tensors. Relations between stress tensors. Conservation of mass. Linear and angular momentum. Laws of linear and angular momenta, and kinetic energy. Local and global forms of the laws. Stress rate.
Objectivity of mechanical variables.
Weak form of equations of motion. Linearization. Principle of virtual work. Generalized principle of virtual work. Energy principles.
Constitutive equations. Linear and non-linear elastic models. Plastic and viscoplastic models. Linearization and tangent material matrix.
Stability. Definitions. Algebraic conditions for stability. Structural and material instability.
Dynamics. Oscillations. Waves in continuum.
Discretization and solution. Finite element method. Interpolation of unknowns. Linearization of discretized equations. Newton's method.

Exercises:

	Examples in non-inear numerical analysis of structures and solids. Application of a commercial computer program.

Temeljna literatura in viri/Readings:

Knjižni viri: (v poštev pridejo deli knjig)/**Books:** (only parts of)

Fung Y.C., Tong P. Classical and computational solid mechanics, World Scientific, 2001, 930 p.

Bonet J., Wood R.D. Nonlinear continuum mechanics for finite element analysis, Cambridge university press, 1997, 248 p.

Belytschko T., Liu W.K., Moran B. Nonlinear finite elements for continua and structures, John Wiley & Sons, 2000, 650 p.

de Souza Neto E.A., Perić D, Owen D.R.J. Computational methods for plasticity, John Wiley& Sons, 2008, 791 p.

Kelly P. Solid mechanics lecture notes, http://homepages.engineering.auckland.ac.nz /~pkel015/

Elektronski viri:/Computer programmes:

Komercialni računalniški program z navodili za uporabo./A general purpose finite element computer programme.

Cilji in kompetence:	**Objectives and competences:**
Cilji: • Sistematično in celostno predstaviti osnovne enačbe nelinearne mehanike deformabilnih teles na višjem nivoju. • Predstaviti metode diskretizacije in numeričnega reševanja enačb deformabilnih teles. • Predstaviti komercialen računalniški program za analizo deformabilnih teles.	**Objectives:** • To present concepts, assumptions and mathematical models, and to derive governing equations of non-linear continuum mechanics at the advanced level. • To introduce discretization and solution methods. • To present a commercial computer program for the nonlinear analysis of structures and solids. **Learning outcomes (competences):** • To comprehend well the assumptions of non-linear continuum mechanics and their meaning and applicability in structural and mechanical engineering. • To be able to interpret and analyse both mechanically and mathematically the meaning of variables, equations and their parts, and to know how to set and classify the equations and the initial-boudary value problem. • To get a firm understanding of the discretization process for the solution of differential equations, and to be able to apply some of the numerical and analytical solution techniques to basic continuum mechanics problems. To know how to use a commercial computer programme for the non-linear analysis of structures and solids, to comprehend and analyse the results, and, based upon the results of the programme, to be able to make an engineering judgement for advanced problems.

Predvideni študijski rezultati:	**Intended learning outcomes:**
Znanje in razumevanje: • Razumeti mehanske količine in enačbe, znati osnovne postopke diskretizacije enačb in poznati tehnike numeričnega reševanja. • Znati smiselno uporabljati komercialni računalniški program za nelinearno analizo deformabilnih teles	**Learning outcomes (competences):** • To comprehend well the assumptions of non-linear continuum mechanics and their meaning and applicability in structural and mechanical engineering. • To be able to interpret and analyse both mechanically and mathematically the meaning

in pravilno presojati rezultate tudi za bolj zahtevne probleme.	of variables, equations and their parts, and to know how to set and classify the equations and the initial-boudary value problem. • To get a firm understanding of the discretization process for the solution of differential equations, and to be able to apply some of the numerical and analytical solution techniques to basic continuum mechanics problems. To know how to use a commercial computer programme for the non-linear analysis of structures and solids, to comprehend and analyse the results, and, based upon the results of the programme, to be able to make an engineering judgement for advanced problems.

Metode poučevanja in učenja:	**Learning and teaching methods:**
Predavanja, vaje, domače naloge, priprava poročila, pregled poročila, predstavitev poročila, osebne konsultacije.	Lectures, exercises in computer laboratory, homework assignments, the report preparation, report and assignment reviews, the report presentation, individual consultations.

Načini ocenjevanja:	**Delež/Weight**	**Assessment:**
Domače naloge	50,00 %	Review of reports and homework assignments
Ustni izpit.	50,00 %	oral examination.

Reference nosilca/Lecturer's references:

SRPČIČ, Stane, SRPČIČ, Jelena, **SAJE, Miran**, TURK, Goran. Mechanical analysis of glulam beams exposed to changing humidity. Wood Science and Technology, 2009, vol. 43, No. 1/2, p. 9-22.

FLAJS, Rado, CEN, Song, **SAJE, Miran**. On convergence of nonconforming convex quadrilateral finite elements AGQ6. Computer Methods in Applied Mechanics and Engineering, 2010, vol. 25-28, p. 1816-1827.

KROFLIČ, Aleš, **SAJE, Miran**, PLANINC, Igor. Non-linear analysis of two-layer beams with interlayer slip and uplift. Computers & Structures, 2011, vol. 89, No. 23/24, p. 2414-2424.

MARKOVIČ, Mojca, **SAJE, Miran**, PLANINC, Igor, BRATINA, Sebastjan. On strain softening in finite element analysis of RC planar frames subjected to fire. Engineering structures, 2012, vol. 45, p. 349-361.

HOZJAN, Tomaž, **SAJE, Miran**, SRPČIČ, Stane, PLANINC, Igor. Geometrically and materially non-linear analysis of planar composite structures with an interlayer slip. Computers & Structures, 2013, vol. 114-115, p. 1-17.

KOLŠEK, Jerneja, HOZJAN, Tomaž, KROFLIČ, Aleš, **SAJE, Miran**, PLANINC, Igor. Non-linear analysis of side-plated RC beams considering longitudinal and transversal interlayer slips. Steel and composite structures, 2014, vol. 16, No. 6, p. 559-576.

UČNI NAČRT PREDMETA/COURSE SYLLABUS

Predmet:	Nelinearna mehanika deformabilnih teles
Course title:	Non-linear Continuum Mechanics

Študijski programi in stopnja	Študijska smer	Letnik	Semestri
Grajeno okolje, tretja stopnja, doktorski	Ni členitve (študijski program)		Letni, Zimski

Univerzitetna koda predmeta/University course code: 1511

Predavanja	Seminar	Vaje	Klinične vaje	Druge oblike študija	Samostojno delo	ECTS
90	0	30	0	130	0	10

Nosilec predmeta/Lecturer: Miran Saje

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:
Ni posebnih pogojev.	No special conditions.

Vsebina:

Kinematika. Opis prostora, časa in telesa. Koordinate. Gibanje. Lagrangev in Eulerjev opis. Pomiki, hitrosti in pospeški. Rotacija, kotna hitrost in kotni pospešek.
Deformacije. Deformacijski gradient. Deformacijske mere. Hitrost deformacij. Polarni razcep.
Napetosti. Tenzorji napetosti. Zveze med tenzorji napetosti. Izrek o ohranitve mase. Izreki o gibalni in vrtilni količini ter energiji. Lokalna oblika gibalnih enačb. Hitrosti napetosti.
Objektivnost mehanskih količin.
Šibka oblika gibalnih enačb. Linearizacija. Princip virtualnega dela. Posplošeni princip virtualnega dela. Energijski izreki.
Konstitucijske enačbe. Linearno in nelinearno elastični modeli. Plastični in viskoplastični modeli. Linearizacija in tangentna matrika.
Stabilnost. Definicija in algebrajski pogoji. Strukturna in materialna nestabilnost.
Dinamika. Nihanje in valovanje.
Diskretizacija enačb in reševanje. Metoda končnih elementov. Linearizacija. Newtonova metoda.

Vaje:
Uporaba računalniškega programa za analizo deformabilnih teles.
Za predmet v obsegu 10 KT ostane vsebina enaka, le da je poglavje Konstitucijske enačbe razširjeno z dodatnimi modeli materiala.

Content (Syllabus outline):

Lectures:
Kinematics. Description of space, time and body. Coordinates. Change of position. Motion. Lagrange's and Euler's descriptions of motion. Displacement, velocity and acceleration. Rotation, angular velocity and angular acceleration.
Strains. Deformation gradient. Strain measures. Polar decomposition. Strain rate.
Stresses. Stress tensors. Relations between stress tensors. Conservation of mass. Linear and angular momentum. Laws of linear and angular momenta, and kinetic energy. Local and global forms of the laws. Stress rate.
Objectivity of mechanical variables.
Weak form of equations of motion. Linearization. Principle of virtual work. Generalized principle of virtual work. Energy principles.
Constitutive equations. Linear and non-linear elastic models. Plastic and viscoplastic models. Linearization and tangent material matrix.
Stability. Definitions. Algebraic conditions for stability. Structural and material instability.
Dynamics. Oscillations. Waves in continuum.
Discretization and solution. Finite element method. Interpolation of unknowns. Linearization of discretized equations. Newton's method.

Exercises:

	Examples in non-inear numerical analysis of structures and solids. Application of a commercial computer program. Valid for both 5- and 10-credit courses. Only the chapter on the constitutive equations is further expanded for the 10-credit course.

Temeljna literatura in viri/Readings:

Knjižni viri: (v poštev pridejo deli knjig)/**Books:** (only parts of)

Fung Y.C., Tong P. Classical and computational solid mechanics, World Scientific, 2001, 930 p.

Bonet J., Wood R.D. Nonlinear continuum mechanics for finite element analysis, Cambridge university press, 1997, 248 p.

Belytschko T., Liu W.K., Moran B. Nonlinear finite elements for continua and structures, John Wiley & Sons, 2000, 650 p.

de Souza Neto E.A., Perić D, Owen D.R.J. Computational methods for plasticity, John Wiley& Sons, 2008, 791 p.

Kelly P. Solid mechanics lecture notes, http://homepages.engineering.auckland.ac.nz /~pkel015/

Elektronski viri:/Computer programmes:

Komercialni računalniški program z navodili za uporabo./A general purpose finite element computer programme.

Cilji in kompetence:	**Objectives and competences:**
Cilji: • Sistematično in celostno predstaviti osnovne enačbe nelinearne mehanike deformabilnih teles na višjem nivoju. • Predstaviti metode diskretizacije in numeričnega reševanja enačb deformabilnih teles. • Predstaviti komercialen računalniški program za analizo deformabilnih teles.	**Objectives:** • To present concepts, assumptions and mathematical models, and to derive governing equations of non-linear continuum mechanics at the advanced level. • To introduce discretization and solution methods. • To present a commercial computer program for the nonlinear analysis of structures and solids. **Learning outcomes (competences):** • To comprehend well the assumptions of non-linear continuum mechanics and their meaning and applicability in structural and mechanical engineering. • To be able to interpret and analyse both mechanically and mathematically the meaning of variables, equations and their parts, and to know how to set and classify the equations and the initial-boudary value problem. • To get a firm understanding of the discretization process for the solution of differential equations, and to be able to apply some of the numerical and analytical solution techniques to basic continuum mechanics problems. To know how to use a commercial computer programme for the non-linear analysis of structures and solids, to comprehend and analyse the results, and, based upon the results of the programme, to be able to make an engineering judgement for advanced problems.

Predvideni študijski rezultati:	**Intended learning outcomes:**
Znanje in razumevanje: • Razumeti mehanske količine in enačbe, znati osnovne postopke diskretizacije enačb in poznati tehnike numeričnega reševanja.	**Learning outcomes (competences):** • To comprehend well the assumptions of non-linear continuum mechanics and their meaning and

• Znati smiselno uporabljati komercialni računalniški program za nelinearno analizo deformabilnih teles in pravilno presojati rezultate tudi za bolj zahtevne probleme.	applicability in structural and mechanical engineering. • To be able to interpret and analyse both mechanically and mathematically the meaning of variables, equations and their parts, and to know how to set and classify the equations and the initial-boudary value problem. • To get a firm understanding of the discretization process for the solution of differential equations, and to be able to apply some of the numerical and analytical solution techniques to basic continuum mechanics problems. To know how to use a commercial computer programme for the non-linear analysis of structures and solids, to comprehend and analyse the results, and, based upon the results of the programme, to be able to make an engineering judgement for advanced problems.

Metode poučevanja in učenja:	**Learning and teaching methods:**
Predavanja, vaje, domače naloge, priprava poročila, pregled poročila, predstavitev poročila, osebne konsultacije.	Lectures, exercises in computer laboratory, homework assignments, the report preparation, report and assignment reviews, the report presentation, individual consultations.

Načini ocenjevanja:	**Delež/Weight**	**Assessment:**
Domače naloge	50,00 %	Review of reports and homework assignments
Ustni izpit.	50,00 %	oral examination.

Reference nosilca/Lecturer's references:

SRPČIČ, Stane, SRPČIČ, Jelena, **SAJE, Miran**, TURK, Goran. Mechanical analysis of glulam beams exposed to changing humidity. Wood Science and Technology, 2009, vol. 43, No. 1/2, p. 9-22.

FLAJS, Rado, CEN, Song, **SAJE, Miran**. On convergence of nonconforming convex quadrilateral finite elements AGQ6. Computer Methods in Applied Mechanics and Engineering, 2010, vol. 25-28, p. 1816-1827.

KROFLIČ, Aleš, **SAJE, Miran**, PLANINC, Igor. Non-linear analysis of two-layer beams with interlayer slip and uplift. Computers & Structures, 2011, vol. 89, No. 23/24, p. 2414-2424.

MARKOVIČ, Mojca, **SAJE, Miran**, PLANINC, Igor, BRATINA, Sebastjan. On strain softening in finite element analysis of RC planar frames subjected to fire. Engineering structures, 2012, vol. 45, p. 349-361.

HOZJAN, Tomaž, **SAJE, Miran**, SRPČIČ, Stane, PLANINC, Igor. Geometrically and materially non-linear analysis of planar composite structures with an interlayer slip. Computers & Structures, 2013, vol. 114-115, p. 1-17.

KOLŠEK, Jerneja, HOZJAN, Tomaž, KROFLIČ, Aleš, **SAJE, Miran**, PLANINC, Igor. Non-linear analysis of side-plated RC beams considering longitudinal and transversal interlayer slips. Steel and composite structures, 2014, vol. 16, No. 6, p. 559-576.

UČNI NAČRT PREDMETA/COURSE SYLLABUS

Predmet:	Nelinearna požarna analiza
Course title:	Nonlinear Fire Analyses

Študijski programi in stopnja	Študijska smer	Letnik	Semestri
Grajeno okolje, tretja stopnja, doktorski	Ni členitve (študijski program)		Letni, Zimski

Univerzitetna koda predmeta/University course code: 1106

Predavanja	Seminar	Vaje	Klinične vaje	Druge oblike študija	Samostojno delo	ECTS
30	50	0	0	170	0	10

Nosilec predmeta/Lecturer: Tomaž Hozjan

Vrsta predmeta/Course type: Izbirni predmet/Elective course

Jeziki/Languages:

Predavanja/Lectures:	Slovenščina, Angleščina
Vaje/Tutorial:	Slovenščina, Angleščina

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:	Prerequisites:
Ni posebnih pogojev.	No special prerequisites.

Vsebina:	Content (Syllabus outline):
• Pregled konstrukterskih problemov v požarnem inženirstvu; • Povezani problemi v analizi temperaturnega in vlažnostnega stanja ter pornih tlakov v konstrukcijah, izpostavljenih požaru; • Matematično modeliranje obnašanja gradbenih konstrukcij v požaru, termomehanski in reološki modeli jekla, betona, lesa; • Kritična presoja poenostavljenih računskih metod za analizo požarne odpornosti konstrukcij, ki jih predpisujejo veljavni tehnični predpisi.	• Overview of typical problems in structural fire engineering, • Fire risk, measures of fire safety, fire load, • Coupled problems in the analysis of the temperature and water content as well as pore pressure field in the structure subjected to fire, • Mathematical and numerical modelling of structural behaviour in fire, thermomechanical, and rheological models of wood, concrete and steel, • Objective estimation of simplified calculation methods for fire analysis of structures used in regulations and standards.

Temeljna literatura in viri/Readings:

- Buchanan, A. H. (2005): Structural Design for Fire Safety, John Wiley & Sons,LTD, 415 str.
- Rasbash D. In sodelavci (2004): Evaluation of Fire Safety, John Wiley & Sons, LTD, 479 str.
- Drysdale, D.: An Introduction to Fire Dynamics, Wiley, 2. izdaja (1998)
- The SFPE Handbook - Fire Protection Engineering, 2nd Edition, Boston, Massachusetts, 1995;
- Tekoči znanstveni in strokovni članki.

Cilji in kompetence:	Objectives and competences:
Cilji: • Nadgraditi osnovno konstruktersko znanje z načeli projektiranja požarno varnih zgradb • V povezavi z drugimi naravoslovnimi, temeljnimi mehanskimi in strokovnimi predmeti spoznati in	**Objectives:** • Improvement of basic knowledge considering the principles of fire safety design in civil engineering practice,

razumeti mehanizme delovanja materialov, elementov in konstrukcij pri visokih temperaturah • Vpeljati osnovna načela matematičnega in numeričnega modeliranja povezanih problemov v požarnem inženirstvu • Spoznati in razumeti osnovne zakonitosti nastanka in razvoja požarov v zgradbah in naravnem okolju ter inženirske modele požarne obtežbe • Privzgojiti občutek za pomen aktivnih in pasivnih ukrepov požarne zaščite v luči sociooloških, naselitvenih, ekonomskih in drugih faktorjev • Vpeljati osnovna načela požarno varnega projektiranja lesenih, armiranobetonskih in jeklenih konstrukcij • Navajati kandidate na določitev in predstavitev požarnih problemov, zajem eksperimentalnih podatkov, izbiro metode reševanja ter predstavitev in kritično oceno rezultatov. **Kompetence**: • Poznavanje terminologije, pomena in enot pomembnejših količin v požarnem inženirstvu • Sposobnost ocene požarne ogroženosti objekta ter načrtovanja ukrepov požarne zaščite • Sposobnost izbire primernega modela požarne obtežbe • Sposobnost izbire primernega matematičnih in numeričnih modelov povezanih problemov v požarnem inženirstvu • Sposobnost uporabe numeričnih metod za oceno požarne odpornosti nosilnih konstrukcij • Poznavanje posebnosti različnih gradbenih materialov in elementov pri visokih temperaturah • Sposobnost izdelave požarnega elaborata za zahtevnejše objekte	• Better understanding of interactive behaviour of materials, load bearing elements and structures considering other natural science, basic mechanical and expert branches of instruction, • Introducing basic principles of mathematical and numerical modelling of coupled problems in fire engineering, • Imparting to the candidates the sense for the importance of passive and active measures of fire protection considering sociological, economical and other factors, • Introducing basic principles of fire safety design of wooden, reinforced concrete and steel structures, • Finally, candidates should be capable of determining and presenting fire safety problems, • Provide candidates to determine and present fire problems, acquiring experimental data as well as defining parameters that should be measured during experiments, critical estimation of results. **Competences:** • Knowledge about the terminology and meaning of essential parameters influencing nonlinear behaviour of load bearing structures in fire, • Capability of estimation of the fire risk of the building and planning the measures of fire safety, • Capability of choosing proper model of fire load, • Capability of choosing proper mathematical and numerical models for coupled problems in fire engineering, • Using suitable numerical methods for determining the fire resistance of load bearing structures, • Knowledge of the specific characteristics of various building materials and elements at high temperatures • Capability of preparing the fire safety report of a more complex building.

Predvideni študijski rezultati:	**Intended learning outcomes:**
Znanje in razumevanje: • Globlje razumevanje pomena požarnega inženirstva. • Razumevanje fizikalnih osnov nastanka in razvoja požara ter vpliva visokih temperatur na materiale in konstrukcije. • Znanje metod in ukrepov aktivne in pasivne požarne zaščite. • Znanje osnovnih in naprednih metod za računsko oceno požarne odpornosti konstrukcij.	Knowledge and understanding: • In-depth understanding of the importance of fire safety engineering. • Understanding the physical basis of the growth and evolution of fire and impact of high temperatures on materials and structures. • Knowledge of methods and measures of active and passive fire protection. • Knowledge of basic and advanced methods for computing assessment of fire resistance of structures.

Metode poučevanja in učenja:	**Learning and teaching methods:**
Predavanja ter izdelava individualne seminarske naloge	Lectures and individual seminar work.

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

Zagovor seminarske naloge ter pisni in/ali ustni izpit, ki obsega vsebino predavanj ter študijskih virov.	100,00 %	Individual seminar work, its explanation and writing and/or oral examination of the lectures and basic literature.

Reference nosilca/Lecturer's references:

1. **HOZJAN, Tomaž**, PLANINC, Igor, SAJE, Miran, SRPČIČ, Stane. Buckling of an axially restrained steel column under fire loading. International journal of structural stability and dynamics, 2011, letn. 11, št. 3, str. 451-472.
2. **HOZJAN, Tomaž**, SVENSSON, Staffan. Theoretical analysis of moisture transport in wood as an open porous hygroscopic material. Holzforschung, 2011, letn. 65, št. 1, str. 97-10
3. **HOZJAN, Tomaž**, SAJE, Miran, SRPČIČ, Stane, PLANINC, Igor. Fire analysis of steel-concrete composite beam with interlayer slip. Computers & Structures, 2011, letn. 89, št. 1-2, str. 189-200.
4. SVENSSON, Staffan, TURK, Goran, **HOZJAN, Tomaž**. Predicting moisture state of timber members in a continuously varying climate. Engineering structures, ISSN 0141-0296. [Print ed.], 2011, letn. 33, št. 11, str. 3064-3070.
5. **HOZJAN, Tomaž**, SAJE, Miran, SRPČIČ, Stane, PLANINC, Igor. Geometrically and materially non-linear analysis of planar composite structures with an interlayer slip. Computers & Structures, 2013, letn. 114-115 , str. 1-17.
6. KOLŠEK, Jerneja, PLANINC, Igor, SAJE, Miran, **HOZJAN, Tomaž**. The fire analysis of a steel-concrete side-plated beam. Finite elements in analysis and design, 2013, letn. 74, str. 93-110.

UČNI NAČRT PREDMETA/COURSE SYLLABUS

Predmet:	Novi materiali
Course title:	New Materials

Študijski programi in stopnja	Študijska smer	Letnik	Semestri
Grajeno okolje, tretja stopnja, doktorski	Ni členitve (študijski program)		Letni, Zimski

Univerzitetna koda predmeta/University course code: 1107

Predavanja	Seminar	Vaje	Klinične vaje	Druge oblike študija	Samostojno delo	ECTS
20	0	20	0	0	85	5

Nosilec predmeta/Lecturer: Zvonko Jagličić

Vrsta predmeta/Course type: Izbirni predmet/Elective course

Jeziki/Languages:

Predavanja/Lectures:	Slovenščina, Angleščina
Vaje/Tutorial:	Slovenščina, Angleščina

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:	Prerequisites:
Ni posebnih pogojev.	No prerequisits.

Vsebina:	Content (Syllabus outline):
Uvod v materiale (Zgodovinski pregled in razvrstitev materialov. Konvencionalni materiali. Napredni materiali.) **Kristalne strukture** (Osnovne celice. Millerjevi indeksi.) **Kristalne napake** (Točkaste napake. Linijske napake (dislokacije). Meje med zrni. Praznine v kristalu.) **Difuzija** (Mikroskopska slika difuzije. Makroskopska slika difuzije.) **Mehanske lastnosti snovi** (Napetost in raztezek. Elastična deformacija. Plastična deformacija. Zdrs. Dislokacije in utrujanje materiala.) **Odpoved materiala** (Žilavi lom. Krhki lom. Ciklično utrujanje. Lezenje.) **Fazni diagrami** (Ravnovesja med fazami. Fe-C fazni diagram.) **Uporaba in obdelava materialov** (Kovine. Keramike. Polimeri. Kompozitni materiali)	**Introduction to materials**: Overview of history and classification of materials. Conventional materials. Advanced materials. **Crystal structures**: Basic cells. Miller indexes. **Crystal defects**: Point defects. Linear defects (dislocations). Grain boundaries. Voids in crystal. **Mechanical properties of matter**. Stress and expansion. Elastic deformation. Plastic deformation. Sliding. Dislocation and fatigue of material. **Failure of material**: Brittle fracture. Ductile fracture. Cyclic fatigue. Anelasticity. **Phase diagrams**: Phase equilibria. Fe-C phase diagram. **Use and treatment of materials**: Metals. Ceramics. Polymers. Composites.

Temeljna literatura in viri/Readings:

M. F. Ashby, D. R. H. Jones, Engineering Materials, Parts 1 and 2, Pergamon, 1980.
J. F. Shackelford, Introduction to Materials Science for Engineers, Macmillian Publishing Company, 2992
W. D. Callister, Materials Science and Engineering, Wiley, 2003.
Periodične publikacije; npr. Nature Materials, Journal of Materials in Civil Engineering.

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

Cilj predmeta je seznaniti študente s celostno problematiko vpliva strukture materialov na njihove gradbeno-fizikalne lastnosti, predvsem na področju prevajanja toplote in optičnih lastnosti.	Students will get acquainted with integral problematic of influence of material structure on their properties in the field of building physics, especially of heat distribution and optical properties.

Predvideni študijski rezultati:	**Intended learning outcomes:**
Znanje in razumevanje: Študentje bodo osvojili osnovne analitične, numerične in eksperimentalne metode reševanja problemov povezanih z vplivom temperaturnih sprememb in pridobili osnovno znanje za samostojno raziskovalno in praktično delo na tem področju.	Knowledge and understanding: Student will absolve basic analytical, numerical and experimental methods for solving of tasks related to influence of temperature changes and acquire basic knowledge for autonomous research and practical work in the field.

Metode poučevanja in učenja:	**Learning and teaching methods:**
Predavanja, seminarji, individualne konzultacije in delo v laboratoriju.	Lectures, seminar work, individual consultations .

Načini ocenjevanja:	**Delež/Weight**	**Assessment:**
Zagovor seminarske naloge, priprava članka za objavo.	100,00 %	Defending of seminar work by presenting portfolio, preparing an article for publication.

Reference nosilca/Lecturer's references:

1. KOŽELJ, Primož, VRTNIK, Stanislav, JELEN, Andreja, JAZBEC, Simon, JAGLIČIĆ, Zvonko, MAITI, S., FEUERBACHER, Michael, STEURER, Walter, DOLINŠEK, Janez. Discovery of a superconducting high-entropy alloy. Physical review letters, 2014, **113**, no. 10, str. 107001-1-107001-5, doi: 10.1103/PhysRevLett.113.10700
2. JAGLIČIĆ, Zvonko, PAJIĆ, Damir, TRONTELJ, Zvonko, DOLINŠEK, Janez, JAGODIČ, Marko. Magnetic memory effect in multiferroic KFe5F15 and K3Cr2Fe3F15. Applied physics letters, 2013, **102**, no. 24, str. 242410-1-242410-4, doi: 10.1063/1.481176
3. COTIČ, Patricia, JAGLIČIĆ, Zvonko, NIEDERLEITHINGER, Ernst, EFFNER, Ute, KRUSCHWITZ, Sabine, TRELA, Christiane, BOSILJKOV, Vlatko. Effect of moisture on the reliability of void detection in brickwork masonry using radar, ultrasonic and complex resistivity tomography. Materials and structures, ISSN 1359-5997, 2013, **46**, št. 10, str. 1723-1735, doi: 10.1617/s11527-012-0011-
4. JAGLIČIĆ, Zvonko, ZENTKOVÁ, Mária, MIHALIK, Marián, ARNOLD, Zdeněk, DROFENIK, Mihael, KRISTL, Matjaž, DOJER, Brina, KASUNIČ, Marta, GOLOBIČ, Amalija, JAGODIČ, Marko. Exchange bias in bulk layered hydroxylammonium fluorocobaltate (NH3OH)2CoF4. Journal of physics, Condensed matter, 2012, **24**, no. 5, 056002 (7 str.). http://dx.doi.org/10.1088/0953-8984/24/5/056002,
5. JAGLIČIĆ, Zvonko, VRTNIK, Stanislav, FEUERBACHER, Michael, DOLINŠEK, Janez. Magnetic properties of FeAl2 and Fe2Al5. Physical review. B, Condensed matter and materials physics, 2011, **83**, no. 22, str. 224427-1-224427-13, doi: 10.1103/PhysRevB.83.224427.
6. JAGLIČIĆ, Zvonko, JAGODIČ, Marko, GRUSHKO, Benjamin, ZIJLSTRA, E. S., WEBER, Th., STEURER, Walter, DOLINŠEK, Janez. The effect of thermal treatment on the magnetic state and cluster-related disorder of icosahedral Al-Pd-Mn quasicrystals. Intermetallics, 2010, **18**, no. 4, str. 623-632, doi: 10.1016/j.intermet.2009.10.017.
7. PREGELJ, Matej, ZAHARKO, Oksana, ZORKO, Andrej, KUTNJAK, Zdravko, JEGLIČ, Peter, BROWN, P. J., JAGODIČ, Marko, JAGLIČIĆ, Zvonko (pisar), BERGER, Helmuth, ARČON, Denis. Spin amplitude modulation driven magnetoelectric coupling in the new multiferroic FeTe2O5Br. Physical review letters, 2009, **103**, no. 14, str. 147202-1-147202-4.

UČNI NAČRT PREDMETA/COURSE SYLLABUS

Predmet:	Novi materiali
Course title:	New Materials

Študijski programi in stopnja	Študijska smer	Letnik	Semestri
Grajeno okolje, tretja stopnja, doktorski	Ni členitve (študijski program)		Letni, Zimski

Univerzitetna koda predmeta/University course code: 1512

Predavanja	Seminar	Vaje	Klinične vaje	Druge oblike študija	Samostojno delo	ECTS
40	0	40	0	0	170	10

Nosilec predmeta/Lecturer: Zvonko Jagličić

Vrsta predmeta/Course type: Izbirni predmet/Elective course

Jeziki/Languages:

Predavanja/Lectures:	Slovenščina, Angleščina
Vaje/Tutorial:	Slovenščina, Angleščina

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:	Prerequisites:
Ni posebnih pogojev.	No prerequisits.

Vsebina:	Content (Syllabus outline):
Uvod v materiale (Zgodovinski pregled in razvrstitev materialov. Konvencionalni materiali. Napredni materiali.) **Kristalne strukture** (Osnovne celice. Millerjevi indeksi.) **Kristalne napake** (Točkaste napake. Linijske napake (dislokacije). Meje med zrni. Praznine v kristalu.) **Difuzija** (Mikroskopska slika difuzije. Makroskopska slika difuzije.) **Mehanske lastnosti snovi** (Napetost in raztezek. Elastična deformacija. Plastična deformacija. Zdrs. Dislokacije in utrujanje materiala.) **Odpoved materiala** (Žilavi lom. Krhki lom. Ciklično utrujanje. Lezenje.) **Fazni diagrami** (Ravnovesja med fazami. Fe-C fazni diagram.) **Uporaba in obdelava materialov** (Kovine. Keramike. Polimeri. Kompozitni materiali) V daljšem kurzu (**10 KT**) so dodatna poglavja: **Nanodelci** (Vpliv dodajanja nanodelcev na lastnosti klasičnih materialov. Uporaba nanodelcev pri preizkušanju materialov in obstoječih zgradb.) **Optična vlakna** **Novi materiali in ekologija** (Vpliv nanodelcev na okolje, organski materiali) **Delo v laboratoriju** (Meritve fizikalnih lastnosti novih materialov. Obdelava in analiza rezultatov.) **Izbrana poglavja**, ki se nanašajo na doktorsko nalogo študenta.	**Introduction to materials**: Overview of history and classification of materials. Conventional materials. Advanced materials. **Crystal structures**: Basic cells. Miller indexes. **Crystal defects**: Point defects. Linear defects (dislocations). Grain boundaries. Voids in crystal. **Mechanical properties of matter**. Stress and expansion. Elastic deformation. Plastic deformation. Sliding. Dislocation and fatigue of material. **Failure of material**: Brittle fracture. Ductile fracture. Cyclic fatigue. Anelasticity. **Phase diagrams**: Phase equilibria. Fe-C phase diagram. **Use and treatment of materials**: Metals. Ceramics. Polymers. Composites. For **10 ETCS**: **Nanoparticles** (An influence of nanoparticle doping on the material's physical properties. Application of nanoparticles for non-destructive testing of materials and buildings.) **Optical fibers** **New materials and ecology** (An influence of nanomaterials and other new materials on environment.) **Laboratory work** (Measurements of physical properties of some new materials. Data processing and interpretation of results.)

	Chosen chapters related to PhD thesis of the candidate.

Temeljna literatura in viri/Readings:

M. F. Ashby, D. R. H. Jones, Engineering Materials, Parts 1 and 2, Pergamon, 1980.
J. F. Shackelford, Introduction to Materials Science for Engineers, Macmillian Publishing Company, 2992
W. D. Callister, Materials Science and Engineering, Wiley, 2003.
Periodične publikacije; npr. Nature Materials, Journal of Materials in Civil Engineering.

Cilji in kompetence:	**Objectives and competences:**
Cilj predmeta je seznaniti študente s celostno problematiko vpliva strukture materialov na njihove gradbeno-fizikalne lastnosti, predvsem na področju prevajanja toplote in optičnih lastnosti.	Students will get acquainted with integral problematic of influence of material structure on their properties in the field of building physics, especially of heat distribution and optical properties.

Predvideni študijski rezultati:	**Intended learning outcomes:**
Znanje in razumevanje: Študentje bodo osvojili osnovne analitične, numerične in eksperimentalne metode reševanja problemov povezanih z vplivom temperaturnih sprememb in pridobili osnovno znanje za samostojno raziskovalno in praktično delo na tem področju.	Knowledge and understanding: Student will absolve basic analytical, numerical and experimental methods for solving of tasks related to influence of temperature changes and acquire basic knowledge for autonomous research and practical work in the field.

Metode poučevanja in učenja:	**Learning and teaching methods:**
Predavanja, seminarji, individualne konzultacije in delo v laboratoriju.	Lectures, seminar work, individual consultations and (if 10 ETCS) experimental work in laboratory for physical properties measurements.

Načini ocenjevanja:	**Delež/Weight**	**Assessment:**
Zagovor seminarske naloge, predstavitev rezultatov laboratorijskega dela (če 10 KT), priprava članka za objavo.	100,00 %	Defending of seminar work by presenting portfolio, preparing an article for publication.

Reference nosilca/Lecturer's references:

1. KOŽELJ, Primož, VRTNIK, Stanislav, JELEN, Andreja, JAZBEC, Simon, JAGLIČIĆ, Zvonko, MAITI, S., FEUERBACHER, Michael, STEURER, Walter, DOLINŠEK, Janez. Discovery of a superconducting high-entropy alloy. Physical review letters, 2014, **113**, no. 10, str. 107001-1-107001-5, doi: 10.1103/PhysRevLett.113.10700
2. JAGLIČIĆ, Zvonko, PAJIĆ, Damir, TRONTELJ, Zvonko, DOLINŠEK, Janez, JAGODIČ, Marko. Magnetic memory effect in multiferroic KFe5F15 and K3Cr2Fe3F15. Applied physics letters, 2013, **102**, no. 24, str. 242410-1-242410-4, doi: 10.1063/1.481176
3. COTIČ, Patricia, JAGLIČIĆ, Zvonko, NIEDERLEITHINGER, Ernst, EFFNER, Ute, KRUSCHWITZ, Sabine, TRELA, Christiane, BOSILJKOV, Vlatko. Effect of moisture on the reliability of void detection in brickwork masonry using radar, ultrasonic and complex resistivity tomography. Materials and structures, ISSN 1359-5997, 2013, **46**, št. 10, str. 1723-1735, doi: 10.1617/s11527-012-0011-
4. JAGLIČIĆ, Zvonko, ZENTKOVÁ, Mária, MIHALIK, Marián, ARNOLD, Zdeněk, DROFENIK, Mihael, KRISTL, Matjaž, DOJER, Brina, KASUNIČ, Marta, GOLOBIČ, Amalija, JAGODIČ, Marko. Exchange bias in bulk layered hydroxylammonium fluorocobaltate (NH3OH)2CoF4. Journal of physics, Condensed matter, 2012, **24**, no. 5, 056002 (7 str.). http://dx.doi.org/10.1088/0953-8984/24/5/056002,
5. JAGLIČIĆ, Zvonko, VRTNIK, Stanislav, FEUERBACHER, Michael, DOLINŠEK, Janez. Magnetic properties of FeAl2 and Fe2Al5. Physical review. B, Condensed matter and materials physics, 2011, **83**, no. 22, str. 224427-1-224427-13, doi: 10.1103/PhysRevB.83.224427.
6. JAGLIČIĆ, Zvonko, JAGODIČ, Marko, GRUSHKO, Benjamin, ZIJLSTRA, E. S., WEBER, Th., STEURER, Walter, DOLINŠEK, Janez. The effect of thermal treatment on the magnetic state and cluster-related disorder of icosahedral Al-Pd-Mn quasicrystals. Intermetallics, 2010, **18**, no. 4, str. 623-632, doi: 10.1016/j.intermet.2009.10.017.

7. PREGELJ, Matej, ZAHARKO, Oksana, ZORKO, Andrej, KUTNJAK, Zdravko, JEGLIČ, Peter, BROWN, P. J., JAGODIČ, Marko, JAGLIČIĆ, Zvonko (pisar), BERGER, Helmuth, ARČON, Denis. Spin amplitude modulation driven magnetoelectric coupling in the new multiferroic FeTe2O5Br. Physical review letters, 2009, **103**, no. 14, str. 147202-1-147202-4.

UČNI NAČRT PREDMETA/COURSE SYLLABUS

Predmet:	Numerične metode v mehaniki konstrukcij
Course title:	Numerical Methods in Structural Mechanics

Študijski programi in stopnja	Študijska smer	Letnik	Semestri
Grajeno okolje, tretja stopnja, doktorski	Ni členitve (študijski program)		Letni, Zimski

Univerzitetna koda predmeta/University course code: 1110

Predavanja	Seminar	Vaje	Klinične vaje	Druge oblike študija	Samostojno delo	ECTS
35	0	5	0	0	85	5

Nosilec predmeta/Lecturer: Dejan Zupan

Vrsta predmeta/Course type: Izbirni predmet/Elective course

Jeziki/Languages:

Predavanja/Lectures:	Slovenščina, Angleščina
Vaje/Tutorial:	Slovenščina, Angleščina

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:	Prerequisites:
Ni posebnih pogojev.	No prerequisits.

Vsebina:	Content (Syllabus outline):
Diskretizacija enačb. Izbira diskretizacijskih točk. Linijska, ploskovna in prostorska vozlišča. Enakomerna in neenakomerna izbira vozlišč. Razlogi za neenakomerno razporeditev vozlišč. *Interpolacija.* Intepolacija krivulje. Polinomska interpolacija, interpolacija z valjčki, interpolacija s kubičnimi zlepki. Ploskovna interpolacija. Interpolacija po trikotniku in pravokotniku. Lastnosti interpolacijskih funkcij. Natančnost interpolacije. *Numerična integracija.* Enodimenzionalna integracija. Gaussova in Lobattova kvadraturna pravila. Integrali z utežjo. Večdimenzionalna integracija. Produktne in neproduktne formule. Napaka numerične integracije. Razlogi za reducirano integracijo. Integriranje napetosti po prečnem prerezu. *Reševanje sistemov algebrajskih enačb.* Iteracijske metode. Newtonova metoda. Gradientne metode. Konvergenca. Iteracijske metode na nelinearnih konfiguracijskih prostorih. Iteracijske metode pri reševanju enačb prostorskih nosilcev. *Reševanje sistemov diferencialnih enačb.* Preproste metode. Metodi 'mid-point' in Newmark. Metode družine Runge-Kutta. Lokalna in globalna napaka. Uporaba teh metod pri dinamiki ravninskih linijskih nosilcev.	*Discretization.* Discretization points (nodes). Line, surface and volume discretization. Equidistant and irregular choice of nodes. *Interpolation.* One-dimensional interpolation: Polynoms, wavelets, splines. Two-dimensional interpolation. Triangle and rectangle- based interpolation. Properties of interpolation functions. Approximation of functions. *Numerical integration.* Integral of a function. Gauss and Lobatto quadrature. Integrals with weights. Double and triple integrals, area integrals. Error of numerical integration. Reasons for reduced integration. Integration of stresses over arbitrary cross- section. *Systems of algebraic equations.* Iteration methods. Newton method. Gradient methods. Convergence. Iterative methods on non-linear configuration spaces. Iterative methods for solving spatial beam equations. *Systems of ordinary differential equations.* Simple methods. Mid-point and Newmark algorithm. Runge-Kutta methods. Local and global error estimation. Solving dynamics of planar frame structures. *Partial differential equations.* Finite differences and the error estimation. Finite element method. Accuracy of finite-element methods. Evaluation of the tensional

Parcialne diferencialne enačbe. Diferenčna metoda. Ocena napake diferenčne metode. Metoda končnih elementov. Natančnost metode končnih elementov. Račun torzijskega vztrajnostnega momenta. Prenos toplote po prerezu nosilca. *Računalniški programi.* Avtorski programi in komercialni programi z vgrajenimi obravnavanimi algoritmi. Opis programov. Primerjava programov. Učinkovitost algoritmov. Parametrične študije.	moment of inertia of cross-section. Heat transfer over cross-section. *Computer programs*. Research and commercial programs employing the above algorithms. Basic description of programs. Comparisons. Efficiencies. Parametric studies.

Temeljna literatura in viri/Readings:

W.H. Press, S.A. Teukolsky, W.T. Vetterling, B. P. Flannery, Numerical Recipes in C. The Art of Scientific Computing, Cambridge University Press, 1992.
O.C. Zienkiewicz, R.L. Taylor, The Finite Element Method, Butterworth Heineman, Oxford, 2000.
The MathWorks, MATLAB, The Language of Technical Computing, Natick, 2006
Web pages at the Chair of Mechanics: http://www.km.fgg.uni-lj.si

Cilji in kompetence:	**Objectives and competences:**
- Natančno predstaviti uveljavljene numerične metode, ki se uporabljajo v računski analizi konstrukcij. - Predstaviti poglavitnejše sodobne pristope, metode in trende v numerični analizi konstrukcij. - Seznanitev s problematiko numeričnega reševanja, natančnostjo, občutljivostjo, konvergenco... - Predstavitev avtorskih in komercialnih računalniških programov.	- To introduce the numerical methods that are used in computational analysis of structures. - To demonstrate significant modern approaches, methods, and trends in numerical analysis of structure. - To learn the problems in finding numerical solutions, accuracy, sensitivity, stability, convergence... - Demonstration of open-source research computer programs and commercial computer programs.

Predvideni študijski rezultati:	**Intended learning outcomes:**
Znanje in razumevanje: - Razumeti vpliv izbire numerične metode pri reševanju problemov. - Dobro poznavanje osnovnih numeričnih postopkov in poznavanje zahtevnejših. - Vpogled v ozadje komercialnih programov za analizo konstrukcij. - Sposobnost uporabe sodobnih numeričnih metod pri analizi konstrukcij.	Knowledge and understanding: - Comprehension of the influence of the choice of numerical methods on the overall numerical solving of problems. - Knowledge of the basic numerical approaches and the ability to use more demanding and sophisticated methods. - Ability to understand the backgrounds of the commercial computer programs. - Ability to employ modern-type numerical methods in analysis of structures.

Metode poučevanja in učenja:	**Learning and teaching methods:**
Predavanja, vaje z računalnikom, seminar, konsultacije.	Lectures, computer based learning and individual seminar work.

Načini ocenjevanja:	**Delež/Weight**	**Assessment:**
Izdelava seminarske naloge	70,00 %	Individual seminar work
Uspešna branitev naloge	30,00 %	Its explanation and oral examination

Reference nosilca/Lecturer's references:

ČEŠAREK, Peter, SAJE, Miran, **ZUPAN, Dejan**. Kinematically exact curved and twisted strain-based beam. International journal of solids and structures, 2012, vol. 49, no. 13, p. 1802-1817.

ZUPAN, Eva, SAJE, Miran, **ZUPAN, Dejan**. Quaternion-based dynamics of geometrically nonlinear spatial beams using the Runge-Kutta method. Finite elements in analysis and design, 2012, vol. 54, p. 48-60.

ZUPAN, Eva, SAJE, Miran, **ZUPAN, Dejan**. Dynamics of spatial beams in quaternion description based on the Newmark integration scheme. Computational mechanics, 2013, vol. 51, no. 1, p. 47-64.

UČNI NAČRT PREDMETA/COURSE SYLLABUS

Predmet:	Numerične metode v raziskovanju grajenega okolja
Course title:	Numerical Methods in the Built Environment Research

Študijski programi in stopnja	Študijska smer	Letnik	Semestri
Grajeno okolje, tretja stopnja, doktorski	Ni členitve (študijski program)		Letni, Zimski

Univerzitetna koda predmeta/University course code: 1715

Predavanja	Seminar	Vaje	Klinične vaje	Druge oblike študija	Samostojno delo	ECTS
30	0	0	10	85	0	5

Nosilec predmeta/Lecturer: Gašper Jaklič

Vrsta predmeta/Course type: Izbirni predmet/Elective course

Jeziki/Languages:

Predavanja/Lectures:	Angleščina, Slovenščina
Vaje/Tutorial:	Angleščina, Slovenščina

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:	Prerequisites:
Opravljen izpit iz obveznega predmeta ORODJA IN METODE V RAZISKOVANJU GRAJENEGA OKOLJA ali osvojena primerljiva matematična znanja.	The module MATHEMATICS IN BUILT ENVIRONMENT RESEARCH of the course TOOLS AND METHODS IN BUILT ENVIRONMENT RESEARCH or competence in comparable mathematical knowledge.

Vsebina:	Content (Syllabus outline):
Uvodni del: aritmetika v premični piki, izvori napak, občutljivost problemov, konvergenca metod in stabilnost računskih procesov, programska oprema za numerično računanje Numerično reševanje nelinearnih enačb, sistemov linearnih in nelinearnih enačb. Iterativne metode (območja privlaka, osnove kaosa, logistična krivulja). Reševanje predoločenih sistemov. Numerično računanje lastnih vrednosti. Aproksimacija in interpolacija, numerično integriranje: aproksimacija s polinomi, Lagrangeova in Newtonova interpolacija, zlepki, Bézierove krivulje. Newton–Cotesova kvadraturna pravila, Rombergova ekstrapolacija, metoda Monte-Carlo. Numerične metode za reševanje navadnih diferencialnih enačb, privlačni cikli, stabilnost	Introduction: floating point arithmetics, sources of error, stability, convergence and stability of processes, software for numerical computation Numerical solution of nonlinear equations, systems of linear and nonlinear equations. Iterative methods (basin of attraction, basics of chaos theory, logistic curve) Predetermined systems. Numerical computation of eigenvalues. Approximation and interpolation, numerical integration: polynomial approximation, Lagrange and Newton interpolation, splines, Bézier curves. Newton-Cotes quadrature rules, Romberg extrapolation, Monte-Carlo method. Numerical methods for solving ordinary differential equations, cycles, stability

Temeljna literatura in viri/Readings:

- Z. Bohte, Numerične metode, DMFA, Ljubljana, 1991.
- B. N. Datta: Numerical Linear Algebra and Applications, Brooks/Cole, Pacific Grove, 1995.
- C. F. Gerald, P. O. Wheatley, *Applied Numerical Analysis*, Addison-Wesley Publishing Company, 1993.
- M. W. Hirsh, S. Smale, R. L. Devaney, *Differential Equations, Dynamical Systems, and an Introduction to Chaos*, Academic Press, 2004.
- D. Kincaid, W. Cheney, Numerical Analysis, Brooks/Cole, Pacific Grove, 1996.

J. Kozak: Numerična analiza, DMFA - založništvo, Ljubljana 2008.
- Y. Pinchover, J. Rubinstein, *An Introduction to Partial Differential Equations*, Cambridge University Press, 2005.
- S. H. Strogatz, *Nonlinear Dynamics and Chaos with applications to Physics, Biology, Chemistry, and Engineering*, Perseus Books Publishing, 1994.

Electronic sources:
Webpage http://ucilnica.fgg.uni-lj.si

Cilji in kompetence:	**Objectives and competences:**
Cilji: • pridobiti znanja iz numeričnih metod, ki so osnovno orodje za znanstveno raziskovalno delo v inženirstvu, • podrobneje se seznaniti s programskimi orodji za numerično računanje • spoznati osnovne pristope za reševanje problemov matematičnega modeliranja. **Pridobljene kompetence:** Za 5KT: • sposobnost uporabe različnih numeričnih metod za reševanje konkretnih problemov, • zmožnost razločevanja med računsko obvladljivimi in neobvladljivimi problemi, • spretnost uporabe računalnika, posebej paketa Mathematica, • razumevanje teorije na podlagi izkušenj praktičnega dela (programiranja). • sposobnost kritične presoje in predstavitve svojih rezultatov.	**Goals:** • acquire knowledge about numerical methods, the basic tool in engineering research, • become thoroughly acquainted with programming tools for numerical computation • get cognizant of fundamental approaches in mathematical modeling. **Competences:** For 5 ECTS: • ability to use various numerical methods for solving real life problems, • awareness of the problem of the chaotic behaviour of nonlinear systems, • proficiency in using computer software, in particular the CAS Mathematica, • understanding theory on basis of practical experiences (programming), • skillfulness in presentation techniques and ability of critical judgement.

Predvideni študijski rezultati:	**Intended learning outcomes:**
Znanje in razumevanje: Pridobiti znanja iz numeričnih metod, ki so osnovno orodje za znanstveno raziskovalno delo v inženirstvu, sposobnost implementacije numeričnih metod v programskem paketu Mathematica/Matlab.	Knowledge and understanding: Acquire knowledge about numerical methods, the basic tool in engineering research. Ability of implementing numerical methods with the CAS Mathematica/Matlab.

Metode poučevanja in učenja:	**Learning and teaching methods:**
Predavanja, vaje, domače naloge, seminarske naloge, študij literature, konzultacije.	Lectures, practice sessions, homework, projects, readings, consultations.

Načini ocenjevanja:	**Delež/Weight**	**Assessment:**
Domače naloge	20,00 %	Homework assignments
Projektne naloge	30,00 %	Projects
Ustni zagovor	50,00 %	Oral exam

Reference nosilca/Lecturer's references:

1. G. Jaklič, J. Kozak, M. Krajnc, V. Vitrih, E. Žagar, High-order parametric polynomial approximation of conic sections, Constructive Approximation, Volume 38, Issue 1 (2013), 1–18.
2. G. Jaklič, J. Kozak, M. Krajnc, V. Vitrih, E. Žagar, Hermite geometric interpolation by rational Bezier spatial curves, SIAM Journal on Numerical Analysis, Vol. 50, No. 5, 2012, pp. 2695–2715.
3. G. Jaklič, E. Žagar, Planar cubic G1 interpolatory splines with small strain energy, Journal of Computational and Applied Mathematics, 235 (2011), 2758–2765.

UČNI NAČRT PREDMETA/COURSE SYLLABUS

Predmet:	Numerične metode v raziskovanju grajenega okolja
Course title:	Numerical Methods in the Built Environment Research

Študijski programi in stopnja	Študijska smer	Letnik	Semestri
Grajeno okolje, tretja stopnja, doktorski	Ni členitve (študijski program)		Letni, Zimski

Univerzitetna koda predmeta/University course code: 1714

Predavanja	Seminar	Vaje	Klinične vaje	Druge oblike študija	Samostojno delo	ECTS
60	0	0	20	170	0	10

Nosilec predmeta/Lecturer: Gašper Jaklič

Vrsta predmeta/Course type: Izbirni predmet/Elective course

Jeziki/Languages:

Predavanja/Lectures:	Angleščina, Slovenščina
Vaje/Tutorial:	Angleščina, Slovenščina

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:	Prerequisites:
Opravljen izpit iz obveznega predmeta ORODJA IN METODE V RAZISKOVANJU GRAJENEGA OKOLJA ali osvojena primerljiva matematična znanja.	The module MATHEMATICS IN BUILT ENVIRONMENT RESEARCH of the course TOOLS AND METHODS IN BUILT ENVIRONMENT RESEARCH or competence in comparable mathematical knowledge.

Vsebina:	Content (Syllabus outline):
Uvodni del: aritmetika v premični piki, izvori napak, občutljivost problemov, konvergenca metod in stabilnost računskih procesov, programska oprema za numerično računanje Numerično reševanje nelinearnih enačb, sistemov linearnih in nelinearnih enačb. Iterativne metode (območja privlaka, osnove kaosa, logistična krivulja). Reševanje predoločenih sistemov. Numerično računanje lastnih vrednosti. Aproksimacija in interpolacija, numerično integriranje: aproksimacija s polinomi, Lagrangeova in Newtonova interpolacija, zlepki, Bézierove krivulje. Newton–Cotesova kvadraturna pravila, Rombergova ekstrapolacija, metoda Monte-Carlo. Numerične metode za reševanje navadnih diferencialnih enačb, privlačni cikli, stabilnost. Dodatna vsebina za 10 KT: Parcialne diferencialne enačbe: enačbe matematične fizike 1. in 2. reda, klasifikacija parcialnih diferencialnih enačb 2. reda, sistemi kvazilinearnih enačb 1. reda, začetni in robni problemi, obstoj in stabilnost rešitve, metode analitičnega reševanja, linearni diferencialni operatorji. Numerično reševanje: končne diference, končni elementi.	Introduction: floating point arithmetics, sources of error, stability, convergence and stability of processes, software for numerical computation Numerical solution of nonlinear equations, systems of linear and nonlinear equations. Iterative methods (basin of attraction, basics of chaos theory, logistic curve) Predetermined systems. Numerical computation of eigenvalues. Approximation and interpolation, numerical integration: polynomial approximation, Lagrange and Newton interpolation, splines, Bézier curves. Newton-Cotes quadrature rules, Romberg extrapolation, Monte-Carlo method. Numerical methods for solving ordinary differential equations, cycles, stability. Extra content for 10 credits: partial differential equations: equations of mathematical physics, classification of second order PDE, first order systems of quasilinear PDE, initial and boundary value problems, existence and stability of solutions, analytic methods, linear differential operators, basics of the theory of distributions, finite differences, finite elements. Chaos theory: bifurcation, Poincaré map, dependency on initial conditions, attractors, fractals.

Teorija kaosa: bifurkacije, Poincaréjeve preslikave, odvisnost od začetnih pogojev, atraktorji, fraktali	

Temeljna literatura in viri/Readings:

- Z. Bohte, Numerične metode, DMFA, Ljubljana, 1991.
- B. N. Datta: Numerical Linear Algebra and Applications, Brooks/Cole, Pacific Grove, 1995.
- C. F. Gerald, P. O. Wheatley, *Applied Numerical Analysis*, Addison-Wesley Publishing Company, 1993.
- M. W. Hirsh, S. Smale, R. L. Devaney, *Differential Equations, Dynamical Systems, and an Introduction to Chaos*, Academic Press, 2004.
- D. Kincaid, W. Cheney, Numerical Analysis, Brooks/Cole, Pacific Grove, 1996.

J. Kozak: Numerična analiza, DMFA - založništvo, Ljubljana 2008.

- Y. Pinchover, J. Rubinstein, *An Introduction to Partial Differential Equations*, Cambridge University Press, 2005.
- S. H. Strogatz, *Nonlinear Dynamics and Chaos with applications to Physics, Biology, Chemistry, and Engineering*, Perseus Books Publishing, 1994.

Electronic sources:
Webpage http://ucilnica.fgg.uni-lj.si

Cilji in kompetence:	**Objectives and competences:**
Cilji: • pridobiti znanja iz numeričnih metod, ki so osnovno orodje za znanstveno raziskovalno delo v inženirstvu, • podrobneje se seznaniti s programskimi orodji za numerično računanje • spoznati osnovne pristope za reševanje problemov matematičnega modeliranja. **Pridobljene kompetence:** Za 10 KT: • formuliranje problemov v obliki parcialnih diferencialnih enačb, • poznavanje analitičnih in numeričnih orodij za reševanje parcialnih diferencialnih enačb, • poznavanje problema kaotičnega obnašanja nelinearnih sistemov, • sposobnost implementacije numeričnih metod v programskem paketu Mathematica/Matlab.	**Goals:** • acquire knowledge about numerical methods, the basic tool in engineering research, • become thoroughly acquainted with programming tools for numerical computation • get cognizant of fundamental approaches in mathematical modeling. **Competences:** For 10 ECTS: • capability of formulating problems in the form of partial differencial equations, • knowledgeability about analytic and numeric tools for solving PDEs, • awareness of the problem of the chaotic behaviour of nonlinear systems, • ability of implementing numerical methods with the CAS Mathematica/Matlab

Predvideni študijski rezultati:	**Intended learning outcomes:**
Znanje in razumevanje: Pridobiti znanja iz numeričnih metod, ki so osnovno orodje za znanstveno raziskovalno delo v inženirstvu, sposobnost implementacije numeričnih metod v programskem paketu Mathematica/Matlab.	Knowledge and understanding: Acquire knowledge about numerical methods, the basic tool in engineering research. Ability of implementing numerical methods with the CAS Mathematica/Matlab.

Metode poučevanja in učenja:	**Learning and teaching methods:**
Predavanja, vaje, domače naloge, seminarske naloge, študij literature, konzultacije.	Lectures, practice sessions, homework, projects, readings, consultations.

Načini ocenjevanja:	**Delež/Weight**	**Assessment:**
Ustni zagovor	50,00 %	Oral exam
Projektne naloge	30,00 %	Projects
Domače naloge	20,00 %	Homework assignments

Reference nosilca/Lecturer's references:

1. G. Jaklič, J. Kozak, M. Krajnc, V. Vitrih, E. Žagar, High-order parametric polynomial approximation of conic sections, Constructive Approximation, Volume 38, Issue 1 (2013), 1–18.
2. G. Jaklič, J. Kozak, M. Krajnc, V. Vitrih, E. Žagar, Hermite geometric interpolation by rational Bezier spatial curves, SIAM Journal on Numerical Analysis, Vol. 50, No. 5, 2012, pp. 2695–2715.
3. G. Jaklič, E. Žagar, Planar cubic G1 interpolatory splines with small strain energy, Journal of Computational and Applied Mathematics, 235 (2011), 2758–2765.

UČNI NAČRT PREDMETA/COURSE SYLLABUS

Predmet:	Numerične metode za elastoplastičnost
Course title:	Numerical Methods for Elastoplasticity

Študijski programi in stopnja	Študijska smer	Letnik	Semestri
Grajeno okolje, tretja stopnja, doktorski	Ni členitve (študijski program)		Letni, Zimski

Univerzitetna koda predmeta/University course code: 1635

Predavanja	Seminar	Vaje	Klinične vaje	Druge oblike študija	Samostojno delo	ECTS
30	0	10	0	0	85	5

Nosilec predmeta/Lecturer: Jože Korelc

Vrsta predmeta/Course type: Izbirni predmet/Elective course

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

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:	**Prerequisites:**
Končana 2. stopnja tehniške ali tehnološke smeri ali fizike ali matematike.	Completed 2. level in Engineering or Technology or Physics or Mathematics

Vsebina:	**Content (Syllabus outline):**
1. 1d plastičnost in poškodovanost 2. 3d plastičnost in poškodovanost 3. Elastoplastičnost za ravninsko napetostno stanje in ravninsko deformacijsko stanje 4. Mešani končni elementi 5. Končni elementi z vstavljeno nezveznostjo 6. Aplikacije	1. 1d plasticityanddamage 2. 3d plasticityanddamage 3. Plane-stressand plane-strainelasto-plasticity 4. Mixedfiniteelements 5. Embedded-discontinuityfiniteelements 6. Applications

Temeljna literatura in viri/Readings:

Temeljni študijski viri:

- KORELC, Jože, STUPKIEWICZ, Stanisław. Closed-form matrixexponentialanditsapplication in finite-strainplasticity. International journal for numericalmethods in engineering, ISSN 0029-5981, 2014, 98(13):960-987, ilustr., doi: 10.1002/nme.4653. [COBISS.SI-ID 6526817]
- M. A. Crisfield, Non-linear Finite Element Analysis of Solids and Structures Vol.1-2, John Wiley & Sons, 1991
- Ibrahimbegovic, A. 2009. Nonlinearsolidmechanics. Dordrecht: Springer.
- DUJC, Jaka, BRANK, Boštjan, IBRAHIMBEGOVIĆ, Adnan. QuadrilateralFinite Element withEmbeddedStrongDiscontinuity for FailureAnalysisofSolids. Computermodeling in engineering&sciences. CMES, ISSN 1526-1492. Tiskana izd., 2010, letn. 69, št. 3, str. 223-260, ilustr., doi:10.3970/cmes.2010.069.223. [COBISS.SI-ID 5301345]
- DUJC, Jaka, BRANK, Boštjan, IBRAHIMBEGOVIĆ, Adnan. Multi-scalecomputational model for failureanalysisof metal framesthatincludessofteningandlocalbuckling. Computer Methods in AppliedMechanicsand Engineering, ISSN 0045-7825. [Printed.], 2010, letn. 199, št. 21-22, str. 1371-1385, ilustr., doi: 10.1016/j.cma.2009.09.003. [COBISS.SI-ID 4816737]

Elektronski viri:e-zbiraka končnih elementov: http://fgg.uni-lj.si/symech/

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

Pridobiti osnovno znanje s področja neelastične (elastoplastične, poškodovanostne) analize različnih konstrukcij: palice, nosilca, konstrukcije v ravninskem napetostnem stanju, konstrukcije v ravninskem deformacijskem stanju, plošče in lupine.	To get an intoductory knowledge related to inelastic (elastoplastic, damage), analysis of different structures: bar, beam, plane-stress structures, plane-strainstructures, plates, shells.

Predvideni študijski rezultati:	**Intended learning outcomes:**
Znanje in razumevanje: postopkov za elastoplastično analizo, postopkov pri analizi poškodovanosti, postopkov pri modeliranju porušitve materiala s končnimi elementi z vgrajenimi nezveznostmi.	Knowledge and understanding: of procedures for elastoplastic analysis, of procedures for damage analysis, of procedures for failure modeling by embedded-discontinuity finite elements.

Metode poučevanja in učenja:	**Learning and teaching methods:**
Predavanja bodo v klasični učilnici. Vaje bodo v računalniški učilnici.	Leactures will be in a standard classroom. Tutorial wil lbe in a computer laboratory.

Načini ocenjevanja:	**Delež/Weight**	**Assessment:**
Pisni izpit	50,00 %	Examination
Projekt	50,00 %	Project

Reference nosilca/Lecturer's references:

1. KORELC, Jože, STUPKIEWICZ, Stanisław. Closed-form matrix exponential and its application in finite-strain plasticity. International journal for numerical methods in engineering, ISSN 0029-5981, 2014, 98(13):960-987, ilustr.,doi: 10.1002/nme.4653. [COBISS.SI-ID 6526817]
2. LAMUT, Martin, KORELC, Jože, RODIČ, Tomaž. Multiscalemodellingofheterogeneousmaterials. Mater. tehnol., 2011, 45(5):421-426.
3. RODIČ, Tomaž, ŠUŠTAR, Tomaž, ŠUŠTARIČ, Primož, KORELC, Jože. Efficientnumericalimplementationofpressure, time and temperature superposition for elasto-visco-plastic material model byusing a symbolicapproach. Int. j. numer. methodseng., 2010, 84:470-484.

UČNI NAČRT PREDMETA/COURSE SYLLABUS

Predmet:	Obdelava podob daljinskega zaznavanja
Course title:	Remote Sensing Image Processing

Študijski programi in stopnja	Študijska smer	Letnik	Semestri
Grajeno okolje, tretja stopnja, doktorski	Ni členitve (študijski program)		Letni, Zimski

Univerzitetna koda predmeta/University course code: 1111

Predavanja	Seminar	Vaje	Klinične vaje	Druge oblike študija	Samostojno delo	ECTS
15	10	15	0	85	0	5

Nosilec predmeta/Lecturer: Krištof Oštir

Vrsta predmeta/Course type: Izbirni predmet/Elective course

Jeziki/Languages:

Predavanja/Lectures:	Slovenščina, Angleščina
Vaje/Tutorial:	Slovenščina, Angleščina

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:	Prerequisites:
Ni posebnih pogojev.	There are no special prerequisites.

Vsebina:	Content (Syllabus outline):
Postopki digitalne obdelave podob v daljinskem zaznavanju	Digital image processing procedures in remote sensing
Geometrijski popravki in registracija, izvedba, postopki, težave, natančnost	Geometric corrections and registration, procedure, problems, accuracy
Atmosferski popravki	Atmospheric corrections
Popravki osvetlitve in topografska normalizacija	Illumination effects, topographic normalization
Kalibracija senzorja	Sensor calibration
Izboljšanje kontrasta, manipulacija histograma	Contrast enhancement, histogram manipulation
Filtriranje, nizkoprepustno, visokoprepustno, filtri robov in odkrivanje robov	Filtering, low-pass, high-pass, edge detection
Aritmetične operacije s podobami	Arithmetic operations
Spektralne transformacije (PCA, KTT, indeksi...) in njihova uporabnost	Spectral transformations (PCA, KTT, indices) and their application
Združevanje podob visoke in nizke prostorske ločljivosti (resolution merge)	Resolution merge (pan sharpening)
Klasifikacija podob, spektralni prostor	Classification, spectral space
Nenadzorovana klasifikacija	Supervised classification
Nadzorovana klasifikacija	Unsupervised classification
Objektna klasifikacija	Object-based classification
Strojno učenje	Machine learning
Ovrednotenje klasifikacije	Classification accuracy
Obdelava podatkov laserskega skeniranja (lidar)	Laser scanning (lidar) data processing
Obdelava radarskih satelitskih posnetkov	Radar image processing
Integracija podatkov: večsenzorska, veččasovna, večločljivostna	Data integration: multisensor, multitemporal, multiresolution
Zaznavanje sprememb in veččasovne analize na podobah	Change detection and time-series analysis
	Practical example of remote sensing image processing (selection of most appropriate steps and methods, processing, result generation)

Izvedba praktičnega primera obdelave podob daljinskega zaznavanja (primerni postopki obdelave, izvedba, priprava izdelkov)	

Temeljna literatura in viri/Readings:

Knjige / Books
Daljinsko zaznavanje / Krištof Oštir. Ljubljana : Znanstvenoraziskovalni center
SAZU, 2006
Image Analysis, Classification and Change Detection in Remote Sensing: With Algorithms for ENVI/IDL and Python / M.J. Canty. – 3. izd. – CRC Press, 2014
Remote Sensing Digital Image Analysis: An Introduction / J.A. Richard in X.
Jia. – 4. izd. – Berlin : Springer, 2006
Computer Processing of Remotely Sensed Images: An Introduction / P.M.
Mather. – 3. izd. – Chichester : John Wiley and Sons, 2004
Introduction to Remote Sensing / James B. Campbell. – 3. izd. – London : Taylor and Francis, 2002

Revije / Journals
IEEE Transactions on Geoscience and Remote Sensing
Remote Sensing of the Environment
International Journal of Remote Sensing
Journal of Photogrammetry and Remote Sensing
Photogrammetric Engineering and Remote Sensing

Cilji in kompetence:	**Objectives and competences:**
Študenti pridobijo znanje o obdelavi podob daljinskega zaznavanja. Spoznajo postopke obdelave optičnih, radarskih in lidarskih podatkov ter se usposobijo za samostojno aplikacijo tehnologije.	Students will acquire knowledge on remote sensing image processing. They learn about the processing of optical, radar and lidar data, and gain the ability for stand-alone application of the technology.

Predvideni študijski rezultati:	**Intended learning outcomes:**
Študenti pridobijo znanje o postopkih digitalne obdelave podob, s poudarkom na uporabi v daljinskem zaznavanju. Spoznajo postopke obdelave posnetkov (optičnih, radarskih in lidarskih) in se usposobijo za samostojno aplikacijo tehnologije. Teoretična poglavja se tesno povezujejo s praktičnimi primeri, študenti se naučijo uporabljati teorijo v praksi, so se sposobni odločati in izbirati primerne metode in podatkovne vire za določeno uporabo. Študenti znanje poglobijo in izvedejo praktični primer obdelave podatkov daljinskega zaznavanja.	Experiences on the digital image processing with emphasis on remote sensing are obtained during the course. Students get theoretical and practical knowledge on processing of optical, radar and lidar data. Theory is strongly connected with practical examples and after finishing the course students are qualified to apply the methodology, are able to select the most appropriate data sources and procedures for a particular case. The students get basic theoretical and practical knowledge, and the experiences, deepened by performing a remote sensing image processing practical example.

Metode poučevanja in učenja:	**Learning and teaching methods:**
Predavanja: v predavalnici, uporaba sodobnih metod poučevanja (predstavitve z računalnikom, grafične ponazoritve in animacije, demonstracije, primeri iz prakse). Praktične vaje: izvedba v predavalnici in računalniški učilnici. Vaje se po potrebi izvajajo tudi individualno oziroma v manjših skupinah na ustrezni opremi (programska oprema za obdelavo podob).	Lectures: in classroom with modern methods (computer presentations, graphical examples, animations, demonstrations, case studies). Practical works: in classroom and computer room. Practical work is performed individually or in small groups on dedicated equipment (image processing software).

Načini ocenjevanja:	**Delež/Weight**	**Assessment:**
Pogoj za opravljen predmet je pozitivno ocenjena seminarska naloga, ki predstavlja primer uporabe daljinskega zaznavanja s	100,00 %	Student has to prepare and present a seminar work, dealing with a remote sensing application from his field. The work has to be presented

področja študentovega dela. Naloga mora biti predstavljena v okviru seminarskih vaj in izdelana v obliki znanstvenega oziroma strokovnega članka.		publicly and prepared as a scientific/professional paper.

Reference nosilca/Lecturer's references:

1. CIGLIČ, Rok, OŠTIR, Krištof. Application of MODIS products to analyze forest phenophases in relation to elevation and distance from sea. Journal of applied remote sensing, ISSN 1931-3195. [Online ed.], 2014, vol. 8, issue 1, str. 083669-1-083669-16. http://remotesensing.spiedigitallibrary.org/article.aspx?articleid=1842326, doi: 10.1117/1.JRS.8.083669. [COBISS.SI-ID 36822829], [JCR, SNIP, WoS do 14. 4. 2014: št. citatov (TC): 0, čistih citatov (CI): 0, čistih citatov na avtorja (CIAu): 0, normirano št. čistih citatov (NC): 0, Scopus do 26. 11. 2014: št. citatov (TC): 0, čistih citatov (CI): 0, čistih citatov na avtorja (CIAu): 0, normirano št. čistih citatov (NC): 0] kategorija: 1A3 (Z1); uvrstitev: SCI, Scopus, MBP; tipologijo je verificiral OSICH
2. MESNER, Nika, OŠTIR, Krištof. Investigating the impact of spatial and spectral resolution of satellite images on segmentation quality. *Journal of applied remote sensing*, ISSN 1931-3195. [Online ed.], 2014, vol. 8, iss. 1, str. 083696-1-083696-14, ilustr. http://remotesensing.spiedigitallibrary.org/article.aspx?articleid=1812805, doi: 10.1117/1.JRS.8.083696. [COBISS.SI-ID 36528685], [JCR, SNIP, WoS do 3. 3. 2014: št. citatov (TC): 0, čistih citatov (CI): 0, čistih citatov na avtorja (CIAu): 0, normirano št. čistih citatov (NC): 0, Scopus do 4. 2. 2014: št. citatov (TC): 0, čistih citatov (CI): 0, čistih citatov na avtorja (CIAu): 0, normirano št. čistih citatov (NC): 0] kategorija: 1A3 (Z1); uvrstitev: SCI, Scopus, MBP; tipologijo je verificiral OSICN

3. ĐURIĆ, Nataša, PEHANI, Peter, OŠTIR, Krištof. Application of in-segment multiple sampling in object-based classification. Remote sensing, ISSN 2072-4292. [Online ed.], Dec. 2014, vol. 6, iss. 12, str. 12138-12165, ilustr. http://www.mdpi.com/2072-4292/6/12/12138, doi: 10.3390/rs61212138. [COBISS.SI-ID 37833517], [JCR, SNIP] kategorija: 1A1 (Z1, A', A1/2); uvrstitev: SCI, Scopus, MBP; tipologijo je verificiral OSICN
4. LAMOVEC, Peter, VELJANOVSKI, Tatjana, MIKOŠ, Matjaž, OŠTIR, Krištof. Detecting flooded areas with machine learning techniques : case study of the Selška Sora river flash flood in September 2007. Journal of applied remote sensing, ISSN 1931-3195. [Online ed.], maj 2013, [Vol.] 7, [no.] 1, str. 1-13, ilustr., doi: 10.1117/1.JRS.7.073564. [COBISS.SI-ID 6253409], [JCR, SNIP, WoS do 16. 9. 2013: št. citatov (TC): 0, čistih citatov (CI): 0, čistih citatov na avtorja (CIAu): 0, normirano št. čistih citatov (NC): 0, Scopus do 19. 8. 2014: št. citatov (TC): 1, čistih citatov (CI): 1, čistih citatov na avtorja (CIAu): 0.25, normirano št. čistih citatov (NC): 1] kategorija: 1A3 (Z1); uvrstitev: SCI, Scopus, MBP; tipologijo je verificiral OSICT
5. ZAKŠEK, Klemen, OŠTIR, Krištof. Downscaling land surface temperature for urban heat island diurnal cycle analysis. Remote sensing of environment, ISSN 0034-4257. [Print ed.], 2012, vol. 117, str. 114-124, ilustr., doi: 10.1016/j.rse.2011.05.027. [COBISS.SI-ID 33178669], [JCR, SNIP, WoS do 12. 11. 2014: št. citatov (TC): 18, čistih citatov (CI): 17, čistih citatov na avtorja (CIAu): 8.50, normirano št. čistih citatov (NC): 11,Scopus do 3. 12. 2014: št. citatov (TC): 30, čistih citatov (CI): 29, čistih citatov na avtorja (CIAu): 14.50, normirano št. čistih citatov (NC): 19] kategorija: 1A1 (Z1, A'', A', A1/2); uvrstitev: SCI, Scopus, MBP; tipologijo je verificiral OSICN
6. ZAKŠEK, Klemen, OŠTIR, Krištof, KOKALJ, Žiga. Sky-view factor as a relief visualization technique. Remote sensing, ISSN 2072-4292. [Online ed.], 2011, 3, 2, str. 398-415, ilustr. http://www.mdpi.com/2072-4292/3/2/398/pdf, doi: 10.3390/rs3020398. [COBISS.SI-ID 32345645], [JCR, SNIP, WoS do 23. 9. 2014: št. citatov (TC): 8, čistih citatov (CI): 6, čistih citatov na avtorja (CIAu): 2.00, normirano št. čistih citatov (NC): 4,Scopus do 1. 10. 2014: št. citatov (TC): 11, čistih citatov (CI): 9, čistih citatov na avtorja (CIAu): 3.00, normirano št. čistih citatov (NC): 6] kategorija: 1A1 (Z1, A', A1/2); uvrstitev: SCI, Scopus, MBP; tipologijo je verificiral OSICN

UČNI NAČRT PREDMETA/COURSE SYLLABUS

Predmet:	Obdelava podob daljinskega zaznavanja
Course title:	Remote Sensing Image Processing

Študijski programi in stopnja	Študijska smer	Letnik	Semestri
Grajeno okolje, tretja stopnja, doktorski	Ni členitve (študijski program)		Letni, Zimski

Univerzitetna koda predmeta/University course code: 1707

Predavanja	Seminar	Vaje	Klinične vaje	Druge oblike študija	Samostojno delo	ECTS
30	20	30	0	85	85	10

Nosilec predmeta/Lecturer: Krištof Oštir

Vrsta predmeta/Course type: Izbirni predmet/Elective course

Jeziki/Languages:

Predavanja/Lectures:	Slovenščina, Angleščina
Vaje/Tutorial:	Slovenščina, Angleščina

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:	Prerequisites:
Ni posebnih pogojev.	There are no special prerequisites.

Vsebina:	Content (Syllabus outline):
Postopki digitalne obdelave podob v daljinskem zaznavanju	Digital image processing procedures in remote sensing
Geometrijski popravki in registracija, izvedba, postopki, težave, natančnost	Geometric corrections and registration, procedure, problems, accuracy
Atmosferski popravki	Atmospheric corrections
Popravki osvetlitve in topografska normalizacija	Illumination effects, topographic normalization
Kalibracija senzorja	Sensor calibration
Izboljšanje kontrasta, manipulacija histograma	Contrast enhancement, histogram manipulation
Filtriranje, nizkoprepustno, visokoprepustno, filtri robov in odkrivanje robov	Pseudocolour display, density slicing
Aritmetične operacije s podobami	Filtering, low-pass, high-pass, edge detection
Spektralne transformacije (PCA, KTT, indeksi...) in njihova uporabnost	Arithmetic operations
Združevanje podob visoke in nizke prostorske ločljivosti (resolution merge)	Spectral transformations (PCA, KTT, indices) and their application
Klasifikacija podob, spektralni prostor	Resolution merge (pan sharpening)
Nenadzorovana klasifikacija	Classification, spectral space
Nadzorovana klasifikacija	Supervised classification
Objektna klasifikacija	Unsupervised classification
Strojno učenje	Object-based classification
Ovrednotenje klasifikacije	Machine learning
Obdelava podatkov laserskega skeniranja (lidar)	Classification accuracy
Obdelava radarskih satelitskih posnetkov	Laser scanning (lidar) data processing
Integracija podatkov: večsenzorska, veččasovna, večločljivostna	Radar image processing
Zaznavanje sprememb in veččasovne analize na podobah	Data integration: multisensor, multitemporal, multiresolution
	Change detection and time-series analysis
	Practical example of remote sensing image processing (selection of most appropriate steps and methods, processing, result generation)

Izvedba praktičnega primera obdelave podob daljinskega zaznavanja (primerni postopki obdelave, izvedba, priprava izdelkov)	

Temeljna literatura in viri/Readings:

Knjige / Books
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SAZU, 2006
Image Analysis, Classification and Change Detection in Remote Sensing: With Algorithms for ENVI/IDL and Python / M.J. Canty. – 3. izd. – CRC Press, 2014
Remote Sensing Digital Image Analysis: An Introduction / J.A. Richard in X.
Jia. – 4. izd. – Berlin : Springer, 2006
Computer Processing of Remotely Sensed Images: An Introduction / P.M.
Mather. – 3. izd. – Chichester : John Wiley and Sons, 2004
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Revije / Journals
IEEE Transactions on Geoscience and Remote Sensing
Remote Sensing of the Environment
International Journal of Remote Sensing
Journal of Photogrammetry and Remote Sensing
Photogrammetric Engineering and Remote Sensing

Cilji in kompetence:	**Objectives and competences:**
Študenti pridobijo znanje o obdelavi podob daljinskega zaznavanja. Spoznajo postopke obdelave optičnih, radarskih in lidarskih podatkov ter se usposobijo za samostojno aplikacijo tehnologije.	Students will acquire knowledge on remote sensing image processing. They learn about the processing of optical, radar and lidar data, and gain the ability for stand-alone application of the technology.

Predvideni študijski rezultati:	**Intended learning outcomes:**
Študenti pridobijo znanje o postopkih digitalne obdelave podob, s poudarkom na uporabi v daljinskem zaznavanju. Spoznajo postopke obdelave posnetkov (optičnih, radarskih in lidarskih) in se usposobijo za samostojno aplikacijo tehnologije. Teoretična poglavja se tesno povezujejo s praktičnimi primeri, študenti se naučijo uporabljati teorijo v praksi, so se sposobni odločati in izbirati primerne metode in podatkovne vire za določeno uporabo. Študenti znanje poglobijo in izvedejo praktični primer obdelave podatkov daljinskega zaznavanja.	Experiences on the digital image processing with emphasis on remote sensing are obtained during the course. Students get theoretical and practical knowledge on processing of optical, radar and lidar data. Theory is strongly connected with practical examples and after finishing the course students are qualified to apply the methodology, are able to select the most appropriate data sources and procedures for a particular case. The students get basic theoretical and practical knowledge, and the experiences, deepened by performing a remote sensing image processing practical example.

Metode poučevanja in učenja:	**Learning and teaching methods:**
Predavanja: v predavalnici, uporaba sodobnih metod poučevanja (predstavitve z računalnikom, grafične ponazoritve in animacije, demonstracije, primeri iz prakse). Praktične vaje: izvedba v predavalnici in računalniški učilnici. Vaje se po potrebi izvajajo tudi individualno oziroma v manjših skupinah na ustrezni opremi (programska oprema za obdelavo podob).	Lectures: in classroom with modern methods (computer presentations, graphical examples, animations, demonstrations, case studies). Practical works: in classroom and computer room. Practical work is performed individually or in small groups on dedicated equipment (image processing software).

Načini ocenjevanja:	**Delež/Weight**	**Assessment:**
Pogoj za opravljen predmet je pozitivno ocenjena seminarska naloga, ki predstavlja primer uporabe daljinskega zaznavanja s	100,00 %	Student has to prepare and present a seminar work, dealing with a remote sensing application from his field. The work has to be presented

področja študentovega dela. Naloga mora biti predstavljena v okviru seminarskih vaj in izdelana v obliki znanstvenega oziroma strokovnega članka.		publicly and prepared as a scientific/professional paper.

Reference nosilca/Lecturer's references:

1. CIGLIČ, Rok, OŠTIR, Krištof. Application of MODIS products to analyze forest phenophases in relation to elevation and distance from sea. Journal of applied remote sensing, ISSN 1931-3195. [Online ed.], 2014, vol. 8, issue 1, str. 083669-1-083669-16. http://remotesensing.spiedigitallibrary.org/article.aspx?articleid=1842326, doi: 10.1117/1.JRS.8.083669. [COBISS.SI-ID 36822829], [JCR, SNIP, WoS do 14. 4. 2014: št. citatov (TC): 0, čistih citatov (CI): 0, čistih citatov na avtorja (CIAu): 0, normirano št. čistih citatov (NC): 0, Scopus do 26. 11. 2014: št. citatov (TC): 0, čistih citatov (CI): 0, čistih citatov na avtorja (CIAu): 0, normirano št. čistih citatov (NC): 0] kategorija: 1A3 (Z1); uvrstitev: SCI, Scopus, MBP; tipologijo je verificiral OSICH
2. MESNER, Nika, OŠTIR, Krištof. Investigating the impact of spatial and spectral resolution of satellite images on segmentation quality. *Journal of applied remote sensing*, ISSN 1931-3195. [Online ed.], 2014, vol. 8, iss. 1, str. 083696-1-083696-14, ilustr. http://remotesensing.spiedigitallibrary.org/article.aspx?articleid=1812805, doi: 10.1117/1.JRS.8.083696. [COBISS.SI-ID 36528685], [JCR, SNIP, WoS do 3. 3. 2014: št. citatov (TC): 0, čistih citatov (CI): 0, čistih citatov na avtorja (CIAu): 0, normirano št. čistih citatov (NC): 0, Scopus do 4. 2. 2014: št. citatov (TC): 0, čistih citatov (CI): 0, čistih citatov na avtorja (CIAu): 0, normirano št. čistih citatov (NC): 0] kategorija: 1A3 (Z1); uvrstitev: SCI, Scopus, MBP; tipologijo je verificiral OSICN

3. ĐURIĆ, Nataša, PEHANI, Peter, OŠTIR, Krištof. Application of in-segment multiple sampling in object-based classification. Remote sensing, ISSN 2072-4292. [Online ed.], Dec. 2014, vol. 6, iss. 12, str. 12138-12165, ilustr. http://www.mdpi.com/2072-4292/6/12/12138, doi: 10.3390/rs61212138. [COBISS.SI-ID 37833517], [JCR, SNIP] kategorija: 1A1 (Z1, A', A1/2); uvrstitev: SCI, Scopus, MBP; tipologijo je verificiral OSICN
4. LAMOVEC, Peter, VELJANOVSKI, Tatjana, MIKOŠ, Matjaž, OŠTIR, Krištof. Detecting flooded areas with machine learning techniques : case study of the Selška Sora river flash flood in September 2007. Journal of applied remote sensing, ISSN 1931-3195. [Online ed.], maj 2013, [Vol.] 7, [no.] 1, str. 1-13, ilustr., doi: 10.1117/1.JRS.7.073564. [COBISS.SI-ID 6253409], [JCR, SNIP, WoS do 16. 9. 2013: št. citatov (TC): 0, čistih citatov (CI): 0, čistih citatov na avtorja (CIAu): 0, normirano št. čistih citatov (NC): 0, Scopus do 19. 8. 2014: št. citatov (TC): 1, čistih citatov (CI): 1, čistih citatov na avtorja (CIAu): 0.25, normirano št. čistih citatov (NC): 1] kategorija: 1A3 (Z1); uvrstitev: SCI, Scopus, MBP; tipologijo je verificiral OSICT
5. ZAKŠEK, Klemen, OŠTIR, Krištof. Downscaling land surface temperature for urban heat island diurnal cycle analysis. Remote sensing of environment, ISSN 0034-4257. [Print ed.], 2012, vol. 117, str. 114-124, ilustr., doi: 10.1016/j.rse.2011.05.027. [COBISS.SI-ID 33178669], [JCR, SNIP, WoS do 12. 11. 2014: št. citatov (TC): 18, čistih citatov (CI): 17, čistih citatov na avtorja (CIAu): 8.50, normirano št. čistih citatov (NC): 11,Scopus do 3. 12. 2014: št. citatov (TC): 30, čistih citatov (CI): 29, čistih citatov na avtorja (CIAu): 14.50, normirano št. čistih citatov (NC): 19] kategorija: 1A1 (Z1, A'', A', A1/2); uvrstitev: SCI, Scopus, MBP; tipologijo je verificiral OSICN
6. ZAKŠEK, Klemen, OŠTIR, Krištof, KOKALJ, Žiga. Sky-view factor as a relief visualization technique. Remote sensing, ISSN 2072-4292. [Online ed.], 2011, 3, 2, str. 398-415, ilustr. http://www.mdpi.com/2072-4292/3/2/398/pdf, doi: 10.3390/rs3020398. [COBISS.SI-ID 32345645], [JCR, SNIP, WoS do 23. 9. 2014: št. citatov (TC): 8, čistih citatov (CI): 6, čistih citatov na avtorja (CIAu): 2.00, normirano št. čistih citatov (NC): 4,Scopus do 1. 10. 2014: št. citatov (TC): 11, čistih citatov (CI): 9, čistih citatov na avtorja (CIAu): 3.00, normirano št. čistih citatov (NC): 6] kategorija: 1A1 (Z1, A', A1/2); uvrstitev: SCI, Scopus, MBP; tipologijo je verificiral OSICN

UČNI NAČRT PREDMETA/COURSE SYLLABUS

Predmet:	Prenova nepremične kulturne dediščine
Course title:	Restoration of Immovable Cultural Heritage

Študijski programi in stopnja	Študijska smer	Letnik	Semestri
Grajeno okolje, tretja stopnja, doktorski	Ni členitve (študijski program)		Letni, Zimski

Univerzitetna koda predmeta/University course code: 1309

Predavanja	Seminar	Vaje	Klinične vaje	Druge oblike študija	Samostojno delo	ECTS
30	10	0	0	85	0	5

Nosilec predmeta/Lecturer: Roko Žarnić

Vrsta predmeta/Course type: Izbirni predmet/Elective course

Jeziki/Languages:

Predavanja/Lectures:	Slovenščina, Angleščina
Vaje/Tutorial:	Slovenščina, Angleščina

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:	Prerequisites:
Ustrezno predznanje s področja gradbenih materialov in prenove in preskušanja konstrukcij pridobljeno na prvostopenjskem ali drugostopenjskem študiju ustrezne smeri.	Exam-proved knowledge on building materials and retrofitting and experimental assessment of structures according to education programme of the undergraduate and graduate level

Vsebina:	Content (Syllabus outline):
• Osnovne konzervatorske zahteve glede ravnanja in posegov v nepremično dediščino • Umeščenost dediščine v naravno in v sodobnop zgrajeno okolje • Tehnični standardi in predpisi • Ogroženost nepremične dediščine zaradi naravnih nesreč in slabega ravnanja • Ocena stanja in odpornosti objektov in njihovo opazovanje • Dediščini prijazni materiali • Sodobne tehnologije za popravilo in utrditev zgodovinskih konstrukcij • Okoljski vidiki prenove dediščine s poudarkom na smotrno rabo energije • Upravljanje in vzdrževanje dediščine	• Basic requirements of the conservation-restoration discipline regarding the management and intervention in immovable cultural heritage • Integration of heritage in the natural and contemporarily built environment • Technical standards, codes and best-practice rules • Mitigation of natural hazard and malicious actions impact on cultural heritage • Assessment, diagnosis and monitoring of heritage objects • Heritage-friendly and compatible materials • Modern technologies for repair and strengthening of heritage objects • Environmental aspects of cultural heritage restoration including rational use of energy • Management and maintenance of cultural heritage

Temeljna literatura in viri/Readings:

- Mednarodne listine ICOMOS, Doktrine 01, ur. J. Grobovšek, ICOMOS/*SI, 2003
- EN 16096:2012. Conservation of cultural property – Condition survey and report of built cultural heritage. Brussels, European Committee for Standardization.
- Recommendations for the analysis, conservation and structural restoration of architectural heritage, ICOMOS 2003

- Vitruvius, P., Deset knjiga o arhitekturi, prevod V.Bedenko, Zagreb: Golden markenting: Institut građevinarstva Hrvatske , 1999
- European Guidelines for the seismic preservation of cultural heritage assets, Perpetuate Project delverable D41, 2013, http://www.perpetuate.eu/category/results-and-documents/technical-reports
- Guidelines for end-users, Deliverables D10.1-D10.5, FP EU Project NIKKER, 2009 http://www.niker.eu/downloads/
- A Scottish Monument Watch. 2012. The case for a proactive maintenance scheme for traditional buildings in Scotland. Report to Technical Conservation Group, Historic Scotland. Stirling City Heritage Trust: 166 str. http://conservation.historic-scotland.gov.uk/scotmonumentwatchfull.pdf
- Zakon o varstvu kulturne dediščine (ZVKD-1). Ur. l. RS, št. 16/2008
- Zakon o graditvi objektov (ZGO-1). Ur. l. RS, št. 110/2002.

Cilji in kompetence:	**Objectives and competences:**
Cilj predmeta je seznaniti študenta s osnovnimi zahtevami, ki glede pristopa k prenovi kulturne dediščine postavlja konzervatorska stroka in ga usposobiti za izpolnjevanje teh zahtev s pomočjo uporabnih znanstvenih metod izhajajočih iz tehničnih in naravoslovnih znanj. Spoznal bo celoten proces prenove od ugotavljanja in dokumentiranja lastnosti obstoječih objektov, do možnosti njihove prenove z uporabo ustreznih materialov in posegov v konstrukcijo ter vzdrževanjem nujnim za ohranjanje dolge življenjske dobe objekta, ki ga je sledeč sodobne principe upravljanja možno koristno uporabljati.	The aim of course is to teach student about the basic requirements of conservators on the approach to the cultural heritage safeguarding and restoration and to qualify him to meet those requirements following the applicable scientific procedures based on natural science and technical science knowledge. Student will be guided through the holistic process of restoration from assessment and documentation of heritage object to the possibilities of their restoration using the appropriate materials and structural interventions including the maintenance process needed for prolongation of the life time of object that can be used for the contemporary needs.

Predvideni študijski rezultati:	**Intended learning outcomes:**
Znanje in razumevanje: • razumevanje konzervatorskih zahtev in pravil ter zakonskih zahtev glede varovanja in zaščite nepemične kulturne dediščine • poznavanje dolgoročnih in nenadnih naravnih in antropogenih škodljivih vplivov znanje o ustreznih konstrukcijskih in nekonstrukcijskih ukrepov potrebnih za dolgotrajno zaščito nepremične dediščine pred škodljvimi vplivi	Knowledge and understanding: • understanding of conservation requirements, rules and legislation related to preservation of cultural heritage assets • knowledge on the lonng-term and sudden natural and anthropogenic risks knowledge on adequate structural and nonstructural interventions in heritage assets in order to mittigate the identified risks

Metode poučevanja in učenja:	**Learning and teaching methods:**
Predavanja, seminarsko delo, vodene diskusije, konzultacije.	Lectures, seminars, guided discussions, consultations.

Načini ocenjevanja:	**Delež/Weight**	**Assessment:**
Seminarska naloga	60,00 %	Seminar theme
Ustno izpraševanje	40,00 %	Oral exam

Reference nosilca/Lecturer's references:

1. ŠIJANEC-ZAVRL, M., ŽARNIĆ, R., ŠELIH, J. Multicriteial sustainability assessment of residential buildings. *Technological and economic development of economy*, ISSN 1392-8619. Print ed., 2009, letn. 15, št. 4, str. 612-630.
2. VODOPIVEC, B., ŽARNIĆ, R., TAMOŠAITIENE, J., LAZAUSKAS, M., ŠELIH, J. Renovation priority ranking by multi-criteria assessment of architectural heritage: the case of castles. *International journal of strategic property management*, ISSN 1648-715X, 2014, letn. 18, št. 1, str. 88-100,
3. JARC SIMONIČ, M., GOSTIČ, S., BOSILJKOV, V., ŽARNIĆ, R. Testing and analysis of walls strengthened with FRP. *Građevinar*, ISSN 0350-2465, 2014, letn. 66, št. 6, str. 533-548.

4. ANTOLINC, D., RAJČIĆ, V., ŽARNIĆ,R. Analysis of hysteretic response of glass infilled wooden frames. *Journal of civil engineering and management*, ISSN 1392-3730. Tiskana izdaja, 2014, letn. 20, št. 4, str. 600-608.
5. KRSTEVSKA, Lidija, TASHKOV, Ljubomir, RAJČIĆ, Vlatka, ŽARNIĆ, Roko. Seismic behaviour of Composite Panel Composed of Laminated Wood and Bearing Glass - Experimental Investigation. *Advanced materials research*, ISSN 1022-6680, 2013, letn. 778, str. 698-705.

UČNI NAČRT PREDMETA/COURSE SYLLABUS

Predmet:	Presoja vodnogospodarske urejenosti porečja
Course title:	Assessment of Water Management Impact on River Basin

Študijski programi in stopnja	Študijska smer	Letnik	Semestri
Grajeno okolje, tretja stopnja, doktorski	Ni členitve (študijski program)		Letni, Zimski

Univerzitetna koda predmeta/University course code: 1708

Predavanja	Seminar	Vaje	Klinične vaje	Druge oblike študija	Samostojno delo	ECTS
40	40	0	0	0	170	10

Nosilec predmeta/Lecturer: Franc Steinman

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:
Dokončana 2. bolonjska stopnja tehnične ali naravoslovne smeri.	Finished 2. Stage Bologna programme in the field of technical or natural sciences

Vsebina:	Content (Syllabus outline):
Stopnja urejenosti sistema, vodnega telesa, porečja, povodja oz. območja obdelave. Indikatorji urejenosti: konceptualni, kvalitativni in kvantitativni. Metodologije in orodja za izdelavo presoje urejenosti, ter povezava z numeričnimi modeli in večkriterijskimi analizami. Standardi in trendi ter nove tehnologije pri oskrbi z vodo in zbiranju in obdelavi odpadnih voda. Funkcionalne povezave zdravstveno-hidrotehnične infrastrukture in vodnega okolja. Monitoring vodnega okolja in grajenih sistemov, ter podpora z okoljskimi modeli za določanje odmika od dobrega stanja vodnih teles. Standardi in trendi ter nove tehnologije pri zbiranju in obdelavi integralnih podatkov o vodah, vodnogospodarskih objektih, napravah in pravnih režimih. EU in slovenski pravni okviri (vodarski) in tehnični vidiki implementacije (VD, IPPC, FD, itd.). Kritična infrastruktura (po direktivi EU) in obvladovanje tveganj. Monitoring odtočnega režima in pravil obratovanja grajenih sistemov, ter podpora z hidravličnimi modeli za določanje odmika od dobrega stanja vodnih teles. Gradniki sistemov, standardi obratovanja in vzdrževanja, pomen benchmarkinga.	Level regulation on a system, water body, river basin or examined regions scale. Indicators of regulation: conceptual, qualitative and quantitative. Methodologies and tools to elaborate regulation assessments, connected with numerical models and multiobjective analyses. Standards, trends and new technologies at water supply, urban drainage and waste water treatment. Functional connection of sanitary infrastructure and water environment. Monitoring the water environment and constructed systems, support by environmental models to determine the offset of good water body conditions. Standards, trends and new technologies in collecting and processing integrated data of waters, water management structures, technologies and legal regimes. Legal environment of EU, implementation into Slovene (water) legal system and the technical issues of implementation (WFD, IPPC, FD,etc.). Critical infrastructure (EU directive) and risk management. Monitoring run-off regimes and operation rules of constructed systems, support with hydraulic models to determine the good condition of water bodies.

Rudarjenje podatkov, strojno učenje, metode in modeli, optimizacija z orodji umetne inteligence, analiza posameznih indikatorjev, sinteza, interpretacija modeliranja ter uporaba kombiniranih (združenih) modelnih orodij pri skupni oceni presoje urejenosti.	System components, operation and maintenance standards, importance of benchmarking. Data mining and machine learning, methods and models, optimization tools of artificial intelligence, analyses of individual indicators, synthesis, interpretation of modeling and use of combined (connected) model tools in an integrated regulation assessment.

Temeljna literatura in viri/Readings:

BREZNIK, M., STEINMAN, F. Desalination of Coastal Karst Springs by Hydro-technical and Adaptable Methods. V: SCHORR, Michael (ur.). *Desalination, trends and technologies*. First published February, 2011. Rijeka: InTech Open Access, 2011, str. 41-70, ilustr. http://www.intechopen.com/books/show/title/desalination-trends-and-technologies.

MÜLLER, M., RAK, G., STEINMAN, F., NOVAK, G.. Katalog poplavnih scenarijev kot strokovna podlaga za načrte zaščite in reševanja ob poplavah. V: ZORN, Matija (ur.), et al. *(Ne)prilagojeni*, (Knjižna zbirka Naravne nesreče, ISSN 1855-8879, 3). Ljubljana: Založba ZRC, 2014, str. 63-72.

MAMMOLITI MOCHET, A., ROVERE, S., SACCARDO, I., MARAN, S., FERCEJ, D., STEINMAN, F., SCHNEIDER, J., FÜREDER, L., LESKY, U., BELLEUDY, P., RUILLET, M., KOPECKI, I., EVRARD, N.. *A problem solving approach for sustainable management of hydropower and river ecosystems in the Alps : handbook*. [s.l.]: Share, 2012. 90 str., ilustr.

KOLLARITS, S., LEBER, D., CORSINI, A., PAPEŽ, J., PREŠEREN, T., SCHNETZER, I., SCHWINGSHANDL, A., KREUTZER, S., PLUNGER, K., STEFANI, M., KOZELJ, D., STEINMAN, F., et al. *Monitor II : new methods for linking hazard mapping and contingency planning*. [S.l.: s.n.], cop. 2010. 47 str., ilustr.

MATIČIČ, B., STEINMAN, F. (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), cop. 2006, str. 447-527, graf. prikazi.

GOSAR, L., STEINMAN, F., KOMPARE, B., BANOVEC, P. (2004). *Določitev območij poselitve v Sloveniji po vodnogospodarskih vidikih = Definition of settlement agglomerations in Slovenia according to water management aspects.* Urbani izziv, 2004, let. 15, št. 1, str. 33-40, 104-107.

Elektronski viri: svetovni splet, baze člankov in iskalniki specializiranih elektronskih revij in baz podatkov

Cilji in kompetence:	**Objectives and competences:**
Cilji: Seznanjanje s postulati Vodnega gospodarstva in povezav z drugimi sektorji. Razumevanje funkcionalne povezanosti procesov in antropogenih posegov v različnih tipih porečij in povodij ter ciljev vodnogospodarskega urejanja. Poglabljanje in posploševanje doseženega znanja na dodiplomskem in podiplomskem študiju, da bi upoštevali skladnost in različnost z drugimi presojami in povezljivost načrtovanja v prostoru in vplivi na vodno okolje. **Kompetence:** Študent zna uporabljati (če namerava izdelati disertacijo na tem področju) različne metode presoj, ter povezovati rezultate modelskih orodij za simulacije procesov in drugih orodij za podporo odločanju, za izdelavo sinteznega poročila o presoji.	**Objectives:** Introducing the postulates of water management in connection with other sectors. Understanding the functional connection of processes and anthropogenic interventions in different types of river basins and water management objectives. Deepening and extending of the achieved knowledge at BSc and MSc studies – consideration of dependencies and differences with other assessments as well as connection of spatial planning and influences on the water environments. **Competences:** The student can use (if he intends to elaborate a dissertation in this area) different methods of assessment, combining modeling results of process simulation and other tools for decision support to elaborate synthesized reports of assessment.

Predvideni študijski rezultati:	**Intended learning outcomes:**
Znanje in razumevanje:	**Knowledge and understanding:**

Študent spozna in razume orodja za oceno ureditev v različnih tipih vodnega okolja. Študent razume procese povezovanja podatkov, pogoje delovanja in povezovanja različnih infrastruktur ter spremljanja stanja (monitoring). Študent razume različne postopke presojevanja in interpretacije rezultatov (npr. indikatorjev).	The student gains knowledge and understands the tools for assessing the arrangements in different water environments. The student understands the processes of connecting data, the functional conditions and the connection of different infrastructures and their monitoring. The student understands the different procedures of assessment and interpretation of results (e.g. indicators).

Metode poučevanja in učenja:	**Learning and teaching methods:**
Predavanja - konzultacije, študij strokovne literature, povezovanje vsebin v seminarsko nalogo.	Lectures - consultations, study of literature, and application of obtained knowledge in an individual seminar work.

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

Reference nosilca/Lecturer's references:

1. ŠANTL, Sašo, STEINMAN Franci. Hydropower Suitability Analysis on a Large Scale Level: Inclusion of a Calibration Phase to Support Determination of Model Parameters, *Water Resources Management,* Springer Science+Business Media, Dordrecht 2014.
2. TRATNIK, Matjaž, STEINMAN, Franci, BATIČ, Silvana, PINTAR, Marina. Evidence in stanje gospodarske javne infrastrukture, primer zadrževalnika Vogršček = Records and state of public infrastructure, the case of the Vogršček reservoir. *Geodetski vestnik*, ISSN 0351-0271. [Tiskana izd.], 2014, letn. 58, št. 1, str. 28-45, ilustr.
3. KOZELJ, Daniel, KAPELAN, Zoran, NOVAK, Gorazd, STEINMAN, Franci. Investigating prior parameter distributions in the inverse modelling of water distribution hydraulic models. *Strojniški vestnik*, ISSN 0039-2480, Nov. 2014, vol. 60, no. 11, str. 725-734, ilustr.
4. PREŠEREN, Tanja, STEINMAN, Franci, ŠIROK, Brane, BAJCAR, Tom. The theoretical densimetric Froude number values with favourable effect on the clarifier performance. *Chemical engineering and processing*, ISSN 0255-2701. [Print ed.], 2013, vol. 74, str. 97-105.
5. CVEJIĆ, Rozalija, TRATNIK, Matjaž, MELJO, Jana, BIZJAK, Aleš, PREŠEREN, Tanja, KOMPARE, Karin, STEINMAN, Franci, MEZGA, Kim, URBANC, Janko, PINTAR, Marina. Trajno varovana kmetijska zemljišča in bližina vodnih virov, primernih za namakanje = Permanently protected agricultural land and the location of water sources suitable for irrigation. *Geodetski vestnik*, ISSN 0351-0271. [Tiskana izd.], 2012, letn. 56, št. 2, str. 308-324, ilustr.
6. NOVAK, Gorazd, STEINMAN, Franci, MÜLLER, Matej, BAJCAR, Tom. Study of velocity field at model sideweir using visualization method. *Journal of hydraulic research*, ISSN 0022-1686, 2012, vol. 50, no. 1, str. 129-133, ilustr.
7. ENGI, Zsuzsanna, TOTH, Gabor, STEINMAN, Franci, BRAUN, Mihaly. Historical morphological reconstruction of the Mura River (SW of the Carpathian Basin) by using GIS methods. *Zeitschrift für Geomorphologie*, ISSN 0372-8854, 2012, letn. 56, št. 2, str. 63-7
8. BAJCAR, T., STEINMAN, F., ŠIROK, B., PREŠEREN, T. Sedimentation efficiency of two continuously operating circular settling tanks with different inlet- and outlet arrangements. *The chemical engineering journal*, ISSN 1385-8947. [Print ed.], 15. Dec. 2011, vol. 178, str. 217-224.

UČNI NAČRT PREDMETA/COURSE SYLLABUS

Predmet:	Pristopi k raziskovanju in načrtovanju rabe prostora
Course title:	Approaches to Spatial Development and Land Use Research

Študijski programi in stopnja	Študijska smer	Letnik	Semestri
Grajeno okolje, tretja stopnja, doktorski	Ni členitve (študijski program)		Letni, Zimski

Univerzitetna koda predmeta/University course code: 1513

Predavanja	Seminar	Vaje	Klinične vaje	Druge oblike študija	Samostojno delo	ECTS
20	20	0	0	85	0	5

Nosilec predmeta/Lecturer: Alma Zavodnik Lamovšek

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:
Znanja prostorskega planiranja na nacionalni, regionalni in lokalni ravni, poznavanje sistema prostorskega planiranja v Sloveniji.	Knowledge of urbanism, regional planning, spatial planning, statistics and environmental protection is required to the extent and level on the 2nd level of a Bologna study programme or a university degree programme.

Vsebina:	Content (Syllabus outline):
Opredelitev konceptov in pojmov prostorskega razvoja ter rabe prostora (land use) ter razlik med njimi. Opredelitev dejavnikov in gonilnih sil (driving forces) za prostorski razvoj in pojav različnih rab prostora. Proučevanje prostorskega razvoja glede na zgodovinski razvoj, naravno geografske danosti ter socio-ekonomske dejavnike. Teorije, metode in tehnike v raziskovanju prostora s poudarkom na vrstah rabe prostora ter z njimi povezanih pravic in omejitev na zemljiščih. Prepoznavanje prostorsko razvojnih potreb, prostorskih potencialov in varstva naravnih virov za proučevanje in načrtovanje rabe prostora. Institucionalni okviri prostorskega razvoja in urejanja prostora v evropskih državah, koncept lastninske in drugih pravic v sistemu prostorskega planiranja. Vpliv evropskih in nacionalnih / regionalnih politik na razvoj in uporabo ter ravnanje s prostorom. Različno razumevanja prostorskega razvoja in rabe prostora na različnih ravneh raziskovanja. Sistem kazalnikov za spremljanje stanja in sprememb v prostoru ; zbiranje in dostopnost podatkov ter različni načini njihove uporabe in prikazovanja; večkriterijsko odločanje v prostoru.	Definitions and concepts of spatial development and land use; distinctions between different uses of land. Identifying of factors and driving forces which influence the state and the trends in land use development Research topics include changes, characteristic, functions, multi-functionality, historical development, natural and geographical conditions, and soci-economic development of spatial development and land use. Theoretical basis, methods and techniques for different spatial development and land use research in connection with rights and restrictions on land plot uses Identifying of development needs, spatial potentials and natural protection for land use studying and planning Institutional frame of sustainable spatial development and spatial arrangement in EU countries; the concept of land-ownership characteristics and rights in the spatial planning system Comprehension of EU and national / regional politics with influence on uses and treatment of land and its development. Various understanding of spatial development and land use on different levels and scales of spatial planning research topics

Opredelitev vzorcev rab in večfunkcionalnosti prostora ter njihov pojav v različnih območjih kot so gorsko-višinska, obalna, urbana, podeželska, obmejna glede na njihov nastanek in razvoj.	Factors and indicators for the assessment of the current conditions and changes of spatial development; collecting of accessible and available sets of data, and different ways of their use and presentation Multicriterial analyses and decision-making for sustainable spatial development. Definition of land use pattern typology (in mountains, coastal, urban, rural, border etc. Areas) on the basis of the multifunctional uses of land, historical development and current driving forces.

Temeljna literatura in viri/Readings:

Mark Deakin, Robert Dixon-Gough, Reinfried Mansberger; Methodologies, models, and instruments for rural and urban land management, Aldershot, Hants, England ; Burlington, VT : Ashgate, cop. 2004
Haall Peter, Urban and regional planning, London ; Boston : Allen and Unwin, 1985
Stefanie Dühr, The visual language of spatial planning : exploring cartographic representations for spatial planning in Europe, New York : Routledge, 2007
Judith E. Innes and David E. Booher, Planning with complexity : an introduction to collaborative rationality for public policy, Milton Park, Abingdon, Oxon ; New York, NY : Routledge, 2010
Beinat, E., Nijkamp, P. 1998. Multicriteria Analysis for Land-Use Management. Klowe Academic Publisher: 373 str.
Hietel, E., Waldhardt, R., Otte, A. 2007. Statistical modeling of land-cover changes based on key socio-economic indicators. Ecological Economics 62, 3-4: 496-507.
Irwin, E., Geoghegan, J. 2001. Theory, data, methods: developing spatially explicit economic models of land use change. Agriculture, Ecosystems and Environment 85, 1-3: 7-24.
Mander, Ü., Wiggering, H., Helming, K. 2007. Multifunctional Land Use – Meeting Future Demands for Landscape Goods and Services. Springer: 424 str.
Veldkamp, A., Fresco, L. O. 1997. Exploring land use scenarios, an alternative approach based on actualland use. Agricultural systems 55, 1: 1-17.
Classics in planning 6, 2007. Land use planning. V: Priemus H. (ur.), Button K. (ur.), Nijkamp P. (ur.). Cheltenham, Velika Britanija in Northampton, ZDA, Elgar Reference Collection: 519 str.
Barrie Needham, Dutch land-use planning : the principles and the practice, Ashgate, 2014
Ioannis Mahakos; Matthias Braun, Land use and land cover mapping in Europe : practices & trends, Dordrecht : Springer, 2014
Aktualne raziskave na spletnih straneh www.espon.eu ter druge aktualne raziskave na ravni EU in OECD ter drugih evropskih in svetovnih institucij.

Cilji in kompetence:	**Objectives and competences:**
Cilj predmeta je poglobitev znanj na področju razumevanja konceptov prostorskega razvoja s poudarkom na rabah prostora in pokrovnosti tal (opredelitev pojmov, tipologija vzorcev rabe prostora glede na izbran koncept in opredeljene dejavnike prostorskega razvoja), konceptov pravic in omejitev na zemljiščih, varstvenih režimov in razpoložljivih naravnih ter družbeno-ekonomskih potencialov prostora. Glede na opredeljene naravne, človeške, gospodarske in druge vire ter omejitve v prostoru je poudarek na razumevanju razvojnih potreb in procesov v prostoru ter kritični uporabi različnih podatkovnih virov v ta namen. Študent se pri predmetu seznani s temeljnimi in najnovejšimi teorijami in metodami raziskav v prostorskih znanostih.	The student becomes familiar and gains a deeper understanding of the definitions and concepts of spatial development with special emphasis on the land use and land cover (terms definitions, typology of land use patterns concerning chosen concepts, recognized historical development and current driving forces for the changing of uses of land), concepts of land-ownership characteristics, rights and restrictions on land plot uses, protection of spatial (natural and cultural) resources, and natural and socio-economic potentials for sustainable spatial development. Concerning all the aforementioned restrictions, protections and potentials emphasis needs to be given in order to understand spatial development processes and challenges.The theories and methods in the fields of spatial sciences will be introduced.

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

Razumevanje procesov v prostoru občin ter regij; razumevanje različnih metod in tehnik načrtovanja, razumevanje vloge sektorjev in rabe prostora. Kritičen odnos do posegov v prostor, do uravnovešanja razvojnih in varovalnih vidikov. Lastna opažanja prostorskih procesov v občini in regiji, soočanje vloge raznih disciplin in sektorjev.	Understanding of spatial processes in municipalities and regions; understanding of different methods and techniques of planning, the role of sectors and land use. Critical attitude to spatial developments, towards balancing the aspects of development and protection. Students' own observations of spatial processes in municipality and region, confrontation of various fields and sectors.

Metode poučevanja in učenja:	**Learning and teaching methods:**
Predavanja, interaktivna predavanja, seminar.	Lectures, interactive lectures, seminar.

Načini ocenjevanja:	**Delež/Weight**	**Assessment:**
Seminarska naloga s projektnim delom	100,00 %	Seminar work with project work

Reference nosilca/Lecturer's references:

KETE, Primož, MIVŠEK, Edvard, JANEŽIČ, Miran, MESNER, Nika, ZAVODNIK LAMOVŠEK, Alma, FOŠKI, Mojca, DROBNE, Samo, KOBETIČ, Leon, KOŠIR, Uroš, PUHAR, Martin, ČERNE, Tomaž, GRILC, Matjaž. Izdelava metodologije za zajem podatkov o dejanski rabi pozidanih zemljišč : poročilo o opravljenem delu - zaključno poročilo. Geodetski inštitut Slovenije; Ljubljana, 2013. 99 str., ilustr. [COBISS.SI-ID 6721633]
ZAVODNIK LAMOVŠEK, Alma. Vpliv spreminjanja rabe prostora na podobo kulturne krajine. V: HUDOKLIN, Jelka (ur.), SIMIČ, Suzana (ur.). Podeželska krajina kot razvojni potencial : zbornik prispevkov posveta Društva krajinskih arhitektov Slovenije, 18. april 2013, Ljubljana. Ljubljana: Društvo krajinskih arhitektov Slovenije, 2013, str. 33-38, ilustr. [COBISS.SI-ID 6249569]

DROBNE, Samo, ŽAUCER, Tadej, FOŠKI, Mojca, ZAVODNIK LAMOVŠEK, Alma. Strnjenost pozidanih površin kot merilo za določanje območij mestnih naselij = Continuous built-up areas as a measure for delineation of urban settlements. Geodetski vestnik, ISSN 0351-0271. [Tiskana izd.], 2014, letn. 58, št. 1, str. 69-102, ilustr. http://geodetski-vestnik.com/cms/images/58/1/gv58-1_drobne1.pdf, doi: 10.15292/geodetski-vestnik.2014.01.069-102. [COBISS.SI-ID 6541665]

POGAČNIK, Andrej, ZAVODNIK LAMOVŠEK, Alma, DROBNE, Samo. A Proposal for Dividing Slovenia into Provinces. Lex localis, ISSN 1581-5374, oktober 2009, letn. 7, št. 4, str. 393-423, ilustr. [COBISS.SI-ID 4781665]

PICHLER-MILANOVIĆ, Nataša, FOŠKI, Mojca, ZAVODNIK LAMOVŠEK, Alma. Turas: Prehod k odpornosti v trajnostnem razvoju mest = Turas: Transitioning towards urban resilience and sustainability. Geodetski vestnik, ISSN 0351-0271. [Tiskana izd.], 2014, letn. 58, št. 1, str. 159-166, ilustr. http://geodetski-vestnik.com/cms/images/58/1/gv58-1_pichler.pdf. [COBISS.SI-ID 6542177]

ZAVODNIK LAMOVŠEK, Alma, KERPAN, Nina, FOŠKI, Mojca. Spremembe namenske rabe prostora glede na razvoj slovenske prostorske zakonodaje v obdobju 1984-2007. Urbani izziv, Posebna izdaja, ISSN 2232-481X, 2012, str. 5-17, ilustr. [COBISS.SI-ID 2496963]

ZAVODNIK LAMOVŠEK, Alma, DROBNE, Samo. Vloga in razvoj urbanih središč v trajnostnem prostorskem razvoju Slovenije = The role and developmentof the urban centres in sustainable spatial development of Slovenia. V: BREZOVEC, Aleksandra (ur.), MEKINC, Janez (ur.). Management, izobraževanje in turizem : družbena odgovornost za trajnostni razvoj : 2. znanstvena konferenca z mednarodno udeležbo, 21.-22. oktober 2010, Portorož : zbornik referatov = proceedings. Portorož: Turistica, Fakulteta za turistične študije, 2010, str. 2296-2305, ilustr. [COBISS.SI-ID 5169761]

UČNI NAČRT PREDMETA/COURSE SYLLABUS

Predmet:	Programiranje distribuiranih inženirskih aplikacij
Course title:	Programming Distributed Engineering Applications

Študijski programi in stopnja	Študijska smer	Letnik	Semestri
Grajeno okolje, tretja stopnja, doktorski	Ni členitve (študijski program)		Letni, Zimski

Univerzitetna koda predmeta/University course code: 1540

Predavanja	Seminar	Vaje	Klinične vaje	Druge oblike študija	Samostojno delo	ECTS
15	30	30	0	50	0	5

Nosilec predmeta/Lecturer: Vlado Stankovski

Vrsta predmeta/Course type: Izbirni predmet/Elective course

Jeziki/Languages:

Predavanja/Lectures:	Slovenščina, Angleščina
Vaje/Tutorial:	Slovenščina, Angleščina

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

- Pregled nad standardi na področju storitveno-orientirane arhitekture in distribuiranega računanja.
- Pregled tehnologij za distribuirano računanje: programska oprema kot storitev, grid, cloud, peer-to-peer.
- Uporaba aplikacijskih programskih vmesnikov različnih okolij za distribuirano računanje.
- Praktična uporaba izbranega okolja za distribuirano računanje oziroma oblakovne platforme.
- Načini in postopki predelave obstoječih programov in algoritmov za uporabo v distribuiranih okoljih. Uporaba programerskih tehnik in skriptnih jezikov (npr. javascript, java, C++, Python).
- Načini in postopki izdelave inženirskih aplikacij (storitev) dostopnih prek Interneta.
- Uporaba tehnologij delotokov pri reševanju inženirskih problemov.
- Nameščanje prilagojenega sistemskega programja in priklop na obstoječo virtualno organizacijo za distribuirano računanje.

Pridobljene kompetence:

- Študent zna primerno analizirati inženirski problem ter zna izdelati načrt distribuirane aplikacije.
- Študent zna namestiti in uporabljati izbrano okolje za distribuirano računanje pri reševanju zastavljenega problema.
- Študent zna poseči v programsko kodo obstoječega programa ali algoritma in jo zna predelati za izvajanje v izbranem okolju za distribuirano računanje.

Prerequisites:

- Overview of Service-Oriented Architecture and parallel and distributed computing related standards.
- Technologies for distributed computing: program as a service, grid, cloud, peer-to-peer.
- Application Programming Interfaces for various distributed computing middleware solutions and platforms.
- Practical use of selected distributed computing middleware or Cloud computing platform.
- Methods and procedures for enabling existing programs and algorithms for distributed computing. The use of programming techniques and script languages (e.g. javascript, java, C++, Python).
- The methods and procedures for developing engineering services exhibiting interfaces over the Internet.
- The use of workflow technologies for solving engineering problems.
- Installation of a selected middleware solution and joining an existing virtual organisation for distributed computing.

Acquired competences:

- Skills to properly define a data and/or computationally intensive problem and to design a distributed application.
- Skills to install and to use a selected middleware solution for distributed computing for the solution of a selected problem.

	• The student is able to adapt an existing program or algorithm for execution in a distributed computing environment.

Vsebina:	**Content (Syllabus outline):**
Vrste podatkovno in računsko intenzivnih inženirskih problemov. Definicija zahtev končnih uporabnikov: storilnost, učinkovitost, zmogljivost, novi načini rabe obstoječih programov in algoritmov, prožnost uporabe, spremljanje in nadzor izvajanja aplikacij, vzdrževanje, integracija, uporabniški vmesniki. Definicija aplikacijskih in sistemskih zahtev: razširljivost, nadgradljivost, medobratovalnost, podpora parametričnim študijam. Storitveno-orientirana arhitektura in razvijajoči se Internetski standardi na tem področju. Arhitekture, metode in tehnike za distribuirano računanje: posredovanje virov in razvrščanje računskih poslov, upravljanje s podatki, upravljanje z metapodatki, spremljanje in nadzor virov. Obstoječa prilagojena sistemska programja. Načini uporabe aplikacijskih programskih vmesnikov: program kot storitev, računalniške gruče, tehnologije grid, cloud in peer-to-peer. Ocena primernosti obstoječih programov ali algoritmov za izvajanje v okoljih za paralelno in distribuirano računanje. Načini in postopki priprave ali predelave programov in algoritmov za izvajanje v distribuiranih okoljih. Programiranje distribuiranih aplikacij s poudarkom na uporabo programskih jezikov, kot so java, Python ipd. Kvaliteta storitev in dogovor na ravni storitev, zasebnost in varnost, virtualne organizacije. Okolja za urejanje in izvajanje delotokov. Distribuirani operacijski sistemi. Semantični splet, grid, cloud.	Types of data and computationally intensive engineering problems. Definition of user requirements: performance, efficiency, new ways of using existing programs and algorithms, flexibility, execution monitoring, maintenance, integration, user interfaces. Definition of application and system requirements: extensibility, scalability, speed-up, interoperability, support for parametric studies. Service-oriented architecture and evolving Internet standards in the area of distributed computing. Architectures, methods and techniques for distributed computing: resource brokering; job, data and metadata management; resource monitoring. Existing middleware solutions and their use: software as a service, computer clusters, grids, cloud, sky and peer-to-peer. Assessment of the suitability of an existing program or algorithm for execution in parallel and distributed computing environments. Methods and procedures for enabling programs and algorithms for execution in distributed computing environments. Programming distributed applications with accent on programming languages, such as java, Python etc. Quality of Service and Service-Level Agreements, privacy and security, virtual organizations. Workflow editors and managers. Distributed Operating Systems. Semantic Web, Grid and Cloud.

Temeljna literatura in viri/Readings:

1. Reese, G. 2009. Cloud Application Architectures, Building Applications and Infrastructure in the Cloud, O'Reilly Media, p. 208.
2. Taylor, I.J., Deelman, E., Gannon, D.B., Shields, M. (uredniki). 2007. Workflows for e-Science Scientific Workflows for Grids. XXII, ISBN: 978–1–84628–519–6: 530p.,181f.

The above readings are informative only. Articles in international scientific journals and other text-books related to the seminar work will be considered.
Other sources: web-links provided at lectures.

Cilji in kompetence:	**Objectives and competences:**
Cilj predmeta je ponuditi študentom metodologijo, tehnike in orodja za reševanje računsko in podatkovno intenzivnih inženirskih problemov. Študent pridobi kompetenco uporabe izbranega okolja za distribuirano računanje.	The course goal is to theach students the methodology, techniques and tools for solving computationally and data intensive engineering problems. The student will gain a competence of using a selected distributed computing environment.

Predvideni študijski rezultati:	**Intended learning outcomes:**
Znanje in razumevanje:	Knowledge and understanding:

Študent razume prednosti uporabe okolij za distribuirano računanje pri reševanju računsko ali podatkovno intenzivnih inženirskih problemov. Študent razume glavne tehnološke probleme pri predelavi obstoječih inženirskih aplikacij za izvajanje v distribuiranem računskem okolju. Študent razume evolucijo Interneta v smer distribuirane računske infrastrukture. Študent se nauči uporabljati različne skriptne jezike.	The student understands the benefits of using distributed computing platforms when solving computationally and data intensive engineering problems. The student understands the key technological problems when enabling an existing engineering application for execution in a distributed computing environment. The student understands the evolution of the Internet towards a distributed computing infrastructure. The student will know how to use various scripting languages.

Metode poučevanja in učenja:	**Learning and teaching methods:**
Predavanja, laboratorijske vaje, kjer se študenti naučijo nameščati in uporabljati različna prilagojena sistemska programja, izdelava seminarja, konzultacije, študij literature.	Lectures, laboratory work, where students learn how to install and use different middleware solutions and Cloud computing platforms, develop distributed applications, seminar work, consultations, study of literature.

Načini ocenjevanja:	**Delež/Weight**	**Assessment:**
Izdelava seminarske naloge in njena predstavitev	70,00 %	Seminar work and its presentation
Ustni izpit	30,00 %	An oral exam

Reference nosilca/Lecturer's references:

1. JUŽNA, Jernej, ČEŠAREK, Peter, PETCU, Dana, STANKOVSKI, Vlado. Solving solid and fluid mechanics problems in the cloud with mOSAIC. IEEE Computing in science & engineering, [Print ed.], 2014, 16 (3), pp. 68-77. [COBISS.SI-ID 6470497]
2. KÖNIG, Matija, DIRNBEK, Jaka, STANKOVSKI, Vlado. Architecture of an open knowledge base for sustainable buildings based on Linked Data technologies. Automation in construction, ISSN 0926-5805. [Print ed.], nov. 2013, 35, pp. 542-550. [COBISS.SI-ID 6309473]
3. MARKIČ, Štefan, STANKOVSKI, Vlado. An equation-discovery approach to earthquake-ground-motion prediction. Engineering applications of artificial intelligence. [Print ed.], apr. 2013, 26 (4), pp. 1339-1347. [COBISS.SI-ID 6210657]
4. STANKOVSKI, Vlado, PETCU, Dana. Developing a Model Driven Approach for engineering applications based on mOSAIC: Towards sharing elastic components in the Cloud. Cluster computing, ISSN 1386-7857, 2014,17 (1), pp. 101-110. [COBISS.SI-ID 6248289]

UČNI NAČRT PREDMETA/COURSE SYLLABUS

Predmet:	Projektiranje in utrditev armiranobetonskih mostov na potresnih območjih
Course title:	Seismic Design and Strengthening of Reinforced Concrete Bridges

Študijski programi in stopnja	Študijska smer	Letnik	Semestri
Grajeno okolje, tretja stopnja, doktorski	Ni členitve (študijski program)		Letni, Zimski

Univerzitetna koda predmeta/University course code: 1114

Predavanja	Seminar	Vaje	Klinične vaje	Druge oblike študija	Samostojno delo	ECTS
20	20	0	0	0	85	5

Nosilec predmeta/Lecturer: Tatjana Isaković

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:
Znanje, ki je enakovredno tistemu pridobljenemu na I. In II. stopnji univerzitetnega študijskega programa Gradbeništvo na UL FGG in sicer v okviru predmetov: Betonske konstrukcije, Osnove potresnega inženirstva, Trdnost, Statika linijskih konstrukcij, Statika gradbenih konstrukcij, DGK in potresno inženirstvo, Zasnova gradbenih konstrukcij.	Knowledge equivalent to the knowledge obtained within the 1st and the 2nd degree of the study program "Civil Engineering" given at the Faculty of Civil and Geodetic Engineering at the University of Ljubljana; in particular within the courses: Concrete Structures, Basis of Earthquake Engineering, Mechanics of Solids, Structural Engineering, Structural Dynamics and Earthquake Engineering, Conceptual Design of Structures

Vsebina:	Content (Syllabus outline):
Uvodni del: osnovni principi projektiranja mostov na potresnih območjih 1. Modeliranje značilnih elementov in njihova nelinearna analiza 2. Projektiranje 3. Izbrana poglavja, ki se nanašajo na doktorsko nalogo študenta	INTRODUCTION: Basic principles of the seismic design of bridges 1. Modelling of bridges (including some typical elements) and their nonlinear analysis 2. Design 3. Chosen topics, which are related to the Ph.D. thesis of the student

Temeljna literatura in viri/Readings:

1. PRIESTLEY M.J.N., SEIBLE F., CALVI G.M., Seismic Design and Retrofit of Bridges, John Wiley & Sons, 1996.
2. SKINNER, R.I., ROBINSON, W.H., McVERRY, G. H., An Introduction to Seismic isolation, John Wiley & Sons, 1993.
3. XANTHAKOS Petros P., Theory and design of bridges, John Wiley & Sons, New York, 1994.
4. TONIAS, Demetrios E., Bridge Engineering, 2nd. Ed., McGraw Hill, New York, 2007.
5. RYALL, M.J., PARKE G:A:R., HARDING, J.E., Manual of Bridge Engineering, The Institution of Civil Engineers, Tomas Telford, 2000.
6. KAPPOS, Andreas J. (urednik), SAIIDI, M. Saiid (urednik), AYDINOĞLU, M. Nuray (urednik), ISAKOVIĆ, Tatjana (urednik). Seismic design and assessment of bridges : inelastic methods of analysis and case studies, (Geotechnical, geological and earthquake engineering, Vol. 21). Dordrecht [etc.]: Springer, cop. 2012. XII, 221 str.

7. PRIESTLEY MJN, CALVI GM, KOWALSKY MJ, Displacement based Seismic Design of Structures, IUSS Press, Pavia, 2007
8. SIST EN 1998-2:2006 - Evrokod 8 - Projektiranje konstrukcij na potresnih območjih - 2. del: Mostovi - Eurocode 8 - Design of structures for earthquake resistance - Part 2: Bridges
9. SIST EN 1998-3:2005 - Evrokod 8: Projektiranje potresnoodpornih konstrukcij – 3. del: Ocena in prenova stavb - Eurocode 8: Design of structures for earthquake resistance - Part 3: Assessment and retrofitting of buildings
10. SIST EN 1992-2:2005 - Evrokod 2: Projektiranje betonskih konstrukcij – 2. del: Betonski mostovi – Projektiranje in pravila za konstruiranje - Eurocode 2 - Design of concrete structures - Concrete bridges - Design and detailing rules

Cilji in kompetence:	**Objectives and competences:**
Študenti pridobijo znanje o osnovnih principih projektiranja in nelinearne analize odziva novih mostov na potresnih območjih. Spoznajo osnovne principe potresne utrditve in potresne sanacije obstoječih konstrukcij in metode in postopke za oceno njihovega potresnega odziva. Posebna pozornost je namenjena principom potresne izolacije novih in obstoječih mostov.	Students gain the knowledge about the basic principles of the analysis and design of bridges in seismic areas and about nonlinear analysis of new bridges. They learn the basics principles of the seismic strengthening and retrofit, as well as about the assessment of as-built and strengthened structures. A special attention is devoted to the principles of seismic isolation of new and existing bridges.

Predvideni študijski rezultati:	**Intended learning outcomes:**
Znanje in razumevanje: Študent razume in obvlada principe potresnega projektiranja mostov, ter principe in postopke za njihovo potresno izolacijo in potresno utrditev. Znanje v okviru predmeta je osnova za nadaljnje raziskovalno delo na področju projektiranja mostov in njihove utrditve na potresnih območjih.	Knowledge and understanding: Student obtains the knowledge and understands the principles of the seismic design of bridges, principles of the seismic isolation as well as the procedures for the seismic assessment and retrofit of existing bridges. The knowledge, which is obtained within this course, is the bases for the research at the filed of the seismic design and strengthening of RC bridges.

Metode poučevanja in učenja:	**Learning and teaching methods:**
Predavanja, seminar	Lectures, Seminar

Načini ocenjevanja:	**Delež/Weight**	**Assessment:**
Pisni izpit	40,00 %	Wiritten exam
Ustni izpit	30,00 %	Oral exam
Seminarska naloga	30,00 %	Seminar

Reference nosilca/Lecturer's references:

1. KAPPOS, Andreas J. (urednik), SAIIDI, M. Saiid (urednik), AYDINOĞLU, M. Nuray (urednik), ISAKOVIĆ, Tatjana (urednik). Seismic design and assessment of bridges : inelastic methods of analysis and case studies, (Geotechnical, geological and earthquake engineering, Vol. 21). Dordrecht [etc.]: Springer, cop. 2012. XII, 221 str.
2. ISAKOVIĆ, Tatjana. Assessment of Existing Structures Using Inelastic Static Analysis. V: BEER, Michael (ur.). Encyclopedia of Earthquake Engineering. Berlin: Springer, 2014, str. 1-14, ilustr., doi: 10.1007/978-3-642-36197-5_201-1
3. ISAKOVIĆ, Tatjana, FISCHINGER, Matej. Inelastic Shear response and Strengthening of RC Bridge Hollow Box Piers. V: FISCHINGER, Matej (ur.). Performance-based seismic engineering : vision for an earthquake resilient society, (Geotechnical, geological, and earthquake engineering, ISSN 1573-6059, vol. 32). Dordrecht [etc.]: Springer, cop. 2014, str. 77-90.
4. ISAKOVIĆ, Tatjana, FISCHINGER, Matej. Seismic analysis and design of bridges with an emphasis to Eurocode standards. V: ANSAL, Atilla (ur.). Perspectives on European Earthquake Engineering and Seismology : Vol. 1, (Geotechnical, geological and earthquake engineering, ISSN 1573-6059, Vol. 34). Berlin: Springer, cop. 2014, str. 195-225.
5. ZOUBEK, Blaž, FAHJAN, Yasin, FISCHINGER, Matej, ISAKOVIĆ, Tatjana. Nonlinear finite element modelling of centric dowel connections in precast buildings. Computers and Concrete, ISSN 1598-8198, 2014, št. 4, letn. 14, str. 463-477, 2014, št. 4, letn. 14, str. 463-477.

6. VIDRIH, Zlatko, FISCHINGER, Matej, ISAKOVIĆ, Tatjana. Numerical investigation on smart magnetically controlled elastomeric bearings. Journal of vibration and control, ISSN 1077-5463. [Tiskana izd.], nov. 2012, letn. 18, št. 13, str. 2073-2084.
7. ISAKOVIĆ, Tatjana, FISCHINGER, Matej. Applicability of Pushover Methods to the Seismic Analyses of an RC Bridge, Experimentally Tested on Tree Shake Tables. Journal of earthquake engineering, ISSN 1363-2469, 2011, št. 2, letn. 15, str. 303-320.
8. ISAKOVIĆ, Tatjana, ZEVNIK, Jaka, FISCHINGER, Matej. Floor response spectra in isolated structures subjected to earthquakes weaker than the design earthquake. Part 2, Isolation with magnetically controlled elastomeric bearings. Structural control & health monitoring, ISSN 1545-2255. [Print ed.], 2011, letn. 18, št. 5, str.540-553.
9. ISAKOVIĆ, Tatjana, ZEVNIK, Jaka, FISCHINGER, Matej. Floor response spectra in isolated structures subjected to earthquakes weaker than the design earthquake. Part 1, Isolation with high-damping rubber bearings. Structural control & health monitoring, ISSN 1545-2255. [Print ed.], 2011, letn. 18, št. 6, str. 635-659.
10. ISAKOVIĆ, Tatjana, FISCHINGER, Matej. Simplified nonlinear method for the analysis of concrete bridges. Građevinar, ISSN 0350-2465, 2009, letn. 61, št. 7, str. 625-633.

UČNI NAČRT PREDMETA/COURSE SYLLABUS

Predmet:	Projektiranje in utrditev armiranobetonskih mostov na potresnih območjih
Course title:	Seismic Design and Strengthening of Reinforced Concrete Bridges

Študijski programi in stopnja	Študijska smer	Letnik	Semestri
Grajeno okolje, tretja stopnja, doktorski	Ni členitve (študijski program)		Letni, Zimski

Univerzitetna koda predmeta/University course code: 1882

Predavanja	Seminar	Vaje	Klinične vaje	Druge oblike študija	Samostojno delo	ECTS
40	40	0	0	0	170	10

Nosilec predmeta/Lecturer: Tatjana Isaković

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:
Znanje, ki je enakovredno tistemu pridobljenemu na I. In II. stopnji univerzitetnega študijskega programa Gradbeništvo na UL FGG in sicer v okviru predmetov: Betonske konstrukcije, Osnove potresnega inženirstva, Trdnost, Statika linijskih konstrukcij, Statika gradbenih konstrukcij, DGK in potresno inženirstvo, Zasnova gradbenih konstrukcij.	Knowledge equivalent to the knowledge obtained within the 1st and the 2nd degree of the study program "Civil Engineering" given at the Faculty of Civil and Geodetic Engineering at the University of Ljubljana; in particular within the courses: Concrete Structures, Basis of Earthquake Engineering, Mechanics of Solids, Structural Engineering, Structural Dynamics and Earthquake Engineering, Conceptual Design of Structures

Vsebina:	Content (Syllabus outline):
Uvodni del: osnovni principi projektiranja mostov na potresnih območjih 1. Modeliranje značilnih elementov in njihova nelinearna analiza 2. Projektiranje 3. Potresna izolacija 4. Ocena nosilnosti in duktilnosti obstoječih mostov in potresna utrditev obstoječih mostov 5. Izbrana poglavja, ki se nanašajo na doktorsko nalogo študenta	INTRODUCTION: Basic principles of the seismic design of bridges 1. Modelling of bridges and their nonlinear analysis 2. Design 3. Seismic isolation of bridges 4. Seismic assessment and strengthening of existing bridges 5. Chosen topics, which are related to the Ph.D. thesis of the student

Temeljna literatura in viri/Readings:

1. PRIESTLEY M.J.N., SEIBLE F., CALVI G.M., Seismic Design and Retrofit of Bridges, John Wiley & Sons, 1996.
2. SKINNER, R.I., ROBINSON, W.H., McVERRY, G. H., An Introduction to Seismic isolation, John Wiley & Sons, 1993.
3. XANTHAKOS Petros P., Theory and design of bridges, John Wiley & Sons, New York, 1994.
4. TONIAS, Demetrios E., Bridge Engineering, 2nd. Ed., McGraw Hill, New York, 2007.
5. RYALL, M.J., PARKE G:A:R., HARDING, J.E., Manual of Bridge Engineering, The Institution of Civil Engineers, Tomas Telford, 2000.

6. KAPPOS, Andreas J. (urednik), SAIIDI, M. Saiid (urednik), AYDINOĞLU, M. Nuray (urednik), ISAKOVIĆ, Tatjana (urednik). Seismic design and assessment of bridges : inelastic methods of analysis and case studies, (Geotechnical, geological and earthquake engineering, Vol. 21). Dordrecht [etc.]: Springer, cop. 2012. XII, 221 str.
7. PRIESTLEY MJN, CALVI GM, KOWALSKY MJ, Displacement based Seismic Design of Structures, IUSS Press, Pavia, 2007
8. SIST EN 1998-2:2006 - Evrokod 8 - Projektiranje konstrukcij na potresnih območjih - 2. del: Mostovi - Eurocode 8 - Design of structures for earthquake resistance - Part 2: Bridges
9. SIST EN 1998-3:2005 - Evrokod 8: Projektiranje potresnoodpornih konstrukcij – 3. del: Ocena in prenova stavb - Eurocode 8: Design of structures for earthquake resistance - Part 3: Assessment and retrofitting of buildings
10. SIST EN 1992-2:2005 - Evrokod 2: Projektiranje betonskih konstrukcij – 2. del: Betonski mostovi – Projektiranje in pravila za konstruiranje - Eurocode 2 - Design of concrete structures - Concrete bridges - Design and detailing rules

Cilji in kompetence:	**Objectives and competences:**
Študenti pridobijo znanje o osnovnih principih projektiranja in nelinearne analize odziva novih mostov na potresnih območjih. Spoznajo osnovne principe potresne utrditve in potresne sanacije obstoječih konstrukcij in metode in postopke za oceno njihovega potresnega odziva. Posebna pozornost je namenjena principom potresne izolacije novih in obstoječih mostov.	Students gain the knowledge about the basic principles of the analysis and design of bridges in seismic areas and about nonlinear analysis of new bridges. They learn the basics principles of the seismic strengthening and retrofit, as well as about the assessment of as-built and strengthened structures. A special attention is devoted to the principles of seismic isolation of new and existing bridges.

Predvideni študijski rezultati:	**Intended learning outcomes:**
Znanje in razumevanje: Študent razume in obvlada principe potresnega projektiranja mostov, ter principe in postopke za njihovo potresno izolacijo in potresno utrditev. Znanje v okviru predmeta je osnova za nadaljnje raziskovalno delo na področju projektiranja mostov in njihove utrditve na potresnih območjih.	Knowledge and understanding: Student obtains the knowledge and understands the principles of the seismic design of bridges, principles of the seismic isolation as well as the procedures for the seismic assessment and retrofit of existing bridges. The knowledge, which is obtained within this course, is the bases for the research at the filed of the seismic design and strengthening of RC bridges.

Metode poučevanja in učenja:	**Learning and teaching methods:**
Predavanja, seminar	Lectures, Seminar

Načini ocenjevanja:	**Delež/Weight**	**Assessment:**
Pisni izpit	40,00 %	Wiritten exam
Seminarska naloga	30,00 %	Seminar
Ustni izpit	30,00 %	Oral exam

Reference nosilca/Lecturer's references:

1. KAPPOS, Andreas J. (urednik), SAIIDI, M. Saiid (urednik), AYDINOĞLU, M. Nuray (urednik), ISAKOVIĆ, Tatjana (urednik). Seismic design and assessment of bridges : inelastic methods of analysis and case studies, (Geotechnical, geological and earthquake engineering, Vol. 21). Dordrecht [etc.]: Springer, cop. 2012. XII, 221 str.
2. ISAKOVIĆ, Tatjana. Assessment of Existing Structures Using Inelastic Static Analysis. V: BEER, Michael (ur.). Encyclopedia of Earthquake Engineering. Berlin: Springer, 2014, str. 1-14, ilustr., doi: 10.1007/978-3-642-36197-5_201-1
3. ISAKOVIĆ, Tatjana, FISCHINGER, Matej. Inelastic Shear response and Strengthening of RC Bridge Hollow Box Piers. V: FISCHINGER, Matej (ur.). Performance-based seismic engineering : vision for an earthquake resilient society, (Geotechnical, geological, and earthquake engineering, ISSN 1573-6059, vol. 32). Dordrecht [etc.]: Springer, cop. 2014, str. 77-90.
4. ISAKOVIĆ, Tatjana, FISCHINGER, Matej. Seismic analysis and design of bridges with an emphasis to Eurocode standards. V: ANSAL, Atilla (ur.). Perspectives on European Earthquake Engineering and Seismology : Vol. 1, (Geotechnical, geological and earthquake engineering, ISSN 1573-6059, Vol. 34). Berlin: Springer, cop. 2014, str. 195-225.

5. ZOUBEK, Blaž, FAHJAN, Yasin, FISCHINGER, Matej, ISAKOVIĆ, Tatjana. Nonlinear finite element modelling of centric dowel connections in precast buildings. Computers and Concrete, ISSN 1598-8198, 2014, št. 4, letn. 14, str. 463-477, 2014, št. 4, letn. 14, str. 463-477.
6. VIDRIH, Zlatko, FISCHINGER, Matej, ISAKOVIĆ, Tatjana. Numerical investigation on smart magnetically controlled elastomeric bearings. Journal of vibration and control, ISSN 1077-5463. [Tiskana izd.], nov. 2012, letn. 18, št. 13, str. 2073-2084.
7. ISAKOVIĆ, Tatjana, FISCHINGER, Matej. Applicability of Pushover Methods to the Seismic Analyses of an RC Bridge, Experimentally Tested on Tree Shake Tables. Journal of earthquake engineering, ISSN 1363-2469, 2011, št. 2, letn. 15, str. 303-320.
8. ISAKOVIĆ, Tatjana, ZEVNIK, Jaka, FISCHINGER, Matej. Floor response spectra in isolated structures subjected to earthquakes weaker than the design earthquake. Part 2, Isolation with magnetically controlled elastomeric bearings. Structural control & health monitoring, ISSN 1545-2255. [Print ed.], 2011, letn. 18, št. 5, str.540-553.
9. ISAKOVIĆ, Tatjana, ZEVNIK, Jaka, FISCHINGER, Matej. Floor response spectra in isolated structures subjected to earthquakes weaker than the design earthquake. Part 1, Isolation with high-damping rubber bearings. Structural control & health monitoring, ISSN 1545-2255. [Print ed.], 2011, letn. 18, št. 6, str. 635-659.
10. ISAKOVIĆ, Tatjana, FISCHINGER, Matej. Simplified nonlinear method for the analysis of concrete bridges. Građevinar, ISSN 0350-2465, 2009, letn. 61, št. 7, str. 625-633.

UČNI NAČRT PREDMETA/COURSE SYLLABUS

Predmet:	Prostorske linijske konstrukcije
Course title:	Spatial Beam Structures

Študijski programi in stopnja	Študijska smer	Letnik	Semestri
Grajeno okolje, tretja stopnja, doktorski	Ni členitve (študijski program)		Letni, Zimski

Univerzitetna koda predmeta/University course code: 1115

Predavanja	Seminar	Vaje	Klinične vaje	Druge oblike študija	Samostojno delo	ECTS
35	0	5	0	0	85	5

Nosilec predmeta/Lecturer: Dejan Zupan

Vrsta predmeta/Course type: Izbirni predmet/Elective course

Jeziki/Languages:

Predavanja/Lectures:	Slovenščina, Angleščina
Vaje/Tutorial:	Slovenščina, Angleščina

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:	Prerequisites:
Ni posebnih pogojev.	No prerequisits.

Vsebina:	Content (Syllabus outline):
Lastnosti zveznih enačb prostorskih nosilcev - *Enačbe prostorskih linijskih nosilcev.* Pregled enačb. Abstraktni in matrični zapis. Relativni in absolutni odvod. Variacijske konstante. Naravna izbira baz za posamezne količine. - *Rotacije.* Objektivnost prostorskih rotacij. Zveza med rotacijami in deformacijami. - *Konsistenca.* Ravnotežne in konstitucijske enačbe. Konsistenca notranjih sil in konsistenca deformacijskih količin. Enakost ravnotežnih in konstitucijskih sil. - *Nelinearnost konstitucijskih enačb.* Opis vpliva nelinearnosti materiala na enačbe prostorskega nosilca. **Diskretizacija enačb** - Posebni prijemi pri klasični formulaciji s pomiki in zasuki. Konstrukcija posebnih oblikovnih funkcij za zasuke. Formulacija Jelenić-Crisfield. - *Kvaternionska formulacija prostorskih nosilcev*. Opis zasukov s kvaternioni. Naravne oblikovne funkcije za kvaternione. - *Deformacijska formulacija linijskih nosilcev.* Izbira deformacijskih vektorjev za osnovne neznanke problema. Posebnosti pri linearizaciji enačb. Vpliv na numerično reševanje diskretnih enačb. **Stabilnost** - *Posebnosti pri deformacijski teoriji prostorskih linijskih nosilcev.* Upoštevanje nelinearnosti konfiguracijskega prostora pri izbiri obtežno deformacijske veje.	**Spatial beam equations** - *Spatial beam equations.* Classification of equation. Abstract-vector and component-matrix description. Relative in absolute derivative. Variational constants. Natural choice of vector bases for beam unknowns. - *Rotations.* Objectivity of spatial rotations. Kinematic equations. - *Consistency.* Equilibrium and constitutive equations. Consistency of stresses and strains. Reasons for discrepancies between equilibrium and constitutive stresses. - *Non-linearity of constitutive equations.* Influences of non-linear constitutive equations on the overall solving of beam structure. **Discretization** - *Special approaches in formulations based on displacements and rotations.* Construction of special shape functions for rotations. Formulation by Jelenić and Crisfield. - *Quaternion-based formulation.* Parameterization of rotations with rotational quaternion. Natural shape functions for quaternion interpolation. - *Strain-based formulation.* Strain vectors chosen for the primary unknowns of the problem. Specialities in linearization and update procedure. **Stability**

- *Vplivi nepopolnosti.* Geometrijska in materialna nepopolnost. Delaminacije. Modeliranje materialnih zakonov med sloji nosilca. **Računalniški program** Avtorski program za deformacijsko analizo prostorskih okvirjev. Opis programa. Pojasnila k razvoju programskih orodij v Matlabu s poudarkom na analizi prostorskih konstrukcij.	- *Specialities in strain-based spatial beam formulation.* Non-linearity of configuration space and its consideration in choosing the load-deflection path. - *Imperfections.* Geometrical in material imperfections. Delaminations. Modelling of the constitutive laws between the layers. **Computer program** Program, developed by lecturer, for finite element strain-based analysis of spatial frames.

Temeljna literatura in viri/Readings:

M.A. Crisfield, G. Jelenić, Objectivity of strain measures in the geometrically exact three- dimensional beam theory and its finite-element implementation, Proc. Roy. Soc. London A
455, 1125—1147, 1999.
D. Zupan, Rotationally invariant strain measures in geometrically exact three-dimensional beam theory, PhD Thesis, Ljubljana, 2003
Web pages at the Chair of Mechanics: http://www.km.fgg.uni-lj.si

Cilji in kompetence:	**Objectives and competences:**
- Predstaviti koncepte, matematične modele in nelinearne prostorske linijske elemente, ki ohranjajo objektivnost prostorskih zasukov in konsistenco notranjih sil. - Predstaviti pomen spoznavanja invariant zveznega problema za razvoj sodobnih numeričnih metod za analizo prostorskih linijskih konstrukcij. - Podrobno predstaviti problem diskretizacije enačb prostorskih linijskih nosilcev in z diskretizacijo povezane izgube lastnosti zveznih enačb. - Predstaviti možne rešitve problema s poudarkom na geometrijsko točni deformacijski teoriji prostorskih linijskih nosilcev, skupaj z avtorskim računalniškim programom.	- To learn ideas, mathematical models and non-linear beam elements with objectivity of strains and consistency of stresses. - To learn and understand the importance of invariants in continuous problems for development of modern numerical methods for analysis of spatial beam structures. - To learn in detail the problem of discretization of beam equations and the possible loss of some properties of continuous system. - To show possible solutions based on geometrically exact beam theory together with the computer program, developed by lecturer.

Predvideni študijski rezultati:	**Intended learning outcomes:**
Znanje in razumevanje: - Razumeti lastnosti zveznih enačb prostorskih linijskih konstrukcij in pomen ohranjanja teh lastnosti pri numeričnem reševanju. - Znanje pristopov formulacije nosilcev po metodi končnih elementov, ki ne temeljijo na pomikih in zasukih. - Sposobnost uporabe ali nadaljnjega razvoja deformacijskih linijskih končnih elementov.	Knowledge and understanding: - Knowledge and comprehension of the importance of invariants in continuous problems for development of modern numerical methods for analysis of spatial beam structures. - Knowledge of the finite-element formulations of the spatial beam equations that are not displacement based. - Ability to use and further develop strain based beam elements.

Metode poučevanja in učenja:	**Learning and teaching methods:**
Predavanja, vaje z računalnikom, seminar, konsultacije.	Lectures, computer based learning and individual seminar work.

Načini ocenjevanja:	**Delež/Weight**	**Assessment:**
Izdelava seminarske naloge	70,00 %	Individual seminar work
Uspešna branitev naloge	30,00 %	Its explanation and oral examination

Reference nosilca/Lecturer's references:

ZUPAN, Eva, SAJE, Miran, **ZUPAN, Dejan**. The quaternion-based three-dimensional beam theory. Computer Methods in Applied Mechanics and Engineering, 2009, vol. 198, no. 49/52, p. 3944-3956.

ČEŠAREK, Peter, SAJE, Miran, **ZUPAN, Dejan**. Dynamics of flexible beams: Finite-element formulation based on interpolation of strain measures. Finite elements in analysis and design, 2013, vol. 72, p. 47-63.

ZUPAN, Eva, SAJE, Miran, **ZUPAN, Dejan**. On a virtual work consistent three-dimensional Reissner-Simo beam formulation using the quaternion algebra. Acta mechanica, 2013, vol. 224, no. 8, p. 1709-1729.

UČNI NAČRT PREDMETA/COURSE SYLLABUS

Predmet:	Raziskovanje vzpostavitve in vodenja topografskih podatkov
Course title:	Research of Topographic Data Establishment and Management

Študijski programi in stopnja	Študijska smer	Letnik	Semestri
Grajeno okolje, tretja stopnja, doktorski	Ni členitve (študijski program)		Letni, Zimski

Univerzitetna koda predmeta/University course code: 1116

Predavanja	Seminar	Vaje	Klinične vaje	Druge oblike študija	Samostojno delo	ECTS
30	0	10	0	85	0	5

Nosilec predmeta/Lecturer: Dušan Petrovič

Vrsta predmeta/Course type: Izbirni predmet/Elective course

Jeziki/Languages:

Predavanja/Lectures:	Slovenščina, Angleščina
Vaje/Tutorial:	Slovenščina, Angleščina

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:	Prerequisites:
Predhodno osvojena znanja iz kartografije in fotogrametrije v obsegu najmanj po 6 ECTS točk.	Prior mastered knowledge in cartography and photogrammetry in scope of 6 ECTS poins at minimum for each.

Vsebina:	Content (Syllabus outline):
P = Petrovič, F = Kosmatin Fras 1. pomen zagotavljanja topografskih podatkov (P) - uporabniki, namen - ustreznost matematične osnove, načrtovanje in izbira 2. posebnosti zajema topografskih podatkov (F) - množični zajem topografskih podatkov, posamični zajem in interpretacija - metode daljinskega zaznavanja (lasersko skeniranje, letalske in satelitske podobe) - topografska fotogrametrija: merske metode (enoslikovni, dvoslikovni, večslikovni postopki), oprema za snemanje in zajem, - integracija tehnologij, 3. organizacija in vodenje topografskih podatkov (P) - mednarodne organizacije, smernice in direktive (INSPIRE) - oblike vodenja podatkov - posebne potrebe uporabnikov - integracija uporabe podatkov v realnem času 4. kakovost topografskih podatkov (F) - zahteve in problematika kakovosti - model kakovosti, določevanje kakovosti	P = Petrovič, F = Kosmatin Fras 1. importance of topographic data (P) - users, purpose - appropriateness of mathematical basis, planning and selection 2. specialities of topographic data acquisition (F) - mass acquisition of topographic data, single acquisition and interpretation - remote sensing methods (laser scanning, aerial and satellite images) - topographic photogrammetry: metric methods (single, stereo and multiple images techniques), equipment for photogrammetric surveying and data collection, - integration of technologies, 3. Organization and management of topographic data (P) - international organizations, guidelines and instructions (INSPIRE) - methods of data management - special needs (requirements) of users - integration of data use in real time 4. Topographic data quality (F) - requirements and problems of quality - quality model, quality evaluation

Temeljna literatura in viri/Readings:

Revije / Journals:
Journal of Photogrammetry and Remote Sensing
Photogrammetric Engineering and Remote Sensing
Cartographic Journal
Cartographica
Cartographic Perspectives
Cartography and GIS Science
International Journal of Cartography

Elektronski viri / web sites :
- ISPRS: http://www.isprs.org/
- ICA: http://www.icaci.org/
- Eurogeographics: http://www.eurogeographics.org
- EuroSDR: http://www.eurosdr.net/

Cilji in kompetence:	**Objectives and competences:**
Cilj predmeta je obravnava in raziskovanje posebnosti pri zajemu in vodenju evidenc prostorskih podatkov in analiza mednarodnih smernic ter priporočil na obravnavanem področju.	The objective of the subject is research of specialities in acquisition and management of spatial data records (databases) and analysis of international trends and guidelines in the focused area.

Predvideni študijski rezultati:	**Intended learning outcomes:**
Znanje in razumevanje: Študent pridobi razumevanje pomena evidenc topografskih podatkov in se zna spopasti s problematiko pri vzpostavljanju in vodenju. Prav tako kritično presoja in razume posebnosti lokalnih ali nacionalnih potreb. Usposobljen je za aktivno sodelovanju pri vzpostavljanju in vodenju sistemov topografskih podatkov na lokalni, nacionalni ali mednarodni ravni.	Knowledge and understanding: A student acquires an understanding of topographic records (databases) and their importance, and is able to engage with problems in establishment and management of records (databases). In addition, a student can critically judge and understands the exceptions of local and national requirements in the topic. A student is qualified for active cooperation in establishment and management of topographical data systems in local, national or international levels.

Metode poučevanja in učenja:	**Learning and teaching methods:**
Predavanja, konzultacije, projektno orientirane seminarske naloge	Lectures, consultations, project oriented seminar works

Načini ocenjevanja:	**Delež/Weight**	**Assessment:**
Ustno izpraševanje	50,00 %	Oral examination
Projekt	50,00 %	Project

Reference nosilca/Lecturer's references:

1. ZUPAN VRENKO, Dunja, PETROVIČ, Dušan. Effective online mapping and map viewer design for the senior population. The cartographic journal, ISSN 0008-7041, [v tisku] 2014, vol. XX, no. X, str. 1–15, ilustr.
2. GRIGILLO, Dejan, KOSMATIN FRAS, Mojca, PETROVIČ, Dušan. Automated building extraction from IKONOS images in suburban areas. International journal of remote sensing, ISSN 0143-1161. [Print ed.], avg. 2012, letn. 33, št. 16, str. 5149–5170, ilustr.
3. ŠAVRIČ, Bojan, JENNY, Bernhard, PATTERSON, Tom, PETROVIČ, Dušan, HURNI, Lorenz. A Polynomial Equation for the Natural Earth Projection. Cartography and geographic information science, ISSN 1523-0406. [Tiskana izd.], okt. 2011, letn. 38, št. 4, str. 363–372, ilustr.
4. TRIGLAV, Joc, PETROVIČ, Dušan, STOPAR, Bojan. Spatio-temporal evaluation matrices for geospatial data. ITC journal, ISSN 0303-2434, feb. 2011, letn. 13, št. 1, str. 100–109, ilustr.

UČNI NAČRT PREDMETA/COURSE SYLLABUS

Predmet:	Rentgenska strukturna analiza
Course title:	X-ray Diffraction Structural Analysis

Študijski programi in stopnja	Študijska smer	Letnik	Semestri
Grajeno okolje, tretja stopnja, doktorski	Ni členitve (študijski program)		Letni, Zimski

Univerzitetna koda predmeta/University course code: 1296

Predavanja	Seminar	Vaje	Klinične vaje	Druge oblike študija	Samostojno delo	ECTS
40	0	20	0	65	0	5

Nosilec predmeta/Lecturer: Matej Dolenec

Vrsta predmeta/Course type: Izbirni predmet/E

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

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:	**Prerequisites:**
Zaključena 2. stopnja študija (MSc) naravoslovne ali tehnične smeri	Completed MSc in natural sciences or engineering

Vsebina:	**Content (Syllabus outline):**
Kristalne strukture in simetrija, princip in geometrija rentgenske difrakcije, recipročna mreža, metode količinske analize, metode reševanja struktur in optimizacija rešitev, modeliranje difraktogramov.	Crystal structure and symmetry, principle and geometry of the X-ray diffraction, reciprocal lattice, the methods of quantitative analysis, crystal structure analysis methods and solution optimization, modeling of difractograms.

Temeljna literatura in viri/Readings:

1) David, W.I.F., Shankland, K., McCusker, L.B., Baerlocher, Ch., 2002: Structure determination from powder diffraction data. Oxford UP, New York, 337 pp.
2) Massa, W., 2000: Crystal structure determination. Springer, Berlin, 206 pp.

Cilji in kompetence:	**Objectives and competences:**
Količinska fazna analiza, določitev kristalne strukture in politipov mineralov z metodo rentgenske difrakcije, ter modeliranje difraktogramov.	The quantitative phase analysis, determination of the crystal structure and mineral politypes by the method of X-ray diffraction and difractogram modeling.

Predvideni študijski rezultati:	**Intended learning outcomes:**
Znanje in razumevanje: Študent pozna kristalne strukture in simetrijske lastnosti mineralov. Osvoji teorijo in zna uporabljati rentgensko difrakcijo, recipročne mreže in količinske analize. Usposobi se za reševanja struktur in modeliranje difraktogramov.	Knowledge and understanding: The student understands the crystal structure and symmetry properties of minerals. He gets acquainted with theory the use of X-ray diffraction, reciprocal network and quantitative analysis. He is able to resolv structures and to model difractograms.

Metode poučevanja in učenja:	Learning and teaching methods:
Predavanja, konzultacije, laboratorijske vaje in izdelava seminarske naloge v okviru seminarskih vaj.	Lectures, consultations, laboratory exercises and seminar work connected to the context of tutorials.

Načini ocenjevanja:	Delež/Weight	Assessment:
Izdelana seminarska naloga	50,00 %	Seminar work
Ustni izpit	50,00 %	Oral examination

Reference nosilca/Lecturer's references:

1. PAVŠIČ, Primož, OŠTIR, Danijel, MLADENOVIČ, Ana, KRAMAR, Sabina, **DOLENEC, Matej**, BUKOVEC, Peter. Sewage-sludge stabilization with biomass ash = Stabiliziranje komunalnega mulja s pepelom biomase. *Materiali in tehnologije*, ISSN 1580-2949. [Tiskana izd.], maj-jun. 2013, letn. 47, št. 3, str. 349-352

2. MILER, Miloš, AMBROŽIČ, Bojan, MIRTIČ, Breda, GOSAR, Mateja, ŠTURM, Sašo, **DOLENEC, Matej**, JERŠEK, Miha. Mineral and chemical composition of the Jezersko meteorite - a new chondrite from Slovenia. *Meteoritics & planetary science*, ISSN 1086-9379, 2014, vol. 49, no. 10, str. 1875-1887, doi: 10.1111/maps.12365.

3. KARPE, Blaž, NAGODE, Aleš, KOSEC, Borut, STOIĆ, Antun, **DOLENEC, Matej**, BIZJAK, Milan. Microstructure evolution and thermal stability of rapidly solidified Al-Ni-Co-Re alloy. *Metalurgija*, ISSN 0543-5846, 2013, vol. 52, br. 3, str. 305-308.

UČNI NAČRT PREDMETA/COURSE SYLLABUS

Predmet:	Sedimentarna evolucija Tetide
Course title:	Sedimentary Evolution of Tethyan Realm

Študijski programi in stopnja	Študijska smer	Letnik	Semestri
Grajeno okolje, tretja stopnja, doktorski	Ni členitve (študijski program)		Letni, Zimski

Univerzitetna koda predmeta/University course code: 1297

Predavanja	Seminar	Vaje	Klinične vaje	Druge oblike študija	Samostojno delo	ECTS
30	10	0	0	85	0	5

Nosilec predmeta/Lecturer: Boštjan Rožič

Vrsta predmeta/Course type: Izbirni predmet/Elective course

Jeziki/Languages:

Predavanja/Lectures:	Slovenščina, Angleščina
Vaje/Tutorial:	Slovenščina, Angleščina

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:	Prerequisites:
Zaključena 2. stopnja študija (MSc) naravoslovne ali tehnične smeri	M.Sc. of Natural or Technical Science

Vsebina:	Content (Syllabus outline):
-Megastrukturne enote Tetidinega prostora in njihove osnovne značilnosti -Srednjetriasni razvoji povezani z odpiranjem Meliate, -Hiperproduktivne pozno triasne platforme, -Jurski rifting in geneza južnega pasivnega roba Alpske Tetide in Vardarskega oceana, -Kredne sukcesije, ki označujejo konvergenco in razvoj flišnih bazenov ob zapiranju Tetide. -Terciarni post-kolizijski bazeni -Stratigrafska in sedimentološka korelacija in soodvisnost bazenov in platform. -Sedimentarna evolucija Tetidiniga prostora	-Megastructural units of Tethyis Realm and their basic caracteristics -Middle Triassic succession dependant on the Meliata opening -Late Triassic hyperproductive carbonate platforms -Jurassic rifting due to the opening of the Alpine Tethys and Vardar Ocean, -Cretaceous successions exhibiting convergence and development of flysch basins due to the closure of the Tehyan ocean -Tertiary post-collisonal basins -Sedimentary correlation of the basins and platforms and co-dependance of the latter two. -Sedimentary evolution of the Tethyian Realm

Temeljna literatura in viri/Readings:

1.) Bertotti, G., Picotti, V., Bernoulli, D. & Castellarin, A. 1993: From rifting to drifting: tectonic evolution of the South-Alpine upper crust from the Triassic to the Early Cretaceous. Sedimentary Geology 86, 53-76.
2.) Cavazza, W., Roure, F., Spakman W. & Stampfli G.W. 2004: The TRANSMED Atlas. The Mediterranean Region from Crust to Mantle: Geological and Geophysical Framework, Springer 127 pp.
3.) Golonka, J. 2007: Late Triassic and Early Jurassic palaeogeography of the world. - Palaeogeography, Palaeoclimatology, Palaeoecology, Volume 244, Issues 1-4, 297-307p.
4.) Santantonio, M. 2002: General Field Trip Guidebook. VI International Symposium on the Jurassic System, 12-22 September 2002, 320 pp.

5.) Stampfli, G.M. and Borel, G.D., 2002. A plate tectonic model for the Paleozoic and Mesozoic constrained by dynamic plate boundaries and restored synthetic oceanic isochrons. Earth and Planetary Science Letters, 196: 17-33.
6.) Stampfli, G.M., Borel, G.D., W. Cavazza, J. Mosar & P.A. Ziegler 2001: The Paleotectonic Atlas of the PeriTethyan Domain.- European geophysical society
7.) Vlahović, I., Tišljar, J. Velić, I. & Matičec, D. 2005: Evolution of the Adriatic Carbonate Platform: Palaeogeography, main events and depositional dynamics. Palaeogeography, Palaeoclimatology, Palaeoecology 220, 333-360.
8.) Yin H., J.M. Dickins, G.R. Tong S. & Tong J. 2000: Permian-Triassic Evolution of Tethys and Western Circum-Pacific, Elsevier, 392 pp

Journals:
Sedimentary Geology
International Journal of Geology
Geology
Sedimentology
Swiss Journal of Geosciences Geologica Carpathica

Cilji in kompetence:	**Objectives and competences:**
Poznavanje in razumevanje geneze in razvoja mezozojskih sukcesij v oziru paleogeografskih sprememb povezanih z nastankom, razvojem in zapiranjem oceana Tetide in podrejenih oceanov.	Knowledge and understanding of genesis and evolution of Mezozoic successions due to the paleogeographic change connected to the genesis,development and closure of the Tethys ocean.

Predvideni študijski rezultati:	**Intended learning outcomes:**
Znanje in razumevanje: Študent(/ka) bo sposoben dojemanja in razumevanja sedimentarnega zapisa določene regije znotraj tetidinega območja v širšem konceptu razvoja Tetide. Na ta način mu bo omogočeno pridobiti znanstveno predznanje, ki je nujno pri umeščanju lokalnih sedimentarnih podatkov v regionalni prostor.	Knowledge and understanding: Student will be capable of perception and undestanding of particulate region sedimentary record of particulate region within the Tethyan Realm in the wide concept of Tethian sedimentary evolution. It will enable him/her to obtain knowledge essential for inplacement of local sedimentary data into regional space.

Metode poučevanja in učenja:	**Learning and teaching methods:**
Predavanja, konzultacije, seminarsko in projektno delo	Lecture, consultations, seminar and project work

Načini ocenjevanja:	**Delež/Weight**	**Assessment:**
Ustni in/ali pisni izpit, seminar, projekt	100,00 %	Writing and/or oral examination, seminar and/or project essay

Reference nosilca/Lecturer's references:

1. ROŽIČ, Boštjan, Kolar-Jurkovšek, T. & Šmuc, A. 2009: Late Triassic sedimentary evolution of Slovenian Basin (eastern Southern Alps): description and correlation of the Slatnik Formation.- Facies, vol. 55, str 137-155.
2. ŠMUC, Andrej, ROŽIČ, Boštjan. The Jurassic Prehodavci Formation of the Julian Alps: easternmost outcrops of Rosso Ammonitico in the Southern Alps (NW Slovenia). Swiss journal of geosciences, ISSN 1661-8726, 2010, vol.103, issue 2, str. 241-255
3. ROŽIČ, Boštjan, ŠMUC, Andrej. 2011: Gravity-flow deposits in the Toarcian Perbla formation (Slovenian basin, NW Slovenia). Rivista italiana di paleontologia e stratigrafia, vol. 117, no. 2, str. 283-294.
4. GORIČAN, Špela, PAVŠIČ, Jernej, ROŽIČ, Boštjan. 2012: Bajocian to Tithonian age of radiolarian cherts in the Tolmin Basin (NW Slovenia). Bulletin de la Société géologique de France, t. 183, no 4, str. 369-382.
5. GALE, Luka, ROŽIČ, Boštjan, MENCIN, Eva, KOLAR-JURKOVŠEK, Tea. 2014: First evidence for late Norian progradation of Julian Platform towards Slovenian Basin, eastern Southern Alps. Rivista italiana di paleontologia e stratigrafia, vol. 120, no. 2, str. 191-214.

UČNI NAČRT PREDMETA/COURSE SYLLABUS

Predmet:	Sedimentni bazeni in sedimentna okolja
Course title:	Sedimentary Basins and Sedimentary Environments

Študijski programi in stopnja	Študijska smer	Letnik	Semestri
Grajeno okolje, tretja stopnja, doktorski	Ni členitve (študijski program)		Letni, Zimski

Univerzitetna koda predmeta/University course code: 1717

Predavanja	Seminar	Vaje	Klinične vaje	Druge oblike študija	Samostojno delo	ECTS
40	0	0	0	85	0	5

Nosilec predmeta/Lecturer: Andrej Šmuc

Vrsta predmeta/Course type: Izbirni predmet/Elective course

Jeziki/Languages:

Predavanja/Lectures:	Slovenščina, Angleščina
Vaje/Tutorial:	Slovenščina, Angleščina

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:	Prerequisites:
Zaključena 2. stopnja študija (MSc) naravoslovne ali tehnične smeri	M.Sc. of Natural or Technical Science

Vsebina:	Content (Syllabus outline):
1. Osnove sedimentnih bazenov (bazeni in tektonika plošč, fizikalne lastnosti litosfere, osnovne lastnosti in klasifikacija sedimentnih bazenov, metode merjenja in pridobivanja podatkov). 2. Mehanizmi nastanka sedimentnih bazenov (litosfersko raztezanje, fleksura, dinamika v plašču, zmična tektonika). 3. Zapolnjevanje sedimentnih bazenov (vplivi na sedimentacijo, facies, sekvence in faciesni modeli, depozicijski cikli, sekvenčna stratigrafija). 4. Uvod v sedimentacijska okola (aluvialna okolja, lakustrična okolja, glacialna okolja, vulkanska okolja, puščavska okolja, morska okolja: plitva, globoka, karbonatna, evaporitna).	1. The foundations of sedimentary basins (basins and their plate tectonic environment, the physical state of the lithosphere, characteristics and classification of sedimentary basins, methods of measuring and recording data) 2. The mechanics of sedimentary basin formation (lithosphere stretching, flexure, effects of mantle dynamics, strike slip tectonics) 3. The sedimentary basin-fill (controls on sedimentation, facies, sequence and facies models, depositional cycles and sequence stratigraphy) 4. Introduction to different sedimentary environments (alluvial, lacustrine, glacial, volcanic, desert-aeolian, marine (shallow seas, deep seas, carbonate systems and marine evaporite basins)

Temeljna literatura in viri/Readings:

1. Miall, A.D. 2000: Principles of sedimentary basin analysis. – Springer-Verlag, 616 pp.
2. Allen P.A. & Allen J.R. 2013: Basin analysis: principles and application to petroleoum play assessment. Willey-Blackwell, 619 pp.
3.Reading H.G. 1996: Sedimentary environments: processes, facies and stratigraphy
4. Bridge. J.S. 2003: Rivers and floodplains: forms, processes and sedimentary record
5. Tucker M.E. & Wright P. 1990: Carbonate sedimentology. Blackwell, 482 pp.
6. Schlager W. 2005: Carbonate sedimentology and sequence stratigraphy, SEPM, 208 pp.
7. Cas R.A.F & Wright J.V. 1995: Volcanic successions: modern and ancient.Chapman & Hall,528 pp.

Cilji in kompetence:	Objectives and competences:
Cilj predmeta je slušatelja seznaniti s kvantitativnimi in kvalitativnimi vidiki nastanka in evolucije sedimentih bazenov v kontektu tektonike plošč in sedimentarne geologije. V drugem delu je cilj študente seznaniti z osnovnimi lastnostmi različnih sedimentnih okolij ter procesi, ki se v njih odvijajo ter z dinamiko nastajanja sedimentov. Kompetence: Sedimentne kamnine predstavljajo najpogostejše kamine, ki jih najdemo na zemljinem površju. V Sloveniji sedimente kamnine pokrivajo 90% površine, tako da se z njimi v svoji poklicni karieri sreča vsak geolog. Nekdanja sedimentacijska okolja, v katerih so omenjne kamine nastajale, rekonstruiramo najprej preko intepretacije procesa ali procesov, ki so povzročili nastanek določenega tipa sedimentov ter v naslednjem koraku preko interpretacije okolja v katerem so ti procesi potekali. Sedimentacijska okolja v katerih nastajajo kamine so izredno raznolika prav tako pa so raznoliki tudi faktorji, ki vplivajo na sedimentacijo. Poznavanje recentnih in nekdanjih sedimentnih okolij, procesov, ki v njih delujejo ter sedimentnih zaporedij, ki so značilna za posamezna okolja je tako bistveno za vse geološke stroke.	Goals: - understanding qualitative and quantitative aspects of basin analysis within the context of plate tectonics and sedimentary geology - to provide understanding of the basic sedimentology with emphasis on the particular environment. - in depth study of a chosen sedimentary environment in order to understand processes and therefore also deposits of a particular sedimentary environment. Competences: sedimentary rocks are the most common rocks that are present on the Earth surface. In Slovenia they cover more than 90% of the area and are therefore important. Ancient sedimentary environments are reconstructed on the basis of the interpretation of the process that caused the deposition of a particular type of sediment. Sedimentary environments are extremely heterogeneous, additionally also controlling sedimentary factors are quite diverse. Recognition of ancient and recent sedimentary environments and processes that operate within them is of crucial importance to all of the geologists and other that are related to these environments.

Predvideni študijski rezultati:	Intended learning outcomes:
Študent spozna in razume procese, ki povzročajo nastanek in evolucijo sedimentnih bazenov. Nadalje spozna različna sedimentacijska okolja in razume procese, ki delujejo v njih. Na podlagi sedimentnih zaporedij zna interpretirati okolja nastanka in dinamiko zapolnjevanja. S pomočjo poznavanja vzrokov sprememb v sedimentaciji razume spremembe regionalnih in lokalnih geoloških procesov in stanj. Zna izbrati in uporabiti ustrezne analitske tehnike ter ustrezno obdelavo podatkov.	Knowledge and understanding: Knowledge and understanding of processes controling the formation and evolution of sedimentary basins. The student gains knowledge about different sedimentary environments and understand the processes that operate within them. On the basis of the sedimentary successions knows how to interpret sedimentary environments and dynamics of the sedimentation. He or she understands the reasons for changes in sedimentation style and can interpret them in the local and regional context. The student can choose and use a proper analytic technique for investigating different.

Metode poučevanja in učenja:	Learning and teaching methods:
Predavanja, individualni pogovori o dogovorjeni literaturi, ki študenta specialno zanima; seminarska vaja z izbrano tematiko iz področja določenega sedimentacijskega okolja.	Course, individual conversations on selected literature connecting with student interest, seminar on chosen theme from the field of sedimentary environments.

Načini ocenjevanja:	Delež/Weight	Assessment:
Način (pisni izpit, ustno izpraševanje, naloge, projekt)	100,00 %	Type (examination, oral, coursework, project)

Reference nosilca/Lecturer's references:

1. ROŽIČ, Boštjan, GORIČAN, Špela, ŠVARA, Astrid, **ŠMUC, Andrej.** The Middle Jurassic to Lower Cretaceous succession of the Ponikve klippe: the Southernmost outcrops of the Slovenian Basin in Western Slovenia. *Rivista italiana di paleontologia e stratigrafia*, ISSN 0035-6883, 2014, vol. 120, no. 1, str. 83-102. [COBISS.SI-ID 1125214], [JCR, SNIP, WoS do 3. 6. 2014: št. citatov (TC): 0, čistih citatov (CI): 0, čistih citatov na avtorja (CIAu): 0, normirano št. čistih citatov (NC): 0, Scopus do 26. 11. 2014: št. citatov (TC): 0, čistih citatov (CI): 0, čistih citatov na avtorja

(CIAu): 0, normirano št. čistih citatov (NC): 0]
kategorija: 1A3 (Z1); uvrstitev: SCI, Scopus, MBP; tipologijo je verificiral OSICN
točke: 18.27, št. avtorjev: 4
2. MURI, Gregor, ČERMELJ, Branko, JAĆIMOVIĆ, Radojko, SKABERNE, Dragomir, **ŠMUC, Andrej**, BURNIK ŠTURM, Martina, TURŠIČ, Janja, VREČA, Polona. Consequences of anthropogenic activity for two remote alpine lakes in NW Slovenia as tracked by sediment geochemistry. *Journal of paleolimnology*, ISSN 0921-2728, 2013, vol. 50, no. 4, str. 457-470, doi: 10.1007/s10933-013-9738-2. [COBISS.SI-ID 26884391], [JCR,SNIP, WoS do 9. 12. 2013: št. citatov (TC): 0, čistih citatov (CI): 0, čistih citatov na avtorja (CIAu): 0, normirano št. čistih citatov (NC): 0, Scopus do 25. 4. 2014: št. citatov (TC): 0, čistih citatov (CI): 0, čistih citatov na avtorja (CIAu): 0, normirano št. čistih citatov (NC): 0]
kategorija: 1A1 (Z1, A', A1/2); uvrstitev: SCI, Scopus, MBP; tipologijo je verificiral OSICN
točke: 12.5, št. avtorjev: 8
3. GALE, Luka, KOLAR-JURKOVŠEK, Tea, **ŠMUC, Andrej,** ROŽIČ, Boštjan. Integrated Rhaetian foraminiferal and conodont biostratigraphy from the Slovenian Basin, eastern Southern Alps. *Swiss journal of geosciences*, ISSN 1661-8726, 2012, vol. 105, issue 3, str. 435-462, doi: 10.1007/s00015-012-0117-1. [COBISS.SI-ID 2103125], [JCR, SNIP, WoS do 5. 11. 2014: št. citatov (TC): 4, čistih citatov (CI): 0, čistih citatov na avtorja (CIAu): 0, normirano št. čistih citatov (NC): 0, Scopus do 5. 9. 2014: št. citatov (TC): 4, čistih citatov (CI): 0, čistih citatov na avtorja (CIAu): 0, normirano št. čistih citatov (NC): 0]
kategorija: 1A2 (Z1, A1/2); uvrstitev: SCI, Scopus, MBP; tipologijo je verificiral OSICN
točke: 20.53, št. avtorjev: 4
4. ROŽIČ, Boštjan, **ŠMUC, Andrej.** Gravity-flow deposits in the Toarcian Perbla formation (Slovenian basin, NW Slovenia). *Rivista italiana di paleontologia e stratigrafia*, ISSN 0035-6883, 2011, vol. 117, no. 2, str. 283-294. [COBISS.SI-ID 915806], [JCR, SNIP, WoS do 25. 11. 2014: št. citatov (TC): 4, čistih citatov (CI): 1, čistih citatov na avtorja (CIAu): 0.50, normirano št. čistih citatov (NC): 1, Scopus do 8. 10. 2014: št. citatov (TC): 4, čistih citatov (CI): 1, čistih citatov na avtorja (CIAu): 0.50, normirano št. čistih citatov (NC): 1]
kategorija: 1A3 (Z1); uvrstitev: SCI, Scopus, MBP; tipologijo je verificiral OSICN
točke: 35.1, št. avtorjev: 2
5. GALE, Luka, RETTORI, Roberto, MARTINI, Rossana, **ŠMUC, Andrej**, KOLAR-JURKOVŠEK, Tea, ROŽIČ, Boštjan. Duostominidae (Foraminiferea, Robertinida) from the Upper Triassic beds of the Slovenian basin (Southern Alps, Slovenia). *Rivista italiana di paleontologia e stratigrafia*, ISSN 0035-6883, 2011, vol. 117, no. 3, str. 375-397. [COBISS.SI-ID 944222], [JCR, SNIP, WoS do 15. 2. 2013: št. citatov (TC): 1, čistih citatov (CI): 0, čistih citatov na avtorja (CIAu): 0, normirano št. čistih citatov (NC): 0, Scopus do 27. 3. 2013: št. citatov (TC): 1, čistih citatov (CI): 0, čistih citatov na avtorja (CIAu): 0, normirano št. čistih citatov (NC): 0]
kategorija: 1A3 (Z1); uvrstitev: SCI, Scopus, MBP; tipologijo je verificiral OSICN
točke: 11.7, št. avtorjev: 6
6. ŠMUC, Andrej, ROŽIČ, Boštjan. The Jurassic Prehodavci Formation of the Julian Alps: easternmost outcrops of Rosso Ammonitico in the Southern Alps (NW Slovenia). *Swiss journal of geosciences*, ISSN 1661-8726, 2010, vol.103, issue 2, str. 241-255, doi: 10.1007/s00015-010-0015-3. [COBISS.SI-ID 835422], [JCR, SNIP, WoS do 3. 6. 2014: št. citatov (TC): 3, čistih citatov (CI): 0, čistih citatov na avtorja (CIAu): 0, normirano št. čistih citatov (NC): 0, Scopus do 3. 6. 2014: št. citatov (TC): 4, čistih citatov (CI): 1, čistih citatov na avtorja (CIAu): 0.50, normirano št. čistih citatov (NC): 1]
kategorija: 1A1 (Z1, A', A1/2); uvrstitev: SCI, Scopus, MBP; tipologijo je verificiral OSICN
točke: 50, št. avtorjev: 2
7. ROŽIČ, Boštjan, KOLAR-JURKOVŠEK, Tea, **ŠMUC, Andrej**. Late Triassic sedimentary evolution of Slovenian Basin (eastern Southern Alps): description and correlation of the Slatnik Formation. *Facies*, ISSN 0172-9179, 2009, vol. 55, no. 1, str. 137-155, doi: 10.1007/s10347-008-0164-2. [COBISS.SI-ID 734302], [JCR, SNIP, WoS do 5. 11. 2014: št. citatov (TC): 9, čistih citatov (CI): 4, čistih citatov na avtorja (CIAu): 1.33, normirano št. čistih citatov (NC): 4, Scopus do 5. 9. 2014: št. citatov (TC): 11, čistih citatov (CI): 6, čistih citatov na avtorja (CIAu): 2.00, normirano št. čistih citatov (NC): 5]
kategorija: 1A1 (Z1, A', A1/2); uvrstitev: SCI, Scopus, MBP; tipologijo je verificiral OSICN
točke: 33.33, št. avtorjev: 3
8. ŠMUC, Andrej, ROŽIČ, Boštjan. Tectonic geomorphology of the Triglav Lakes Valley (easternmost Southern Alps, NW Slovenia). *Geomorphology*, ISSN 0169-555X. [Print ed.], 2009, issue 4, vol. 103, str. 597-604, doi: 10.1016/j.geomorph.2008.08.005. [COBISS.SI-ID 725086], [JCR, SNIP, WoS do 5. 11. 2014: št. citatov (TC): 5, čistih citatov (CI): 3, čistih citatov na avtorja (CIAu): 1.50, normirano št. čistih citatov (NC): 3,Scopus do 25. 4. 2014: št. citatov (TC): 6, čistih citatov (CI): 4, čistih citatov na avtorja (CIAu): 2.00, normirano št. čistih citatov (NC): 4]
kategorija: 1A1 (Z1, A', A1/2); uvrstitev: SCI, Scopus, MBP; tipologijo je verificiral OSICN
točke: 57.96, št. avtorjev: 2

UČNI NAČRT PREDMETA/COURSE SYLLABUS

Predmet:	Sedimentni bazeni in sedimentna okolja
Course title:	Sedimentary Basins and Sedimentary Environments

Študijski programi in stopnja	Študijska smer	Letnik	Semestri
Grajeno okolje, tretja stopnja, doktorski	Ni členitve (študijski program)		Letni, Zimski

Univerzitetna koda predmeta/University course code: 1716

Predavanja	Seminar	Vaje	Klinične vaje	Druge oblike študija	Samostojno delo	ECTS
80	0	0	0	170	0	10

Nosilec predmeta/Lecturer: Andrej Šmuc

Vrsta predmeta/Course type: Izbirni predmet/Elective course

Jeziki/Languages:

Predavanja/Lectures:	Slovenščina, Angleščina
Vaje/Tutorial:	Slovenščina, Angleščina

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:	Prerequisites:
Zaključena 2. stopnja študija (MSc) naravoslovne ali tehnične smeri	M.Sc. of Natural or Technical Science

Vsebina:	Content (Syllabus outline):
1. Osnove sedimentnih bazenov (bazeni in tektonika plošč, fizikalne lastnosti litosfere, osnovne lastnosti in klasifikacija sedimentnih bazenov, metode merjenja in pridobivanja podatkov). 2. Mehanizmi nastanka sedimentnih bazenov (litosfersko raztezanje, fleksura, dinamika v plašču, zmična tektonika). 3. Zapolnjevanje sedimentnih bazenov (vplivi na sedimentacijo, facies, sekvence in faciesni modeli, depozicijski cikli, sekvenčna stratigrafija). 4. Uvod v sedimentacijska okola (aluvialna okolja, lakustrična okolja, glacialna okolja, vulkanska okolja, puščavska okolja, morska okolja: plitva, globoka, karbonatna, evaporitna). **Dodatno za 10 kreditov** Poglobljena analiza različnih izbranih sedimentacijskih okolij. 1) Eolska okolja (puščave, lastnosti delcev, ki se transportirajo z vetrom, sedimentne oblike, puščavska okolja, sedimenti in njihove značilnosti). 2) Reke in aluvialne pahljače (fluvialni in aluvialni sistemi, poplavne ravnice, aluvialne pahljače, prst in paleoprst, sedimenti in njihove značilnosti). 3) Jezera (sladkovodna, slana, vplivi na sedimentacijo, sedimenti in njihove značilnosti).	1. The foundations of sedimentary basins (basins and their plate tectonic environment, the physical state of the lithosphere, characteristics and classification of sedimentary basins, methods of measuring and recording data) 2. The mechanics of sedimentary basin formation (lithosphere stretching, flexure, effects of mantle dynamics, strike slip tectonics) 3. The sedimentary basin-fill (controls on sedimentation, facies, sequence and facies models, depositional cycles and sequence stratigraphy) 4. Introduction to different sedimentary environments (alluvial, lacustrine, glacial, volcanic, desert-aeolian, marine (shallow seas, deep seas, carbonate systems and marine evaporite basins) **Additional 10KT** In-depth study of different sedimentary environments 1) Aeolian environments (transport mechanisms, deserts, characteristic of wind-blow particles, aeolian bedforms, desert environments, criteria for recognition of the deposits). 2) Rivers and alluvial fans (fluvial and alluvial systems, river forms, floodplain deposition, alluvial fans, soils and paleosoil, criteria for recognition of the deposits).

4) Morska okolja: oblika in procesi (razdelitev, plimovanje, valovanje, tokovi, kemijski in biokemijski sedimenti, morski in fosili in sledovi lazenja). 5) Delte (tipi, morfološki različki delt, facies, stratigrafija ter sedimenti in njihove značilnosti) 6) Klastične obale in estuarji (obale, plaže, lagunski sistemi, obalna zaporedja estuarji, sedimenti in njihove značilnosti). 7) Plitva klastična morja (morja pod vplivom neviht ter plimovanja, vplivi spreminjanja gladine morja, sedimenti in njihove značilnosti). 8) Plitvomorska karbonatna in evaporitna okolja (tipi okolij, obalni karbonati in evaporiti, plitvomorski karbonati, karbonatne paltforme, morski evaporiti, mešana siliciklastično-karbonatna okolja, sedimenti in njihove značilnosti). 9) Globokomorska okolja (oceanski bazeni, podmorske pahljače, predpasniki, globokomorski tokovi, oceanski sedimenti in njih prepoznavanje) 10) Vulkanska okolja (transport, odlaganje, stili erupcij, facies, sedimenti in njihove značilnosti)	3) Lakes (freshwater lakes, saline lakes, ephemeral lakes, controls on lake deposition, criteria for recognition of the deposits). 4) Marine realm: morphology and processes (division, tides, wave and storm processes, thermohaline and geostrophic currents, chemical and biochemical sedimentation, marine and trace fossils). 5) Deltas (types, environment, variations in morphology and facies, cycles and stratigraphy, criteria for recognition of the deposits). 6) Clastic coasts and estuaries (coast, beaches, barrier and lagoon systems, coastal successions, estuaries, criteria for recognition of the deposits) 7) Shallow sandy seas (storm dominated, tide dominated, responses to changes in sea level, criteria for recognition of the deposits) 8) Shallow marine carbonate and evaporite environments (types of the depositional environments, coastal carbonates and evaporites, shallow-marine carbonates, types of carbonate platforms, marine evaporites, mixed-siliciclastic-carbonate environments) 9) Deep marine environments (ocean basins, submarine fans, slope aprons, contourites, oceanic sediments, recognition of the deposits) 10) Volcanic rocks and sediments (transport and deposition, eruption styles, facieses, volcanic rocks in Earth history, criteria for recognition of the deposits)

Temeljna literatura in viri/Readings:

1. Miall, A.D. 2000: Principles of sedimentary basin analysis. – Springer-Verlag, 616 pp.
2. Allen P.A. & Allen J.R. 2013: Basin analysis: principles and application to petroleoum play assessment. Willey-Blackwell, 619 pp.
3.Reading H.G. 1996: Sedimentary environments: processes, facies and stratigraphy
4. Bridge. J.S. 2003: Rivers and floodplains: forms, processes and sedimentary record
5. Tucker M.E. & Wright P. 1990: Carbonate sedimentology. Blackwell, 482 pp.
6. Schlager W. 2005: Carbonate sedimentology and sequence stratigraphy, SEPM, 208 pp.
7. Cas R.A.F & Wright J.V. 1995: Volcanic successions: modern and ancient.Chapman & Hall,528 pp.

Cilji in kompetence:	**Objectives and competences:**
Cilj predmeta je slušatelja seznaniti s kvantitativnimi in kvalitativnimi vidiki nastanka in evolucije sedimentih bazenov v kontektu tektonike plošč in sedimentarne geologije. V drugem delu je cilj študente seznaniti z osnovnimi lastnostmi različnih sedimentnih okolij ter procesi, ki se v njih odvijajo ter z dinamiko nastajanja sedimentov. Kompetence: Sedimentne kamnine predstavljajo najpogostejše kamine, ki jih najdemo na zemljinem površju. V Sloveniji sedimente kamnine pokrivajo 90% površine, tako da se z njimi v svoji poklicni karieri sreča vsak geolog. Nekdanja sedimentacijska okolja, v katerih so omenjne kamine nastajale, rekonstruiramo najprej preko intepretacije procesa ali procesov, ki so povzročili nastanek določenega tipa sedimentov ter v naslednjem koraku preko interpretacije okolja v katerem so ti procesi potekali. Sedimentacijska okolja v katerih nastajajo kamine so izredno raznolika prav tako pa so raznoliki tudi faktorji, ki vplivajo na sedimentacijo.	Goals: - understanding qualitative and quantitative aspects of basin analysis within the context of plate tectonics and sedimentary geology - to provide understanding of the basic sedimentology with emphasis on the particular environment. - in depth study of a chosen sedimentary environment in order to understand processes and therefore also deposits of a particular sedimentary environment. Competences: sedimentary rocks are the most common rocks that are present on the Earth surface. In Slovenia they cover more than 90% of the area and are therefore important. Ancient sedimentary environments are reconstructed on the basis of the interpretation of the process that caused the deposition of a particular type of sediment. Sedimentary environments are extremely heterogeneous, additionally also controlling sedimentary factors are quite diverse. Recognition of ancient and recent sedimentary environments and

Poznavanje recentnih in nekdanjih sedimentnih okolij, procesov, ki v njih delujejo ter sedimentnih zaporedij, ki so značilna za posamezna okolja je tako bistveno za vse geološke stroke.	processes that operate within them is of crucial importance to all of the geologists and other that are related to these environments.

Predvideni študijski rezultati:	**Intended learning outcomes:**
Študent spozna in razume procese, ki povzročajo nastanek in evolucijo sedimentnih bazenov. Nadalje spozna različna sedimentacijska okolja in razume procese, ki delujejo v njih. Na podlagi sedimentnih zaporedij zna interpretirati okolja nastanka in dinamiko zapolnjevanja. S pomočjo poznavanja vzrokov sprememb v sedimentaciji razume spremembe regionalnih in lokalnih geoloških procesov in stanj. Zna izbrati in uporabiti ustrezne analitske tehnike ter ustrezno obdelavo podatkov.	Knowledge and understanding: Knowledge and understanding of processes controling the formation and evolution of sedimentary basins. The student gains knowledge about different sedimentary environments and understand the processes that operate within them. On the basis of the sedimentary successions knows how to interpret sedimentary environments and dynamics of the sedimentation. He or she understands the reasons for changes in sedimentation style and can interpret them in the local and regional context. The student can choose and use a proper analytic technique for investigating different.

Metode poučevanja in učenja:	**Learning and teaching methods:**
Predavanja, individualni pogovori o dogovorjeni literaturi, ki študenta specialno zanima; seminarska vaja z izbrano tematiko iz področja določenega sedimentacijskega okolja.	Course, individual conversations on selected literature connecting with student interest, seminar on chosen theme from the field of sedimentary environments.

Načini ocenjevanja:	**Delež/Weight**	**Assessment:**
Način (pisni izpit, ustno izpraševanje, naloge, projekt)	100,00 %	Type (examination, oral, coursework, project)

Reference nosilca/Lecturer's references:

1. ROŽIČ, Boštjan, GORIČAN, Špela, ŠVARA, Astrid, **ŠMUC, Andrej.** The Middle Jurassic to Lower Cretaceous succession of the Ponikve klippe: the Southernmost outcrops of the Slovenian Basin in Western Slovenia. *Rivista italiana di paleontologia e stratigrafia*, ISSN 0035-6883, 2014, vol. 120, no. 1, str. 83-102. [COBISS.SI-ID 1125214], [JCR, SNIP, WoS do 3. 6. 2014: št. citatov (TC): 0, čistih citatov (CI): 0, čistih citatov na avtorja (CIAu): 0, normirano št. čistih citatov (NC): 0, Scopus do 26. 11. 2014: št. citatov (TC): 0, čistih citatov (CI): 0, čistih citatov na avtorja (CIAu): 0, normirano št. čistih citatov (NC): 0]
kategorija: 1A3 (Z1); uvrstitev: SCI, Scopus, MBP; tipologijo je verificiral OSICN
točke: 18.27, št. avtorjev: 4

2. MURI, Gregor, ČERMELJ, Branko, JAĆIMOVIĆ, Radojko, SKABERNE, Dragomir, **ŠMUC, Andrej**, BURNIK ŠTURM, Martina, TURŠIČ, Janja, VREČA, Polona. Consequences of anthropogenic activity for two remote alpine lakes in NW Slovenia as tracked by sediment geochemistry. *Journal of paleolimnology*, ISSN 0921-2728, 2013, vol. 50, no. 4, str. 457-470, doi: 10.1007/s10933-013-9738-2. [COBISS.SI-ID 26884391], [JCR,SNIP, WoS do 9. 12. 2013: št. citatov (TC): 0, čistih citatov (CI): 0, čistih citatov na avtorja (CIAu): 0, normirano št. čistih citatov (NC): 0, Scopus do 25. 4. 2014: št. citatov (TC): 0, čistih citatov (CI): 0, čistih citatov na avtorja (CIAu): 0, normirano št. čistih citatov (NC): 0]
kategorija: 1A1 (Z1, A', A1/2); uvrstitev: SCI, Scopus, MBP; tipologijo je verificiral OSICN
točke: 12.5, št. avtorjev: 8

3. GALE, Luka, KOLAR-JURKOVŠEK, Tea, **ŠMUC, Andrej,** ROŽIČ, Boštjan. Integrated Rhaetian foraminiferal and conodont biostratigraphy from the Slovenian Basin, eastern Southern Alps. *Swiss journal of geosciences*, ISSN 1661-8726, 2012, vol. 105, issue 3, str. 435-462, doi: 10.1007/s00015-012-0117-1. [COBISS.SI-ID 2103125], [JCR, SNIP, WoS do 5. 11. 2014: št. citatov (TC): 4, čistih citatov (CI): 0, čistih citatov na avtorja (CIAu): 0, normirano št. čistih citatov (NC): 0, Scopus do 5. 9. 2014: št. citatov (TC): 4, čistih citatov (CI): 0, čistih citatov na avtorja (CIAu): 0, normirano št. čistih citatov (NC): 0]
kategorija: 1A2 (Z1, A1/2); uvrstitev: SCI, Scopus, MBP; tipologijo je verificiral OSICN
točke: 20.53, št. avtorjev: 4

4. ROŽIČ, Boštjan, **ŠMUC, Andrej.** Gravity-flow deposits in the Toarcian Perbla formation (Slovenian basin, NW Slovenia). *Rivista italiana di paleontologia e stratigrafia*, ISSN 0035-6883, 2011, vol. 117, no. 2, str. 283-294. [COBISS.SI-ID 915806], [JCR, SNIP, WoS do 25. 11. 2014: št. citatov (TC): 4, čistih citatov (CI): 1, čistih citatov na avtorja (CIAu): 0.50, normirano št. čistih citatov (NC): 1, Scopus do 8. 10. 2014: št. citatov (TC): 4, čistih citatov (CI): 1, čistih citatov na avtorja (CIAu): 0.50, normirano št. čistih citatov (NC): 1]
kategorija: 1A3 (Z1); uvrstitev: SCI, Scopus, MBP; tipologijo je verificiral OSICN
točke: 35.1, št. avtorjev: 2
5. GALE, Luka, RETTORI, Roberto, MARTINI, Rossana, **ŠMUC, Andrej**, KOLAR-JURKOVŠEK, Tea, ROŽIČ, Boštjan. Duostominidae (Foraminiferea, Robertinida) from the Upper Triassic beds of the Slovenian basin (Southern Alps, Slovenia). *Rivista italiana di paleontologia e stratigrafia*, ISSN 0035-6883, 2011, vol. 117, no. 3, str. 375-397. [COBISS.SI-ID 944222], [JCR, SNIP, WoS do 15. 2. 2013: št. citatov (TC): 1, čistih citatov (CI): 0, čistih citatov na avtorja (CIAu): 0, normirano št. čistih citatov (NC): 0, Scopus do 27. 3. 2013: št. citatov (TC): 1, čistih citatov (CI): 0, čistih citatov na avtorja (CIAu): 0, normirano št. čistih citatov (NC): 0]
kategorija: 1A3 (Z1); uvrstitev: SCI, Scopus, MBP; tipologijo je verificiral OSICN
točke: 11.7, št. avtorjev: 6
6. ŠMUC, Andrej, ROŽIČ, Boštjan. The Jurassic Prehodavci Formation of the Julian Alps: easternmost outcrops of Rosso Ammonitico in the Southern Alps (NW Slovenia). *Swiss journal of geosciences*, ISSN 1661-8726, 2010, vol.103, issue 2, str. 241-255, doi: 10.1007/s00015-010-0015-3. [COBISS.SI-ID 835422], [JCR, SNIP, WoS do 3. 6. 2014: št. citatov (TC): 3, čistih citatov (CI): 0, čistih citatov na avtorja (CIAu): 0, normirano št. čistih citatov (NC): 0, Scopus do 3. 6. 2014: št. citatov (TC): 4, čistih citatov (CI): 1, čistih citatov na avtorja (CIAu): 0.50, normirano št. čistih citatov (NC): 1]
kategorija: 1A1 (Z1, A', A1/2); uvrstitev: SCI, Scopus, MBP; tipologijo je verificiral OSICN
točke: 50, št. avtorjev: 2
7. ROŽIČ, Boštjan, KOLAR-JURKOVŠEK, Tea, **ŠMUC, Andrej**. Late Triassic sedimentary evolution of Slovenian Basin (eastern Southern Alps): description and correlation of the Slatnik Formation. *Facies*, ISSN 0172-9179, 2009, vol. 55, no. 1, str. 137-155, doi: 10.1007/s10347-008-0164-2. [COBISS.SI-ID 734302], [JCR, SNIP, WoS do 5. 11. 2014: št. citatov (TC): 9, čistih citatov (CI): 4, čistih citatov na avtorja (CIAu): 1.33, normirano št. čistih citatov (NC): 4, Scopus do 5. 9. 2014: št. citatov (TC): 11, čistih citatov (CI): 6, čistih citatov na avtorja (CIAu): 2.00, normirano št. čistih citatov (NC): 5]
kategorija: 1A1 (Z1, A', A1/2); uvrstitev: SCI, Scopus, MBP; tipologijo je verificiral OSICN
točke: 33.33, št. avtorjev: 3
8. ŠMUC, Andrej, ROŽIČ, Boštjan. Tectonic geomorphology of the Triglav Lakes Valley (easternmost Southern Alps, NW Slovenia). *Geomorphology*, ISSN 0169-555X. [Print ed.], 2009, issue 4, vol. 103, str. 597-604, doi: 10.1016/j.geomorph.2008.08.005. [COBISS.SI-ID 725086], [JCR, SNIP, WoS do 5. 11. 2014: št. citatov (TC): 5, čistih citatov (CI): 3, čistih citatov na avtorja (CIAu): 1.50, normirano št. čistih citatov (NC): 3,Scopus do 25. 4. 2014: št. citatov (TC): 6, čistih citatov (CI): 4, čistih citatov na avtorja (CIAu): 2.00, normirano št. čistih citatov (NC): 4]
kategorija: 1A1 (Z1, A', A1/2); uvrstitev: SCI, Scopus, MBP; tipologijo je verificiral OSICN
točke: 57.96, št. avtorjev: 2

UČNI NAČRT PREDMETA/COURSE SYLLABUS

Predmet:	Seizmološke analize in raziskave
Course title:	Seismological Analyses and Investigations

Študijski programi in stopnja	Študijska smer	Letnik	Semestri
Grajeno okolje, tretja stopnja, doktorski	Ni členitve (študijski program)		Letni, Zimski

Univerzitetna koda predmeta/University course code: 1299

Predavanja	Seminar	Vaje	Klinične vaje	Druge oblike študija	Samostojno delo	ECTS
20	10	10	0	85	0	5

Nosilec predmeta/Lecturer: Andrej Gosar

Vrsta predmeta/Course type: Izbirni predmet/Elective course

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

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:	Prerequisites:
Ni posebnih pogojev.	No special conditions.

Vsebina:	Content (Syllabus outline):
- Opazovanje potresov: vrste potresov, mehanizmi nastajanja potresov, teorija prožnega odskoka, potresni valovi, delovanje seizmometra, akcelerometra in seizmografa, mreže potresnih opazovalnic - Opredeljevanje potresnih parametrov: analiza seizmogramov in akcelerogramov, seizmološke faze, lociranje lokalnih in regionalnih potresov, teleseizmi, poti seizmičnih valov skozi notranjost Zemlje in hodohrone, metode relociranja potresov, različne magnitude potresov, sproščena energija, intenziteta potresa, makroseizmika, potresne lestvice, seizmološki bilteni, digitalna analiza seizmičnih signalov, avtomatsko opredeljevanje potresnih parametrov - Seizmičnost: katalogi potresov in njihova analiza, prostorska in časovna porazdelitev potresov, odvisnost frekvence potresov od magnitude-Gutenberg-Richterjev zakon, popotresi, časovna porazdelitev popotresov-Omorijev zakon, predpotresi, potresni roji, vloga mednarodnih seizmoloških centrov - Seizmotektonika: seizmičnost in tektonika plošč, žariščni mehanizem potresa, metode določevanja žariščnih mehanizmov, metode raziskav seizmogenih prelomov, dolžina pretrga, premik ob prelomu, seizmotektonski modeli - Potresi in notranja zgradba Zemlje: model zgradbe notranjosti Zemlje in seizmične hitrosti, hitrostne	- Monitoring of earthquakes: earthquake types, source mechanisms, elastic rebound theory, seismic waves, seismometer, accelerometer and seismograph – principles of operation, seismological networks. - Determination of earthquake parameters: analysis of seismograms and accelerograms, seismological phases, location of local and regional earthquakes, teleseisms, raypaths through the Earth's interiors and traveltime curves, relocation methods, earthquake magnitudes, energy of earthquakes, intensity, macrosesimic investigations, intensity grades, seismological bulletins, digital analysis of seismic signals, automatic determination of earthquake parameters. -Seismicity: earthquake catalogues and their analysis, spatial and temporal distribution of earthquakes, magnitude-frequency (Gutenberg-Richter) relation, temporal distribution of aftershocks (Omori's law), foreshocks, earthquake swarms, the role of international seismological centres. -Seismotectonics: seismicity and plate tectonics, focal mechanisms and methods of determination, investigation methods of seismogenic faults, fault rupture – length and displacement, seismotectonic models. -Earthquakes and Earth's interior: models of Earth's interior with seismic velocities, velocity discontinuities, seismic tomography, analysis of surface waves, analysis of teleseisms.

diskontinuitete, seizmična tomografija, analiza površinskih valov, analiza teleseizmov - Seizmičnost Slovenije: opazovanje potresov v Sloveniji, karte seizmičnosti, močnejši potresi, seizmotektonske značilnosti, karte potresne nevarnost.	-Seismicity of Slovenia: monitoring of earthquakes in Slovenia, seismicity maps, stronger earthquakes, seismotectonic characteristics, earthquake hazard maps

Temeljna literatura in viri/Readings:

1.) Shearer, P.M. 1999: Introduction to seismology. Cambridge, 260 pp.
2.) Stein, S., Wysession, M. 2003: An introduction to seismology, earthquakes, and earth structure. Blackwell, 498 pp.
3.) Udias, A. 1999: Principles of seismology. Cambridge, 475 pp.
4.) Yeats, R.S., Sieh, K., Allen, C.R. 1997: The geology of earthquakes. Oxford, 568 pp.
5.) Lowrie, W. 2007: Fundamentals of geophysics. Cambridge, 381 pp.
6.) Gosar, A. 2011: Osnove seizmologije. Naravoslovnotehniška fakulteta, 70 pp.
članki v domačih in mednarodnih revijah /papers from national and international journals

Cilji in kompetence:	**Objectives and competences:**
Cilji: -razumevanje geološko-fizikalnih značilnosti potresov, -razumevanje seizmoloških raziskovalnih metod. Kompetence: -poznavanje seizmologije, geologije potresov in notranje zgradbe Zemlje, -zmožnost izvajanja seizmoloških analiz in opredeljevanja potresnih parametrov, -sposobnost raziskovalnega dela v seizmologiji.	Objectives: - understanding geological and physical characteristics of earthquakes, - understanding the principles of seismological research methods. Competences: - knowledge on seismology, geology of earthquakes and Earth's interior, - ability to conduct seismological analyses and determine earthquake parameters, - ability of research work in seismology.

Predvideni študijski rezultati:	**Intended learning outcomes:**
Znanje in razumevanje: - fizikalnih in geoloških procesov povezanih s potresi - potresov, njihovega nastanka ter pojavljanja - metod raziskovanja potresov in njihovih učinkov - seizmološkega monitoringa	Knowledge and understanding: - phisical and geological processes related to earthquakes - earthquakes, their origin and occurence - investigation methods of earthquakes and their consequences- seismological monitoring

Metode poučevanja in učenja:	**Learning and teaching methods:**
Predavanja, seminarske vaje za utrditev vsebine predavanj in laboratorijske vaje s praktičnimi primeri v računalniški učilnici, izdelava seminarske naloge	Lectures, seminar exercises, laboratory work with practical examples in computer room, preparation of seminar

Načini ocenjevanja:	**Delež/Weight**	**Assessment:**
Zagovor laboratorijskih vaj	30,00 %	Defence of laboratory work
Zagovor seminarske naloge	20,00 %	Presentation of seminar
Pisni izpit	50,00 %	Written exam

Reference nosilca/Lecturer's references:

1. Gosar, A., Martinec, M. 2009: Microtremor HVSR study of site effects in the Ilirska Bistrica town area (S Slovenia). *Journal of Earthquake Engineering*, vol. 13, str. 50-67.
2. Gosar, A., Rošer, J., Šket Motnikar, B., Zupančič, P. 2010: Microtremor study of site effects and soil-structure resonance in the city of Ljubljana (central Slovenia). *Bulletin of earthquake engineering*, vol. 8, no. 3, str. 571-592.
3. Gosar, A. 2010: Site effects and soil-structure resonance study in the Kobarid basin (NW Slovenia) using microtremors. *Nat. hazards earth syst. sci.*, vol. 10, no. 4, str. 761-772.

4. Gosar, A. 2012: Determination of masonry building fundamental frequencies in five Slovenian towns by microtremor excitation and implications for seismic risk assessment. *Natural. hazards*, vol. 62, no. 3, str. 1059-1079.
5. Gosar, A. 2012: Derivation of sediments iso-frequency map for the Litija basin (Central Slovenia) by microtremor analysis and implications for soil-structure resonance. *Acta geodynamica et geomaterialia*, no. 2, 166, str. 237-249.
6. Gosar, A., Brenčič, M. 2012:. Possible relation between the sudden sinking of river Iška and the sequence of weak earthquakes in september-october 2010 near Iška vas (Central Slovenia). *Acta carsologica*, vol. 41, no. 2/3, str. 265-274.
7. Gosar, A. 2012: Application of Environmental Seismic Intensity scale (ESI 2007) to Krn Mountains 1998 Mw = 5.6 earthquake (NW Slovenia) with emphasis on rockfalls. *Nat. hazards earth syst. sci.*, vol. 12, no. 5, str. 1659-1670.
8. Gosar, A. 2014: Analysis of the impact of fault mechanism radiation patterns on macroseismic filelds in the epicentral area of 1998 and 2004 Krn Mountains earthquakes (NW Slovenia). *The Scientific World Journal*. Article ID 206843, 1-11.
9. Ivan, M., Ghica, D. V., Gosar, A., Hatzidimitriou, P., Hofstetter, R., Polat, G., Wang, R. 2014: Lowermost mantle velocity estimations beneath the Central North Atlantic area from Pdif observed at Balkan, East Mediterranean, and American stations. *Pure and Applied Geophysics*, vol.171, str. 1-10.

UČNI NAČRT PREDMETA/COURSE SYLLABUS

Predmet:	Seizmološke analize in raziskave
Course title:	Seismological Analyses and Investigations

Študijski programi in stopnja	Študijska smer	Letnik	Semestri
Grajeno okolje, tretja stopnja, doktorski	Ni členitve (študijski program)		Letni, Zimski

Univerzitetna koda predmeta/University course code: 1718

Predavanja	Seminar	Vaje	Klinične vaje	Druge oblike študija	Samostojno delo	ECTS
40	20	20	0	170	0	10

Nosilec predmeta/Lecturer: Andrej Gosar

Vrsta predmeta/Course type: Izbirni predmet/Elective course

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

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:	Prerequisites:
Ni posebnih pogojev.	No special conditions.

Vsebina:	Content (Syllabus outline):
- Opazovanje potresov: vrste potresov, mehanizmi nastajanja potresov, teorija prožnega odskoka, potresni valovi, delovanje seizmometra, akcelerometra in seizmografa, mreže potresnih opazovalnic - Opredeljevanje potresnih parametrov: analiza seizmogramov in akcelerogramov, seizmološke faze, lociranje lokalnih in regionalnih potresov, teleseizmi, poti seizmičnih valov skozi notranjost Zemlje in hodohrone, metode relociranja potresov, različne magnitude potresov, sproščena energija, intenziteta potresa, makroseizmika, potresne lestvice, seizmološki bilteni, digitalna analiza seizmičnih signalov, avtomatsko opredeljevanje potresnih parametrov - Seizmičnost: katalogi potresov in njihova analiza, prostorska in časovna porazdelitev potresov, odvisnost frekvence potresov od magnitude-Gutenberg-Richterjev zakon, popotresi, časovna porazdelitev popotresov-Omorijev zakon, predpotresi, potresni roji, vloga mednarodnih seizmoloških centrov - Seizmotektonika: seizmičnost in tektonika plošč, žariščni mehanizem potresa, metode določevanja žariščnih mehanizmov, metode raziskav seizmogenih prelomov, dolžina pretrga, premik ob prelomu, seizmotektonski modeli - Potresi in notranja zgradba Zemlje: model zgradbe notranjosti Zemlje in seizmične hitrosti, hitrostne	- Monitoring of earthquakes: earthquake types, source mechanisms, elastic rebound theory, seismic waves, seismometer, accelerometer and seismograph – principles of operation, seismological networks. - Determination of earthquake parameters: analysis of seismograms and accelerograms, seismological phases, location of local and regional earthquakes, teleseisms, raypaths through the Earth's interiors and traveltime curves, relocation methods, earthquake magnitudes, energy of earthquakes, intensity, macrosesimic investigations, intensity grades, seismological bulletins, digital analysis of seismic signals, automatic determination of earthquake parameters. -Seismicity: earthquake catalogues and their analysis, spatial and temporal distribution of earthquakes, magnitude-frequency (Gutenberg-Richter) relation, temporal distribution of aftershocks (Omori's law), foreshocks, earthquake swarms, the role of international seismological centres. -Seismotectonics: seismicity and plate tectonics, focal mechanisms and methods of determination, investigation methods of seismogenic faults, fault rupture – length and displacement, seismotectonic models. -Earthquakes and Earth's interior: models of Earth's interior with seismic velocities, velocity discontinuities, seismic tomography, analysis of surface waves, analysis of teleseisms.

diskontinuitete, seizmična tomografija, analiza površinskih valov, analiza teleseizmov - Seizmičnost Slovenije: opazovanje potresov v Sloveniji, karte seizmičnosti, močnejši potresi, seizmotektonske značilnosti, karte potresne nevarnost. Dodatno za 10 KT - Potresna nevarnost: verjetnostne in deterministične metode ocenjevanja potresne nevarnosti, modeli seizmičnih izborov, karte potresne nevarnosti (karte projektnega pospeška tal in karte intenzitete), potresna ogroženost - Vplivi tal na učinke potresov: inženirska seizmologija, vpliv geološke zgradbe na potresno nihanje tal in metode raziskav (instrumentalne, numerične, empirične), metoda referenčne točke, metoda spektralnega razmerja, 1D in 2D modeliranje, metoda mikrotremorjev, potresna mikrorajonizacija, klasifikacija tal, standard Eurocode 8, interakcija med tlemi in objekti, likvefakcija, učinki potresov na naravno okolje, tsunamiji - Seizmičnost Evropsko-Sredozemskega prostora: karte seizmičnosti in seizmotektonske karte, močnejši potresi, opazovanje potresov, potresna nevarnost - Paleoseizmologija, paleoseizmični indikatorji, paleoseizmološke metode raziskav, - Potresno inženirstvo	-Seismicity of Slovenia: monitoring of earthquakes in Slovenia, seismicity maps, stronger earthquakes, seismotectonic characteristics, earthquake hazard maps In addition for 10 ECTS - Earthquake hazard: probabilistic and deterministic methods of earthquake hazard assessment, seismic source models, earthquake hazard maps (maps of design ground acceleration, intensity maps), seismic risk. - Influence of soft soil on earthquake effects: engineering seismology, effects of local geological structure on seismic ground motion and methods of determination (instrumental, numerical, empirical), reference point method, spectral ratio method, 1D and 2D modelling, microtremor method, seismic microzonation, soil classification, Eurocode 8 standard, soil-structure interaction, liquefaction, effects of earthquake on natural environment, tsunami. -Seismicity of Euro-Mediterranean region: seismicity and seismotectonic maps, stronger earthquakes, monitoring of earthquakes, earthquake hazard - Paleoseismology, paleoseismic indicators, paleoseizmological investigation methods -Earthquake engineering

Temeljna literatura in viri/Readings:

1.) Shearer, P.M. 1999: Introduction to seismology. Cambridge, 260 pp.
2.) Stein, S., Wysession, M. 2003: An introduction to seismology, earthquakes, and earth structure. Blackwell, 498 pp.
3.) Udias, A. 1999: Principles of seismology. Cambridge, 475 pp.
4.) Yeats, R.S., Sieh, K., Allen, C.R. 1997: The geology of earthquakes. Oxford, 568 pp.
5.) Lowrie, W. 2007: Fundamentals of geophysics. Cambridge, 381 pp.
6.) Gosar, A. 2011: Osnove seizmologije. Naravoslovnotehniška fakulteta, 70 pp.
članki v domačih in mednarodnih revijah /papers from national and international journals

Cilji in kompetence:	**Objectives and competences:**
Cilji: -razumevanje geološko-fizikalnih značilnosti potresov, -razumevanje seizmoloških raziskovalnih metod. Kompetence: -poznavanje seizmologije, geologije potresov in notranje zgradbe Zemlje, -zmožnost izvajanja seizmoloških analiz in opredeljevanja potresnih parametrov, -sposobnost raziskovalnega dela v seizmologiji.	Objectives: - understanding geological and physical characteristics of earthquakes, - understanding the principles of seismological research methods. Competences: - knowledge on seismology, geology of earthquakes and Earth's interior, - ability to conduct seismological analyses and determine earthquake parameters, - ability of research work in seismology.

Predvideni študijski rezultati:	**Intended learning outcomes:**
Znanje in razumevanje: - fizikalnih in geoloških procesov povezanih s potresi - potresov, njihovega nastanka ter pojavljanja - metod raziskovanja potresov in njihovih učinkov - seizmološkega monitoringa	Knowledge and understanding: - phisical and geological processes related to earthquakes - earthquakes, their origin and occurence - investigation methods of earthquakes and their consequences- seismological monitoring

Metode poučevanja in učenja:	Learning and teaching methods:
Predavanja, seminarske vaje za utrditev vsebine predavanj in laboratorijske vaje s praktičnimi primeri v računalniški učilnici, izdelava seminarske naloge	Lectures, seminar exercises, laboratory work with practical examples in computer room, preparation of seminar

Načini ocenjevanja:	Delež/Weight	Assessment:
Pisni izpit	50,00 %	Written exam
Zagovor laboratorijskih vaj	30,00 %	Defence of laboratory work
Zagovor seminarske naloge	20,00 %	Presentation of seminar

Reference nosilca/Lecturer's references:

1. Gosar, A., Martinec, M. 2009: Microtremor HVSR study of site effects in the Ilirska Bistrica town area (S Slovenia). *Journal of Earthquake Engineering*, vol. 13, str. 50-67.
2. Gosar, A., Rošer, J., Šket Motnikar, B., Zupančič, P. 2010: Microtremor study of site effects and soil-structure resonance in the city of Ljubljana (central Slovenia). *Bulletin of earthquake engineering*, vol. 8, no. 3, str. 571-592.
3. Gosar, A. 2010: Site effects and soil-structure resonance study in the Kobarid basin (NW Slovenia) using microtremors. *Nat. hazards earth syst. sci.*, vol. 10, no. 4, str. 761-772.
4. Gosar, A. 2012: Determination of masonry building fundamental frequencies in five Slovenian towns by microtremor excitation and implications for seismic risk assessment. *Natural. hazards*, vol. 62, no. 3, str. 1059-1079.
5. Gosar, A. 2012: Derivation of sediments iso-frequency map for the Litija basin (Central Slovenia) by microtremor analysis and implications for soil-structure resonance. *Acta geodynamica et geomaterialia*, no. 2, 166, str. 237-249.
6. Gosar, A., Brenčič, M. 2012:. Possible relation between the sudden sinking of river Iška and the sequence of weak earthquakes in september-october 2010 near Iška vas (Central Slovenia). *Acta carsologica*, vol. 41, no. 2/3, str. 265-274.
7. Gosar, A. 2012: Application of Environmental Seismic Intensity scale (ESI 2007) to Krn Mountains 1998 Mw = 5.6 earthquake (NW Slovenia) with emphasis on rockfalls. *Nat. hazards earth syst. sci.*, vol. 12, no. 5, str. 1659-1670.
8. Gosar, A. 2014: Analysis of the impact of fault mechanism radiation patterns on macroseismic filelds in the epicentral area of 1998 and 2004 Krn Mountains earthquakes (NW Slovenia). *The Scientific World Journal*. Article ID 206843, 1-11.
9. Ivan, M., Ghica, D. V., Gosar, A., Hatzidimitriou, P., Hofstetter, R., Polat, G., Wang, R. 2014: Lowermost mantle velocity estimations beneath the Central North Atlantic area from Pdif observed at Balkan, East Mediterranean, and American stations. *Pure and Applied Geophysics*, vol.171, str. 1-10.

UČNI NAČRT PREDMETA/COURSE SYLLABUS

Predmet:	Sodobna terestrična geodetska merska tehnologija
Course title:	Modern Terrestrial Geodetic Measurement Technology

Študijski programi in stopnja	Študijska smer	Letnik	Semestri
Grajeno okolje, tretja stopnja, doktorski	Ni členitve (študijski program)		Letni, Zimski

Univerzitetna koda predmeta/University course code: 1305

Predavanja	Seminar	Vaje	Klinične vaje	Druge oblike študija	Samostojno delo	ECTS
30	10	0	0	0	85	5

Nosilec predmeta/Lecturer: Dušan Kogoj

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:
Znanja iz vsebin predmetov dodiplomskih študijev geodezije FGG UL: UNI: Geodezija I, Geodezija II, Terenske vaje I, Terenske vaje II, Geodezija v inženirstvu I, Geodezija v inženirstvu II (45 KT). GG: Uvod v geodezijo, Detajlna izmera, Precizna klasična geodetska izmera, Geodezija v inženirstvu I, Geodetski merski sistemi, Geodezija v inženirstvu II (44 KT) TUN: Geodezija, Terestrična detajlna izmera, Geodezija pri gradnji objektov, Geodetski instrumenti in metode, Analiza opazovanj v geodeziji, Geodezija v inženirstvu (36 KT)	Finished courses thematically related to the following topics: UNI: Geodezija I, Geodezija II, Terenske vaje I, Terenske vaje II, Geodezija v inženirstvu I, Geodezija v inženirstvu II (45 ECTS). GG: Uvod v geodezijo, Detajlna izmera, Precizna klasična geodetska izmera, Geodezija v inženirstvu I, Geodetski merski sistemi, Geodezija v inženirstvu II (44 ECTS) TUN: Geodezija, Terestrična detajlna izmera, Geodezija pri gradnji objektov, Geodetski instrumenti in metode, Analiza opazovanj v geodeziji, Geodezija v inženirstvu (36 ECTS)

Vsebina:	Content (Syllabus outline):
- sodobna geodetska merska tehnika in metode za zajemanje prostorskih podatkov - združevanje različnih geodetskih in fizikalnih merskih senzorjev - izvajanje kompleksnih meritev v inženirskih merskih mrežah - obdelava in interpretacija rezultatov heterogenih meritev	- modern terrestrial geodetic measurement technology and methods for collecting the spatial data - combination of heterogeneous geodetic and physical measurement sensors - execution of complex measurements within geodetic networks - calculation and interpretation of the results of the heterogeneous measurement

Temeljna literatura in viri/Readings:

- Schlemmer H.: Grundlagen der Sensorik, Eine Instrumentenkunde für Vermessungsingenieure, Wichmann Verlag, 1996
- strokovna literatura v knjižni in elektronski obliki / Relevant specialist literature in paper and electronic version

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

Cilji:	Goals:
- spoznati in razumeti sodobne terestrične merske tehnologije in metode za zajemanje prostorskih podatkov - spoznati načine združevanja heterogenih meritev - spoznati interpretacijo rezultatov - slediti raziskavam in razvoju tega področja **Kompetence:** - študent zna uporabljati mersko opremo, pridobiti podatke, jih obdelati in analizirati - študent zna uporabiti razpoložljiva računalniška orodja in programje - študent zna uporabljati strokovno in znanstveno literaturo s tega področja - študent zna predstaviti dobljene izsledke drugim strokovnjakom	- To understand modern terrestrial measurement technologies and methods for collecting the spatial data - To understand the ways of combining heterogeneous measurements - To interprete the results - To follow the research and development of the scientific field **Competence:** - Candidate is able to use measurement equipment, extract data, process and analyse them - Candidate is able to use available hardware and software - Candidate is able to use relevant specialist literature - Candidate is able to present results of the deformation analysis to other experts

Predvideni študijski rezultati:	Intended learning outcomes:
Znanje in razumevanje: **Rezultati:** - študent razume principe tehnologij in jih zna pravilno uporabljati - študent obdela rezultate meritev z vsemi vplivi in jih zna analizirati - študent zna interpretirati dobljene rezultate - študent je sposoben komunicirati in sodelovati s strokovnjaki iz drugih področij	Knowledge and understanding: **Results:** - Candidate understands technology principles and uses them correctly - Candidate processes the results of the measurements together with all relevant impacts and knows how to analyse them - Candidate is able to interpret the results - Candidate is able to communicate and cooperate with the experts from other scientific fields

Metode poučevanja in učenja:	Learning and teaching methods:
Predavanja, individualne konzultacije in izdelava individualne seminarske naloge na izbrano temo.	Lectures, individual consultations and preparation of individual term-paper regarding the chosen topic.

Načini ocenjevanja:	Delež/Weight	Assessment:
Izdelava in zagovor seminarske naloge na izbrano temo. Ustni izpit, ki obsega teoretični del (vsebino predavanj ter obvezne in priporočene literature).	100,00 %	Preparation and presentation of term-paper regarding the chosen topic, oral examination regarding the theory (contents of the lectures and compulsory and recommended literature).

Reference nosilca/Lecturer's references:

- TUNO, Nedim, MULAHUSIĆ, Admir, MARJETIČ, Aleš, KOGOJ, Dušan. Pregled razvoja elektronskih tahimetrov leica geosystems = Overview of development of electronic tachymeters leica geosystems. *Geodetski vestnik*, 2010, letn. 54, št. 4, str. 643-660. [COBISS.SI-ID 5231201]
- MARJETIČ, Aleš, KOGOJ, Dušan. Comparator With Optical Encoder System for the Calibration of Leveling Staffs. *Journal of testing and evaluation*, 2013, letn. 41, št. 5, str. 818-825. [COBISS.SI-ID 6312545]
- KREGAR, Klemen, TURK, Goran, KOGOJ, Dušan. Statistical testing of directions observations independence. *Survey review*, 2013, letn. 45, št. 329, str. 117-125. [COBISS.SI-ID 5871713]

UČNI NAČRT PREDMETA/COURSE SYLLABUS

Predmet:	Stabilni izotopi in fiziološki procesi
Course title:	Stable Isotopes and Physiological Processes

Študijski programi in stopnja	Študijska smer	Letnik	Semestri
Grajeno okolje, tretja stopnja, doktorski	Ni členitve (študijski program)		Letni, Zimski

Univerzitetna koda predmeta/University course code: 1300

Predavanja	Seminar	Vaje	Klinične vaje	Druge oblike študija	Samostojno delo	ECTS
40	0	20	0	65	0	5

Nosilec predmeta/Lecturer: Matej Dolenec

Vrsta predmeta/Course type: Izbirni predmet/Elective course

Jeziki/Languages:

Predavanja/Lectures:	Angleščina, Slovenščina
Vaje/Tutorial:	Angleščina, Slovenščina

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:	Prerequisites:
Predhodno osvojena znanja iz geologije, mineralogije in geokemije	Prior knowledge from geology, mineralogy and geochemistry

Vsebina:	Content (Syllabus outline):
Vsebina predmeta je razdeljena na teoretsko izotopsko geokemijo v okviru katere se študentje podrobneje spoznajo z značilnostmi globalnih biogeokemičnih ciklov, njihovimi geokemičnimi in izotopskimi značilnostmi ter okoljem njihovega nastopanja in na vaje, ki obsegajo praktični del na računalniku ter delo z računalniškim programom GWB.	The subject is divided into theoretical Isotope Geochemistry in which students learn in detail the characteristics of the global biogeochemical cycles, their geochemical and isotopic characteristics and environment of their appearance and tutorial that include practical work on the computer and the computer program GWB.

Temeljna literatura in viri/Readings:

Izbrana poglavja iz knjig / Selected chapters from books:
1) L.B. Flangan et al., 2005 - Stable isotopes and biosphere-atmosphere interactions;
2) Broder J. Merkel and B. Planer-Friedrich, 2005 - Groundwater Geochemistry
3) C.M. Bethke, 1996 - Geochemical Reaction Modeling

Cilji in kompetence:	Objectives and competences:
Študent se seznani z aplikacijami in uporabnost stabilnih izotopov za proučevanje ekologije rastlin in živali.	Students get acquainted with applications and use of stable isotopes to study the ecology of plants and animals.

Predvideni študijski rezultati:	Intended learning outcomes:
Znanje in razumevanje: Študent razume delovanje globalnih biogeokemičnih ciklov ter prepozna njihove značilnostm in okolja njihovega nastopanja. Usposobi se za samostojno delo z računalniškim programom GWB.	Knowledge and understanding: The student understands the functioning of the global biogeochemical cycles and identify their characteristics and environment of their appearance. Students is able to work with a computer program GWB.

Metode poučevanja in učenja:	Learning and teaching methods:
Predavanja, prikaz slikovnega gradiva (LCD projektor), delo na računalniku (program GWB 4.0)	Lectures, display images (LCD projector), work on the computer (program GWB 4.0)

Načini ocenjevanja:	Delež/Weight	Assessment:
Pisni izpit iz predavanj in vaj	100,00 %	Written exam based on lectures and tutorial

Reference nosilca/Lecturer's references:

1. ŽVAB ROŽIČ, Petra, DOLENEC, Tadej, LOJEN, Sonja, KNIEWALD, Goran, **DOLENEC, Matej**. Using stable nitrogen isotopes in Patella sp. to trace sewage-derived material in coastal ecosystems. *Ecological indicators*, ISSN 1470-160X, 2014, vol. 36, str. 224-230, doi: 10.1016/j.ecolind.2013.07.023.

2. ŽVAB ROŽIČ, Petra, DOLENEC, Tadej, BAŽDARIĆ, Branimir, KARAMARKO, Vatroslav, KNIEWALD, Goran, **DOLENEC, Matej**. Element levels in cultured and wild sea bass (Dicentrarchus labrax) and gilthead sea bream (Sparus aurata) from the Adriatic Sea and potential risk assessment. *Environmental geochemistry and health*, ISSN 0269-4042, 2014, vol. 36, issue 1, str. 19-39, doi: 10.1007/s10653-013-9516-0.

3. POPADIĆ, Adriana, VIDOVIĆ, Jelena, ĆOSOVIĆ, Vlasta, MEDAKOVIĆ, Davorin, **DOLENEC, Matej**, FELJA, Igor. Impact evaluation of the industrial activities in the Bay of Bakar (Adriatic Sea, Croatia): Recent benthic foraminifera and heavy metals. *Marine pollution bulletin*, ISSN 0025-326X, 2013, vol. 76, iss. 1-2, str. 333-348, doi: http://dx.doi.org/10.1016/j.marpolbul.2013.09.039.

UČNI NAČRT PREDMETA/COURSE SYLLABUS

Predmet:	Stabilnost konstrukcij
Course title:	Stability of Structures

Študijski programi in stopnja	Študijska smer	Letnik	Semestri
Grajeno okolje, tretja stopnja, doktorski	Ni členitve (študijski program)		Letni, Zimski

Univerzitetna koda predmeta/University course code: 1117

Predavanja	Seminar	Vaje	Klinične vaje	Druge oblike študija	Samostojno delo	ECTS
25	0	15	0	0	85	5

Nosilec predmeta/Lecturer: Igor Planinc

Vrsta predmeta/Course type: Izbirni predmet/Elective course

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

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:	Prerequisites:
Ni posebnih pogojev.	No prerequisits.

Vsebina:	Content (Syllabus outline):
- Osnovni koncepti stabilnostne analize konstrukcij; tipi stabilnosti (bifurkacijska in limitna točka obtežno-deformacijske krivulje), Lagrangeov-Dirichletov izrek ter izrek Ljapunova, osnove preturbacijske analize, osnovni stabilnostni pojavi značilni pri gradbenih konstrukcijah; - Stabilnostna analiza elastičnih konstrukcij (uklon stebrov in okvirjev, uklon plošč in lupin, občutljivost konstrukcij na vse vrste nepopolnosti skladno s Koiterovo teorijo; - Dinamična analiza stabilnosti (nihanje stebrov in okvirjev, klasifikacija obtežb, pojav t.i. flutterja, parametrična resonanca); - Stabilnostna analiza plastičnih konstrukcij (Shanleyev steber, uklon plastičnih stebrov in vpliv vseh vrst nepopolnosti, splošna stabilnostna analiza plastičnih konstrukcij); - Viskoelastični in viskoplastični uklon stebrov (armiranobetonskih stebrov); - Stabilnostni pojavi povezani z lokalizacijami deformacij (materialni modeli mehčanja snovi, vpliv mehčanja prečnih prerezov na stabilnost okvirnih gradbenih konstrukcij); - Nelinearna numerična stabilnostna analiza konstrukcij (klasifikacija kritičnih točk obtežno-deformacijskih krivulj, inkrementno iteracijske metode, metode ločne dolžine, indirektne in direktne metode določanja kritičnih točk, metode za prehod na sekundarne veje obtežno-deformacijske krivulje);	- Basic concepts of stability of structures (Constraints and forces in discrete systems, stability of motion of discrete systems, Lagrange-Dirichlet theorem, Lyapunov theorem, load-displacement curve, classification of simple critical points, bifurcation and limit points), - Stability analysis of elastic structures (buckling of columns, frames, plates and shells, Koiter's theory, imperfection sensitivity and interaction of modes); - Dynamic analysis of stability (vibration of columns or frames and divergence, nonconservative loads and flutter, pulsating loads and parametric resonance); - Elastoplastic stability analysis (Shanley's column, general elasto-plastic stability analysis of beams, Hutchinson's post-bifurcation analysis); - Damage and localization instabilities (constitutive equations for strain softening, softening behaviour of reinforced concrete beams and frames); - Viscoelastic and viscoplastic buckling (creep buckling of reinforced concrete columns); - Solution procedures for stability analysis of structures (classification of critical points on load-deflection paths, continuation methods, arc-length and related methods, direct and indirect methods for the computation of stability points, branch switching methods); - Critical evaluation of simplified calculation methods for stability analysis of civil engineering structures that can be found in regulations and standards.

- Kritična presoja poenostavljenih računskih metod za stabilnostno analizo gradbenih konstrukcij, ki jih predpisujejo veljavni tehnični predpisi.	

Temeljna literatura in viri/Readings:

Bažant Z.P., Cedolin L. (1991): Stability of Structures, Oxford University press, pp 3-474, 585-623 in 830-937.
Nguyen Q. S. (2000): Stability and Nonlinear Solid Mechanics, John Wiley & Sons, Ltd., pp 185-231.
Crisfield M. A. (1997): Non-linear Finite Element Analysis of Solids and Structures, Vol. 2, John Wiley & Sons, pp 338-379.
Scientific papers.

Cilji in kompetence:	**Objectives and competences:**
- Nadgraditi osnovno konstruktersko znanje s poznavanjem stabilnostnih pojavov gradbenih konstrukcij; - V povezavi z drugimi naravoslovnimi, temeljnimi mehanskimi in strokovnimi predmeti spoznati in razumeti stabilnostne pojave; - Vpeljati osnovna načela matematičnega in numeričnega modeliranja stabilnostne analize gradbenih konstrukcij; - Navajati kandidate na določitev in predstavitev problemov povezanih s stabilnostnimi pojavi, zajem eksperimentalnih podatkov, izbiro metode reševanja ter predstavitev in kritično oceno rezultatov.	- Improvement of basic knowledge considering stability of structures and their behaviour in civil engineering practice, - Introducing basic principles of mathematical and numerical stability analysis of civil engineering structures, - Finally, candidates should be capable of determining and presenting stability problems and results of properly chosen analysis as well as defining parameters that should be measured during experiments.

Predvideni študijski rezultati:	**Intended learning outcomes:**
Znanje in razumevanje: - Poznavanje terminologije in pomena pomembnejših količin v stabilnostni analizi gradbenih konstrukcij; - Sposobnost izbire primernega matematičnega in numeričnega modela za stabilnostno analizo gradbenih konstrukcij; - Sposobnost uporabe numeričnih metod za stabilnostno analizo gradbenih konstrukcij.	Knowledge and understanding: - Knowledge about the terminology and meaning of essential parameters influencing stability behaviour of structures, - Capability of choosing proper mathematical and numerical model for stability analysis of civil engineering structures, - Using suitable numerical methods for stability analysis of civil engineering structures.

Metode poučevanja in učenja:	**Learning and teaching methods:**
Predavanja, seminar, konsultacije.	Lectures and individual seminar work.

Načini ocenjevanja:	**Delež/Weight**	**Assessment:**
Izdelava seminarske naloge	70,00 %	Individual seminar work
uspešna ustna ali pisna branitev naloge	30,00 %	Its explanation and writing/oral examination.

Reference nosilca/Lecturer's references:

KRYŽANOWSKI, Andrej, **PLANINC, Igor**, SCHNABL, Simon. Slip-buckling analysis of longitudinally delaminated composite columns. Engineering structures, ISSN 0141-0296. [Print ed.], 2014, letn. 76, str. 404-414.

SCHNABL, Simon, **PLANINC, Igor.** Exact buckling loads of two-layer composite Reissner's columns with interlayer slip and uplift. International journal of solids and structures, ISSN 0020-7683. [Print ed.], 2013, letn. 50, št. 1, str. 30-37.

SCHNABL, Simon, TURK, Goran, **PLANINC, Igor**. Buckling of timber columns exposed to fire. Fire safety journal, ISSN 0379-7112. [Print ed.], 2011, letn. 46, št. 7, str. 431-439.

UČNI NAČRT PREDMETA/COURSE SYLLABUS

Predmet:	Stratigrafija fanerozoika
Course title:	Stratigraphy of the Phanerozoic

Študijski programi in stopnja	Študijska smer	Letnik	Semestri
Grajeno okolje, tretja stopnja, doktorski	Ni členitve (študijski program)		Letni, Zimski

Univerzitetna koda predmeta/University course code: 1301

Predavanja	Seminar	Vaje	Klinične vaje	Druge oblike študija	Samostojno delo	ECTS
20	30	0	0	75	0	5

Nosilec predmeta/Lecturer: Boštjan Rožič

Vrsta predmeta/Course type: Izbirni predmet/Elective course

Jeziki/Languages:

Predavanja/Lectures:	Angleščina, Slovenščina
Vaje/Tutorial:	Angleščina, Slovenščina

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:	Prerequisites:
Končan študij 2. bolonjske stopnje na naravoslovnih in tehničnih smereh, znanja iz regionalne geologije, paleontologije, sedimentologije in stratigrafije na ravni 2. bolonjske stopnje oz. univerzitetne diplome.	M.Sc. of Natural or Technical Science, basic knowledge of regional geology, palaeontology, sedimentology and stratigraphy

Vsebina:	Content (Syllabus outline):
- Ponovitev teorije osnovnih stratigrafskih orodij in klasifikacij - Filozofija stratigrafije - Glavni globalni dogodki v Zemljini zgodovini: sedimentni zapis, datiranje, interpretacija, razširjenost, prepoznavanje, korelacije - Visoko resolucijska stratigrafija - Rekonstrukcija Zemljine zgodovine: globalni in regionalni dogodki v posameznih stratigrafskih obdobjih (paleozoik, mezozoik, kenozoik, kvartar)	- Recapitulation of basic stratigraphic tools and classifications - Philosophy of stratigraphy, - Global events in Earth history: sedimentary record, dating, interpretation, extension, correlation - Stratigraphical tools and methods of recording stratigraphical data, - High resolution stratigraphy - Reconstructing of Earth's history: global and regional events in different stratigraphical eras (Paleozoic, Mesozoic, Cenozoic, Quaternary)

Temeljna literatura in viri/Readings:

Books:

Miall, A. D., 2004: Empiricism and model building in stratigraphy: The historical roots of present-day practices. – Stratigraphy, 1, 3-25.
Miall, A. D. & Miall, C. E. 2004: Empiricism and model-building in stratigraphy: Around the hermeneutic circle in the pursuit of stratigraphic correlation. - Stratigraphy, 1, 27-46.
Ross, G. M. 1999: Paleogeography: an earth systems perspective. - Chemical Geology 161, 5–16.
Walsh, S. L. 2005: The role of stratotypes in stratigraphy. Part 1. Stratotype function. – Earth-Science reviews, 69, 307-332.
Zalasiewicz et al. 2004: Symplifying the stratigraphy of time. – Geology, 32, 1-4.
Barnes C. R. 1999: Paleoceanography and paleoclimatology: an Earth system perspective - Chemical Geology 161, 17–35.

Pillans, B. 2007: Defining the Quaternary: Where we go from here? – Stratigraphy. 4, 145-149. Berggren, W.A. et al. Eds. 1995: Geochronology, time scales and global stratigraphic correlation. – SEPM Spec. Publ. 54, 386 pp.
Blundell, D. J. & Scott, A. C. Eds. 1998: The Past is the Key to the Present.- Geological Society London, Spec. Publ., 143.

Journals: Stratigraphy Lethaia Geology
International Journal of Geology
Facies
Geologica Carpathica
Creataceous Research
Quaternary Research

Cilji in kompetence:	**Objectives and competences:**
Cilji predmeta so poznavanje in razumevanje značilnih stratigrafskih zaporedij v povezavi z globalnimi in/ali regionalnimi evolucijskimi, tektonskimi, evstatičnimi in klimatskimi dogodki, ki so vezani na določeno stratigrafsko obdobje fanerozoika.	The aim of the course is knowledge and understanding of typical Phanerozoic stratigraphic successions on the basis of global and/or regional evolutionary, tectonic, eustatic and climatic events

Predvideni študijski rezultati:	**Intended learning outcomes:**
Znanje in razumevanje: Slušatelj bo sposoben samostojnega dela na terenu, prepoznavanja, teoretičnega razumevanja in interpretacije različnih fanerozojskih sedimentnih stratigrafskih zapisov na lokalnem in regionalnem nivoju ter njihove korelacije na globalni ravni.	Znanje in razumevanje: Slušatelj bo sposoben samostojnega dela na terenu, prepoznavanja, teoretičnega razumevanja in interpretacije različnih fanerozojskih sedimentnih stratigrafskih zapisov na lokalnem in regionalnem nivoju ter njihove korelacije na globalni ravni.

Metode poučevanja in učenja:	**Learning and teaching methods:**
Predavanja, individualna seminarska naloga z izbrano tematiko iz navedene vsebinske domene, projektno delo.	Lecture, consultations, seminar and project work

Načini ocenjevanja:	**Delež/Weight**	**Assessment:**
Ustni in/ali pisni izpit, ocena seminarja oz. projekta	100,00 %	Writing and/or oral examination, seminar and/or project essay

Reference nosilca/Lecturer's references:

1. ROŽIČ, Boštjan. 2009: Perbla and Tolmin formations: revised Toarcian to Tithonian stratigraphy of the Tolmin Basin (NW Slovenia) and regional correlations.- Bull.Soc.Geol.France., vol. 180, pp. 409-426.
2. GALE, Luka, KOLAR-JURKOVŠEK, Tea, ŠMUC, Andrej, **ROŽIČ, Boštjan**. 2012: Integrated Rhaetian foraminiferal and conodont biostratigraphy from the Slovenian Basin, eastern Southern Alps. *Swiss journal of geosciences*, vol. 105, issue 3, str. 435-462.
3. GALE, Luka, KASTELIC, Aleksander, **ROŽIČ, Boštjan.** 2013: Taphonomic features of Late Triassic foraminifera from Mount Begunjščica, Karavanke Mountains, Slovenia. Palaios, vol. 28, no. 11, str. 771-792.
4. ROŽIČ, Boštjan, VENTURI, Federico, ŠMUC, Andrej. 2014: Ammonites from Mt Kobla (Julian Alps, NW Slovenia) and their significance for precise dating of Pliensbachian tectono-sedimentary event. RMZ - Materials and geoenvironment, let. 61, št. 2-3, str. 191-201.
5. ROŽIČ, Boštjan, GORIČAN, Špela, ŠVARA, Astrid, ŠMUC, Andrej. 2014: The Middle Jurassic to Lower Cretaceous succession of the Ponikve klippe: the Southernmost outcrops of the Slovenian Basin in Western Slovenia. Rivista italiana di paleontologia e stratigrafia, vol. 120, no. 1, str. 83-102.

UČNI NAČRT PREDMETA/COURSE SYLLABUS

Predmet:	Tehnično upravljanje nepremičnin - izbrana poglavja
Course title:	Technical Real-estate Management - Selected Chapters

Študijski programi in stopnja	Študijska smer	Letnik	Semestri
Grajeno okolje, tretja stopnja, doktorski	Ni členitve (študijski program)		Letni, Zimski

Univerzitetna koda predmeta/University course code: 1118

Predavanja	Seminar	Vaje	Klinične vaje	Druge oblike študija	Samostojno delo	ECTS
40	0	0	0	85	0	5

Nosilec predmeta/Lecturer: Maruška Šubic-Kovač

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:
Ni posebnih pogojev.	No specific prerequisites.

Vsebina:	Content (Syllabus outline):
Razvoj nepremičnin in tehnično upravljanje nepremičnin v celotnem življenjskem ciklu nepremičnine; pravni, ekonomski in institucionalni vidiki. Urejanje prostora in tehnično upravljanje nepremičnin na državni in lokalni ravni. Teorija in modeliranje razvojnega potenciala in optimalne izrabe urbanega prostora ter modeli za ocenjevanje najboljše rabe zemljišč. Teorija vrednotenja upravičenosti in učinkovitosti investicij javnega in zasebnega sektorja za značilne skupine nepremičnin. Metode in modeli urejanja zemljišč kot sredstvo za realizacijo načrtov na lokalni ravni (vloga zemljiškega managementa pri pridobivanju stavbnih zemljišč za gradnjo v splošnem in pri realizaciji načrtovanih infrastrukturnih objektov, realizaciji zahtev varstva narave itn.). Sistemi in komponente upravljanja za značilne skupine nepremičnin: grajeno javno dobro, infrastrukturni sistemi, stanovanjsko - poslovne stavbe in druge nepremičnine. Produkcijske funkcije infrastrukturnih sistemov. Teorija in specifične metode vrednotenja nepremičnin. Raziskave trga nepremičnin kot podlaga za razvoj in upravljanje nepremičnin. Potrebne informacijske baze in podatki za upravljanje z nepremičninami.	Real estate development, and technical management of real estate throughout its life cycle; legal, economic and institutional aspects. Spatial management and technical management of real estate at the national and regional / local levels. Theory and modelling of developmental potential and optimal use of urban space, and best-land-use assessment models. Theory of valuation of eligibility and efficiency of the public and private sector investments into the characteristic groups of real estate. Land management methods and models as the means for implementing plans at regional / local levels (the role of land management in acquiring building land for construction in general, as well as at implementation of planned infrastructural facilities, of nature conservation requirements etc.) Management systems and components of characteristic groups of real estate: built public good, infrastructural systems, residential and service buildings, and other real estate. Production functions of infrastructural systems. Theory and specific real estate valuation methods. Real estate market research as basis of real estate development and management. Information data bases and data required for real estate management.

Aktualna tematika in mednarodni trendi v raziskavah na področju upravljanja nepremičnin.	Current topics and international trends in real estate management research.

Temeljna literatura in viri/Readings:

Učbeniki: / Textbooks:
Ratcliffe, J., Stubbs, M. in Keeping, M. (2009): Urban planning and real estate development, Routledge.
Schmitz, A. in Brett, D. L. (2009): Real estate market analysis, Urban land institute.
Kroell, R. (2004): Rechte und Belastungen bei der Verkehrswertermittlungen von Grunstuecken, Luchterhand.
Epley, D. R., Rabianski, J. S. in Haney, R. L. (2002): Real estate decisions, South-Western Thomson Learning.
Revije: / Journals:
Building and Environmental, Elsevier.
Land Use Policy, Elsevier.
Journal of Urban Economics, Elsevier.
Journal of Environmental Management, Elsevier.
Journal of Real Estate Finance and Economics, Elsevier.
Real Estate Issue

Cilji in kompetence:	**Objectives and competences:**
Cilji predmeta so poglobitev in pridobitev specifičnih znanj s področja upravljanja značilnih skupin nepremičnin, s področij rabe in izrabe urbanega prostora, urejanja zemljišč in specifičnih metod vrednotenja nepremičnin. Kompetence, ki jih študent pridobi, so predvsem poznavanje in razumevanje teorij na področju upravljanja nepremičnin, poznavanje in razumevanje aktualne tematike, poznavanje in razumevanje najnovejših metod in modelov ter potreb po informacijskih bazah in podatkih za namene upravljanja nepremičnin.	Objectives of the course comprise obtaining the more detailed and intensified specific knowledge in managing the characteristic groups of real estate, the use and utilisation of urban space, land management, and specific real estate valuation methods. Competences acquired by students comprise in particular the familiarisation with and understanding of relevant theories applicable to real estate management, familiarisation with and understanding of current topics, the most up-to-date methods and models, and information database and data requirements for the real estate management purposes.

Predvideni študijski rezultati:	**Intended learning outcomes:**
Znanje in razumevanje: Študent pridobi zahtevnejša specifična teoretična znanja s področja tehničnega upravljanja nepremičnin v celotnem življenjskem ciklu nepremičnin, še posebej na področju izbranih vsebin. Na podlagi pridobljenega znanja študent razume problematiko na področju upravljanja nepremičnin, zna opredeliti posamičen problem, ga na podlagi ustreznih metod (orodij) analizirati, dobljene rezultate kritično presojati in odločati. Usposobljen je za razvoj novih znanj na področju upravljanja z nepremičninami.	Knowledge and understanding: Students shall be able to acquire proficiency in most complex specific theory in technical management of real estate throughout its lifecycle, in particular in substances here selected and presented. Based on proficiencies attained, students shall be able to understand the specific real estate management issues, define the particular issues and, using relevant methods (tools), analyse them, critically assess the results obtained, and make appropriate decisions. Having reached this stage, students shall be well qualified for acquiring and developing new real estate management expertise.

Metode poučevanja in učenja:	**Learning and teaching methods:**
Predavanja, interaktivna predavanja, seminar.	Lectures, interactive lectures, seminar.

Načini ocenjevanja:	**Delež/Weight**	**Assessment:**
Projekt	70,00 %	Project
Naloge	30,00 %	Coursework

Reference nosilca/Lecturer's references:

1. CELLMER, Radoslaw, BELEJ, Miroslaw, ŹRÓBEK, Sabina, ŠUBIC KOVAČ, Maruška. Karte vrednosti stavbnih zemljišč : metodološki pristop = Urban land value maps - a methodological approach. *Geodetski vestnik*, ISSN 0351-0271. [Tiskana izd.], 2014, letn. 58, št. 3, str. 535-551, ilustr. http://geodetski-vestnik.com/58/3/gv58-3_cellmer.pdf, doi: 10.15292/geodetski-vestnik.2014.03.535-551.
2. KRAJEWSKA, Małgorzata, ŹRÓBEK, Sabina, ŠUBIC KOVAČ, Maruška. The Role of Spatial Planning in the Investment Process in Poland and Slovenia. *Real Estate Management and Valuation*, ISSN 2300-5289, 2014, letn. 22, št. 2, str. 52-66, ilustr., doi: 10.2478/remav-2014-0017.
3. ŠUBIC KOVAČ, Maruška, RAKAR, Albin. Model vrednotenja zemljišč kategoriziranih cest za namene pravnega prometa. *Geodetski vestnik*, ISSN 0351-0271. [Tiskana izd.], 2010, letn. 54, št. 2, str. 253-266, ilustr. http://www.geodetski-vestnik.com/54/2/gv54-2_253-266.pdf.
4. SVETINA, Matija, ISTENIČ STARČIČ, Andreja, JUVANČIČ, Matevž, NOVLJAN, Tomaž, ŠUBIC KOVAČ, Maruška, VEROVŠEK, Špela, ZUPANČIČ-STROJAN, Tadeja. Beliefs about the environment : moving from the egocentric towards the ecocentric perspective. *The international journal of sustainable development and world ecology*, ISSN 1350-4509. [Print ed.], 2014, letn. 21, št. 6, str. 540-545, ilustr., doi: 10.1080/13504509.2014.963735.
5. KUŠAR, Matej, ŠUBIC KOVAČ, Maruška, ŠELIH, Jana. Selection of Efficient Retrofit Scenarios for Public Buildings. V: JUOZAPAITIS, Algirdas (ur.). *11th International Conference on Modern Building Materials, Structures and Techniques, MBMST 2013, 16 - 17 May 2013, Vilnius, Lithuania*, (Procedia engineering, ISSN 1877-7058, Vol. 57). Kidlington: Elsevier, 2013, vol. 57, str. 651-656, ilustr., doi: 10.1016/j.proeng.2013.04.082.
6. SITAR, Metka, LORBER, Lučka, ŠUBIC KOVAČ, Maruška. Revitalization of Industrial Zones in the Context of Sustainable Urban Land Development: Case Study of Business and Industrial Zone Tezno, Maribor. V: TIRA, Maurizio (ur.), IVANIČKA, Koloman (ur.), ŠPIRKOVÁ, Daniela (ur.). *Industrial urban land redevelopment : COST Action TU0602 - land management for urban dynamics : proceedings of Bratislava meeting*. COST office: Maggiolli; Santarcangelo di Romagna, 2011, str. 89-106.
7. ŠUBIC KOVAČ, Maruška. Land Development Potential under Conditions of Sustainable Development in the Republic of Slovenia. V: HEPPERLE, Erwin (ur.). *Land Management : Potential, Problems and Stumbling Blocks = Landmanagement - Potenzial, Problemfelder und Stolpersteine*. Zürich: VDF Hochschulverlag AG an der ETH, 2013, str. 177-185. http://www.vdf.ethz.ch/service/3479/3480_Landmanagement_OA.pdf.

UČNI NAČRT PREDMETA/COURSE SYLLABUS

Predmet:	Tektonske strukture in procesi
Course title:	Tectonic Structures and Processes

Študijski programi in stopnja	Študijska smer	Letnik	Semestri
Grajeno okolje, tretja stopnja, doktorski	Ni členitve (študijski program)		Letni, Zimski

Univerzitetna koda predmeta/University course code: 1720

Predavanja	Seminar	Vaje	Klinične vaje	Druge oblike študija	Samostojno delo	ECTS
20	10	10	0	85	0	5

Nosilec predmeta/Lecturer: Marko Vrabec

Vrsta predmeta/Course type: Izbirni predmet/Elective course

Jeziki/Languages:

Predavanja/Lectures:	Slovenščina, Angleščina
Vaje/Tutorial:	Angleščina, Slovenščina

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:	Prerequisites:
Ni posebnih pogojev.	No special prerequisites.

Vsebina:	Content (Syllabus outline):
• Mehanika in reologija kamnin v različnih nivojih litosfere. • Geometrijske značilnosti in geneza mikroskopskih, mezoskopskih in regionalnih struktur in strukturnih sistemov. • Kvantitativne metode strukturne analize in analiza deformacij v strukturni geologiji. • Aplikativna strukturna geologija. • Tektonika in geodinamika sedimentnih bazenov. • Tektonika in geodinamika orogenov. • Aktivni tektonski procesi. • Deformacije litosfere kot odziv na različne geodinamske procese (vertikalni in horizontalni premiki skorje). • Vpliv geodinamike na geološke procese (magmatizem, metamorfizem, sedimentacija, razvoj reliefa, nastanek rudišč, biotska evolucija, itd.). • Regionalne tektonske enote v območju Slovenije in alpsko-mediteranskega prostora. • Geodinamski razvoj alpsko-mediteranskega prostora skozi geološko zgodovino.	• Rock mechanics and mechanics of litospheric deformation. • Geometrical characteristics and genesis of microscopic, mesoscopic and regional structures and structural systems. • Quantitative methods of structural analysis and strain analysis techniques. • Applied structural geology. • Tectonics and geodynamics of sedimentary basins. • Tectonics and geodynamics of orogens. • Active tectonic processes • Deformation as the response of litosphere to geodynamic processes (vertical and horizontal movements of the crust). • Geodynamical control on geological processes (magmatism, metamorphism, sedimentation, relief development, origin of mineralizations, bioevolution, etc.). • Regional tectonic units in the area of Slovenia and the Alpine-Mediterranean region. • Geodynamical evolution of the Alpine-Mediterranean region.

Temeljna literatura in viri/Readings:

1.) Twiss R.J., Moores E.M.: Structural Geology (2. izdaja). W. H. Freeman, 2006, 532 str., ISBN: 978-0716749516.
2.) Pollard D.D., Fletcher R.C.: Fundamentals of Structural Geology. Cambridge University Press, 2005, 512 str., ISBN 978-0521839273.

3.) Stüwe K.: Geodynamics of the Litosphere. (2. izdaja.) Springer, 2007, 493 str. ISBN: 978-3540712367.
4.) Cavazza W., Roure F., Spakman W., Stampfli G.M., Ziegler P.A. (ur.): The TRANSMED Atlas. The Mediterranean Region from Crust to Mantle. Springer, 2004, 141 str. ISBN: 978-3-540-22181-4

Cilji in kompetence:	**Objectives and competences:**
Poglobljen študij geoloških struktur v različnih merilih in različnih okoljih nastanka. Spoznavanje z naprednimi metodami strukturne analize. Študenti pridobijo znanje o različnih vidikih in manifestacijah geodinamskih procesov v regionalnem merilu. Spoznajo razvoj geodinamskih procesov v območju Slovenije in širše okolice skozi geološko zgodovino.	Students will expand and deepen their understanding of geometry and development of geological structures in all scales. They will learn advanced methods of structural analysis. Students will acquire knowledge on various aspects of geodynamical processes in the regional scale, and their manifestations. They will learn the geodynamic development of the region of Slovenia and surroundings.

Predvideni študijski rezultati:	**Intended learning outcomes:**
Študent zna interpretirati izvor in časovni razvoj geoloških struktur ter opredeliti fizikalne pogoje njihovega nastanka. Zna karakterizirati strukture na podlagi terenskih opazovanj in geofizikalnih podatkov in zmore na podlagi tega kvantitativno opredeliti in prognozirati njihove geometrijske značilnosti.	The student will be able to interpret the origin and temporal development of geological structures and infer physical conditions during their formation. The student will be capable of charaterizing structures from field observations and geophysical data, and will be able to quantify, model and forecast their geometrical characteristics.

Metode poučevanja in učenja:	**Learning and teaching methods:**
Predavanja, vaje, konzultacije, seminarji. Študent pripravi seminarsko nalogo s področja lastnega ožjega zanimanja iz vsebine predmeta.	Lectures, lab classes, seminars. Each student will prepare a seminar work from their area of interest in the field of structural geology and tectonics.

Načini ocenjevanja:	**Delež/Weight**	**Assessment:**
Zagovor seminarske naloge	50,00 %	Presentation of term-paper
Pisni ali ustni izpit iz teme.	50,00 %	Oral or written examination
Za opravljen izpit se lahko šteje objava vsebine seminarske naloge v znanstveni periodiki.	100,00 %	Examination may be waived if the seminar work is published in a scientific journal

Reference nosilca/Lecturer's references:

1. JAMŠEK RUPNIK, Petra, BENEDETTI, Lucilla, PREUSSER, Frank, BAVEC, Miloš, VRABEC, Marko. Geomorphic evidence of recent activity along the Vodice thrustfault in the Ljubljana Basin (Slovenia) a preliminary study. Annals of geophysics, ISSN 2037-416X, 2013, vol. 56, no. 6, 8 str., doi: 10.4401/ag-6252.
2. ŽALOHAR, Jure, VRABEC, Marko. Kinematics and dynamics of fault reactivation: the Cosserat approach. Journal of Structural Geology, ISSN 0191-8141. [Print ed.], 2010, issue 1, vol. 32, str. 15-27, doi: 10.1016/j.jsg.2009.06.008.
3. WEBER, John, VRABEC, Marko, PAVLOVČIČ PREŠEREN, Polona, DIXON, Tim, JIANG, Yan, STOPAR, Bojan. GPS-derived motion of the Adriatic microplate from Istria Peninsula and Po Plain sites and geodynamic implications. Tectonophysics, ISSN 0040-1951. [Print ed.], mar. 2010, vol. 483, iss. 3-4, str. 214-222, ilustr., doi: 10.1016/j.tecto.2009.09.001.

UČNI NAČRT PREDMETA/COURSE SYLLABUS

Predmet:	Teorija zanesljivosti konstrukcij
Course title:	Reliability of Structures

Študijski programi in stopnja	Študijska smer	Letnik	Semestri
Grajeno okolje, tretja stopnja, doktorski	Ni členitve (študijski program)		Letni, Zimski

Univerzitetna koda predmeta/University course code: 1119

Predavanja	Seminar	Vaje	Klinične vaje	Druge oblike študija	Samostojno delo	ECTS
40	0	0	0	0	85	5

Nosilec predmeta/Lecturer: Goran Turk

Vrsta predmeta/Course type: Izbirni predmet/Elective course

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

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:	Prerequisites:
Ni posebnih pogojev.	No special prerequisits.

Vsebina:	Content (Syllabus outline):
• Pomen zanesljivosti konstrukcij. Povezava med stohastičnimi in deterministčnimi metodami. • Karakteristične vrednosti, definicija, določitev po različnih metodah. • Osnovni problem zanesljivosti konstrukcij, različne posplošitve. Metoda prvega reda drugega momenta; Metoda drugega reda – drugega momenta. • Metoda Monte Carlo. Generiranje vzorcev slučajnih spremenljivk in vektorjev. Metode zmanjševanje variance, generiranje po pomembnosti, antitetične spremenljivke, korelirene spremenljivke. • Zanesljivost sistemov: približne in točne metode. • Metoda odzivnih ploskev. Prednosti in slabosti metode. Izbira optimalnega načrta eksperimentov, izbira optimalne odzivne funkcije, analiza in interpretacija rezultatov. • Aplikacija stohastičnih metod pri oceni robustnosti konstrukcij in konstrukcijskih sklopov.	• The importance of reliability analysis, the relationship between stochastic and deterministic methods. • Basic analysis of structural safety: the definition of characteristic values, safety factors, reliability index and probability of failure. • Basic structural reliability problem: determination of probability of failure, First- order second-moment method, second order methods. • Monte Carlo methods, basic (naive) simulations, variance reduction techniques, e.g. importance sampling, correlated variables, antithetic variables, etc. • System reliability (serial and parallel systems), bounds on reliability of systems. • Response surface method. Advantages and disadvantages, the optimal experimental design, the optimal response function, the analysis and interpretation. • The application of stochastic methods in structural robustness assessment.

Temeljna literatura in viri/Readings:

1. Benjamin, J.R.;Cornell, C.A.,1970,Probability, Statistics,and Decision forCivil Engineers, McGraw-Hill.
2. R.Y.Rubinstein, 1981, Simulation and the Monte Carlo Method, John Wiley &Sons, New York.
3. Turk,G.2012, Verjetnostniračun in statistika,1. izd. Ljubljana: Fakultetazagradbeništvo in geodezijo.
4. Thoft-Christensen, P; Baker, M.J., 1982, Structural Reliability Theory and its Applications, Spriger-Verlag.

5. Ellingwood, B.;Galambos, T.V.;MacGregor,J.G.;Cornell, C.A.,1980, Development ofa Probability Based Load Criterion forANS A58, NBS.
6. Melchers, R.E.,1987, StructuralReliability, Analysisand Prediction,John Wiley & Sons.
7. Blockley,D. (ed.),1992, EngineeringSafety,McGraw-Hill.
8. Madsen, H.O.,Krenk, S.,Lind, N.C.,1986, Methods ofStructuralSafety,Prentice- Hall.

Cilji in kompetence:	**Objectives and competences:**
Cilji: Spoznati pomen zanesljivostnih metod v konstruktivi. Razumeti prehod med stohastičnimi metodami in v praksiuporabljenimi deterministčnimi metodami – pomen varnostnih faktorjev in karakterističnih vrednosti. Spoznavanje z različnimi naprednimi metodami zanesljivosti konstrukcij. Kompetence: Zna urediti in pripraviti podatke za analizo zanesljivosti konstrukcij. Zna uporabiti ustrezno programsko opremo za rešitev problema. Zna določiti varnostne faktorje na osnovi stohastične analize in aplicirati stohastične metode na analizo robustnosti konstrukcije.	To learn about the importance of reliability methods in structural engineering. To understand the relationship between stochastic methods in usually used deterministic methods. The significance of safety factors and characteristic values. The comprehension of modern reliability analysis methods. Capability to prepare and arrange the data for reliability analysis. Knowledge about the available software for reliability analysis. Capability of safety factor determination based on stochasticanalysis, and application of stochasticmethods on the determination of structural robustness.

Predvideni študijski rezultati:	**Intended learning outcomes:**
Znanje in razumevanje: Osvoji poglobljeno znanje in razumevanje o pomenu zanesljivosti konstrukcij ter o metodah določitve stopnje zanesljivosti.	Knowledge and understanding: Obtain a thorough knowledge of the importance oft hereliability of structures as well as the methods for reliability assesment.

Metode poučevanja in učenja:	**Learning and teaching methods:**
Predavanja, priprava seminarske naloge in njena predstavitev.	Lectures, preparation of term-paper and its presentation

Načini ocenjevanja:	**Delež/Weight**	**Assessment:**
Zagovor seminarske naloge	50,00 %	Pesentation of term-paper
Pisni ali ustni izpit iz teme.	50,00 %	Oral or written examination

Reference nosilca/Lecturer's references:

1. SCHNABL, Simon, PLANINC, Igor, TURK, Goran. Buckling loads of two-layer composite columns with interlayer slip and stochastic material properties. Journal of engineering mechanics, ISSN 0733-9399, 2013, letn. 139, št. 8, str. 1124-1132.
2. VRANKAR, Leopold, LIBRE, Nicolas Ali, LING, Leevan, TURK, Goran, RUNOVC, Franc. Solving moving-boundary problems with the wavelet adaptive radial basis functions method. Computers & Fluids, ISSN 0045-7930. [Print ed.], 2013, vol. 86, str. 37-44.
3. VRANKAR, Leopold, KANSA, Edward J., LING, Leevan, RUNOVC, Franc, TURK, Goran. Moving-boundary problems solved by adaptive radial basis functions. Computers & Fluids, ISSN 0045-7930. [Print ed.], 2010, vol. 39, no. 9, p. 1480-1490.
4. SVENSSON, Staffan, TURK, Goran, HOZJAN, Tomaž. Predicting moisture state of timber members in a continuously varying climate. Engineering structures, ISSN 0141-0296. [Print ed.], 2011, letn. 33, št. 11, str. 3064-3070.
5. TURK, Goran. Verjetnostniračun in statistika. 1. izd. Ljubljana: Fakultetazagradbeništvo in geodezijo, 2012. VI, 264 str.

UČNI NAČRT PREDMETA/COURSE SYLLABUS

Predmet:	Upravljanje s kakovostjo prostorskih podatkov
Course title:	Management of Spatial Data Quality

Študijski programi in stopnja	Študijska smer	Letnik	Semestri
Grajeno okolje, tretja stopnja, doktorski	Ni členitve (študijski program)		Letni, Zimski

Univerzitetna koda predmeta/University course code: 1542

Predavanja	Seminar	Vaje	Klinične vaje	Druge oblike študija	Samostojno delo	ECTS
35	0	5	0	20	65	5

Nosilec predmeta/Lecturer: Tomaž Podobnikar

Vrsta predmeta/Course type: Izbirni predmet/Elective course

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

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:	**Prerequisites:**
Predmet sestavljata dva modula: *Od negotovosti h kakovosti prostorskih podatkov* ter *Kakovost digitalnega modela reliefa kot ploskve*. Študent lahko izbere vsak modul posebej ali oba skupaj. Za modul I je potrebno znanje s področja katerekoli smeri geodezije ali gradbeništva v obsegu 6 KT in za modul II je nujno znanje s področja kartografije in fotogrametrije v obsegu 6 KT oziroma ustrezna primerljiva znanja.	The course constitutes of two modules: From uncertainty towards quality of spatial data, and *Quality of digital terrain model as a surface*. Student can choose either one module or both. For module I it is necessary to have knowledge in the any course in civil engineering or geodesy of 6 ECTS, and for module II it is necessary to have knowledge in the field of cartography and photogrammetry of 6 ECTS, or adequate knowledge.

Vsebina:	**Content (Syllabus outline):**
MODUL I – Od negotovosti h kakovosti prostorskih podatkov (5 kt) Notranja/zunanja kakovost, semantična kakovost/negotovost podatkov, model kakovosti, ocena kakovosti/ocena negotovosti, abstrakcija, generalizacija/specializacija, elementi kakovosti, metapodatki in standardizacija, medopravilnost, simulacije negotovosti, stacionarnost/nestacionarnost polja negotovosti. Izdelava in uporaba simulacij negotovosti. Metode kontrole kakovosti. Kakovost v smislu časovne vrste. **MODUL II – Kakovost digitalnega modela reliefa kot ploskve (5 kt)** Konceptualni model DMR-ja, numerične in vizualne metode kontrole kakovosti in namen uporabe DMR-ja. »Klasični« in visokoločljivostni (lidarski) DMR in DMP. Interpolacija, filtriranje in vzorčenje podatkov. Klasifikacija napak DMR-ja glede na spremenljivke reliefa (naklon, ekspozicija, ukrivljenost ipd.).	**MODULE I – From uncertainty towards quality of spatial data (5 ECTS)** inner / outer quality, semantic quality / uncertainty of data, model of quality, quality assessment / evaluation of uncertainty, abstraction, generalization / specialisation, elements of quality, metadata and standardisation, interoperability, simulation of uncertainty, stationary / non-stationary uncertainty fields. Production and use of uncertainty simulations. Quality control methods. Quality in terms of time-series. **MODULE II – Quality of digital terrain model as a surface (5 ECTS)** Conceptual model of DTM, numerical and visual quality control methods and the use of DTM's. "Classical" and high-resolution (lidar) DTM and DMP. Interpolation, filtering and sampling of data. DTM errors classification according to the topographic variables (slope, aspect, curvature, etc.).

Temeljna literatura in viri/Readings:

Knjižni viri (izbrana poglavja) / Printed sources (selected contents):

- Burrough, P., McDonnell, R. (1998) Principles of Geographical Information Systems, Oxford.
- de Smith, M., Goodchild, M., Longley, P. (2006-2015) Geospatial Analysis - a comprehensive guide. SPLINT, 3rd edition.
- Foody, G.M., Atkinson, P. (eds.) (2002) Uncertainty in Remote Sensing and GIS. Chichester, UK: John Wiley, xviii + 307 p.
- Höhle, J., Höhle, M. (2009) Accuracy assessment of digital elevation models by means of robust statistical methods. ISPRS Journal of Photogrammetry and Remote Sensing 64, 398-406.
- Kimball, R., Caserta, J. (2004) The Data Warehouse ETL Toolkit: Practical Techniques for Extracting, Cleaning, Conforming, and Delivering Data, John Wiley & Sons, New York
- Lloyd, C.D. (2011) Local Models for Spatial Analysis. Second Edition. Boca Raton: CRC Press, 336 p.
- Olsen, J.E. (2003) Data Quality: The Accuracy Dimension, Morgan Kaufmann Publishers, New York.
- Oksanen J., Sarjakoski T. (2006) Uncovering the statistical and spatial characteristics of fine toposcale DEM error. International Journal of Geographical Information Science, 20(4): 345–369.
- Wilson, J.P., Gallant, J.C. (eds.) (2000) Terrain analysis – Principles and Applications. John Wiley & Sons, New York, 479 p.
- Monografije / Monographs Geografski informacijski sistemi v Sloveniji, Založba ZRC / ZRC Publishing (1991–2014).

Elektronski viri (izbrane vsebine) / Electronic sources (selected contents):

- http://www.spatial-accuracy.org/
- http://www.geodetski-vestnik.com
- http://www.solver.com/simulation/monte-carlo-simulation/index.html
- http://www.uncertweb.org/documents/presentations
- http://mucm.aston.ac.uk/toolkit/
- http://www.physics.nist.gov/cuu/index.html
- http://www.bipm.org/utils/common/documents/jcgm/JCGM_100_2008_E.pdf
- http://sapiens.revues.org/738
- http://meetingorganizer.copernicus.org/EGU2011/EGU2011-9504-3.pdf
- http://meetingorganizer.copernicus.org/EGU2012/EGU2012-12954-2.pdf
- http://onlinelibrary.wiley.com/doi/10.1111/j.1467-9671.2012.01335.x/abstract
- http://drugg.fgg.uni-lj.si/4593/1/gv57-4_sustersic_kd.pdf

Cilji in kompetence:	**Objectives and competences:**
Cilj predmeta je ponuditi študentom metodologijo, metode, tehnike in orodja za upravljanje s kakovostjo prostorskih podatkov in informacij: • Motivacija za sistematično obravnavo kakovosti in negotovosti prostorskih podatkov. • Umestitev konceptov kakovosti in negotovosti v okvir teorij prostora (realnost – konceptualni model – podatek – informacija). • Spoznati lastnosti prostorskih podatkov in pri tem natančneje digitalni model reliefa (DMR). DMR je vir informacij o prostoru, pridobljenih na osnovi različnih geomorfometričnih analiz. • Razumeti naravo napak DMR-ja kot ploskve, pri čemer gre praviloma za nestacionarno in hkrati avtokorelirano polje napak/negotovosti, ki ga je treba obravnavati drugače kot napake diskretnih vrednosti. • Oceniti kakovost podatkov na osnovi metapodatkov in analiz kakovosti. • Doseči in pridobiti dodatno vrednost podatkov, npr. na osnovi profiliranja ali čiščenja (prebiranja) podatkov, ETL-a ipd. • Spoznati možnosti upravljanja kakovosti na primerih priprave podatkov (npr. pri izdelavi karte	The goal of the course is offer to students the methodology, methods, techniques and tools for management of spatial data and information quality: • Motivation for systematic study of the spatial data quality and uncertainty. • Assigning of the quality and uncertainty conception within frame of the spatial theory (reality – conceptual model – data – information). • Comprehend the characteristics of spatial data and the more accurately the digital terrain model (DTM). The DTM is the source of information about the space acquired through a variety of geomorphometric analysis. • Understand the nature of the DTM errors as a surface, which is usually non-stationary and at the same time autocorrelated error field, and should be treated differently from errors as discrete values. • Assess the quality of the data based on metadata and analyses of quality. • Attain and acquire additional data value, for example based on profiling or data cleansing, ETL, etc. • Understand feasibility of quality management in cases of data preparation (e.g. in the production of

topografskih podatkov ali na podlagi integracije podatkov). • Razumeti in vrednotiti vlogo kakovosti pri uporabnosti podatkov in pri pridobivanju informacij v smislu zmanjševanja negotovosti.	topographic maps or based on data or data integration). • Understand and evaluate the role of quality and usefulness of the data in obtaining information in terms of reducing uncertainty.

Predvideni študijski rezultati:	**Intended learning outcomes:**
Znanje in razumevanje: • Znati ločiti napake izvornih (glede na metodologijo meritev, sprememb v naravi ipd.) in izvedenih podatkov (napake operacij med podatki). • Znati oceniti kakovost izbranih prostorskih podatkov na podlagi numeričnih in vizualnih metod, npr. znati ovrednotiti DMR pri uporabi različnih interpolacijskih metod. • Znati izvesti in analizirati izbrane simulacije napak kartografskega gradiva ali DMR-ja ter pri tem določiti pomen človeškega faktorja. • Razumeti zagotavljanje in izboljševanje kakovosti izbranih podatkov v smislu celovitega upravljanja (oz. kontrole) kakovosti. • V smislu sinteze izdelati konceptualizacijo izbranega prostorskega podatka, npr. DMR-ja za izbran namen uporabe in pri tem znati ločiti visokoločljivostni DMR od »klasičnega« ter DMR od DMP-ja. • Znati izbrati in vrednotiti podatke za določen namen v smislu izbire primernega koncepta, merila, ločljivosti, ter drugih elementov kakovosti podatkov.	Knowledge and understanding: • Ability to separate error sources (according to the methodology of measurement, changes in the nature, etc.) and derivative data (errors of operations between the datasets). • Ability to assess the quality of spatial data selected on the basis of numerical and visual methods, for example ability to evaluate the DTM using different interpolation methods. • Ability to perform and analyse simulations of selected cartographic material errors or DTM, and defining the importance of human factors. • Ability to understand quality assurance and improvement of selected data in terms of total quality management (or control). • In terms of synthesis elaborate the conceptualization of the selected spatial data, for example a DTM for the selected purpose, and in doing so able to separate a high resolution DTM from a "classic" DTM and from a DSM. • Ability to select and evaluate data for a particular purpose in terms of choice of a suitable concept, scale, resolution, and other elements of data quality.

Metode poučevanja in učenja:	**Learning and teaching methods:**
Predavanja in konzultacije, študij strokovne literature, uporaba (enostavnih) programskih orodij za modeliranje negotovosti, vključno z aplikacijami na spletu, prikaz uporabe modeliranja različnih modelov reliefa in drugih topografskih/prostorskih podatkov, terenska kontrola podatkov in modelov.	Lectures and consultations, study of professional literature, usage of (simple) programs for digital terrain models together with the web-based applications, presentation of different digital terrain models applications and other topographic/spatial data, field control of data and models.

Načini ocenjevanja:	**Delež/Weight**	**Assessment:**
Izdelava seminarske naloge ali prednostno objava v znanstveni periodiki.	100,00 %	Completion of a seminar work or preferably publication of a paper in scientific literature.

Reference nosilca/Lecturer's references:

Doc. dr. / Assist. Prof. Dr. Tomaž Podobnikar:

- Čeh, M., Smole, D., **Podobnikar, T.** 2013. Semantični splet in koncept globalne geo-ontologije = Semantic web and the concept of global geo-ontology. *Geodetski vestnik*, 57 (3), 513-522 [COBISS.SI-ID 6343009]
- Somodi, I., Čarni, A., Ribeiro, D., **Podobnikar, T.** 2012. Recognition of the invasive species Robinia pseudacacia from combined remote sensing and GIS sources. *Biological Conservation*, 150 (1), 59-67 [COBISS.SI-ID 34027053]
- Dorigo, W., Lucieer, A., **Podobnikar, T.**, Čarni, A. 2012. Mapping invasive Fallopia japonica by combined spectral, spatial, and temporal analysis of digital orthophotos. *ITC journal*, 19, 185-195 [COBISS.SI-ID 34327853]
- Smole, D., Čeh, M., **Podobnikar, T.** 2011. Evaluation of inductive logic programming for information extraction from natural language texts to support spatial data recommendation services. *International Journal of Geographical Information Science*, 25 (11), 1809-182 [COBISS.SI-ID 33178413]

- **Podobnikar, T.** 2010. Historical maps of Ljubljana for GIS applications. *Acta geod. geophys. Hung.*, 45 (1), 80-88 [COBISS.SI-ID 31117613]
- **Podobnikar, T.** 2009. Georeferencing and quality assessment of Josephine survey maps for the mountainous region in the Triglav National Park. *Acta geod. geophys. Hung.*, 44 (1), 49-66 [COBISS.SI-ID 29462061]

UČNI NAČRT PREDMETA/COURSE SYLLABUS

Predmet:	Upravljanje s kakovostjo prostorskih podatkov
Course title:	Management of Spatial Data Quality

Študijski programi in stopnja	Študijska smer	Letnik	Semestri
Grajeno okolje, tretja stopnja, doktorski	Ni členitve (študijski program)		Letni, Zimski

Univerzitetna koda predmeta/University course code: 1549

Predavanja	Seminar	Vaje	Klinične vaje	Druge oblike študija	Samostojno delo	ECTS
70	0	10	0	40	130	10

Nosilec predmeta/Lecturer: Tomaž Podobnikar

Vrsta predmeta/Course type: Izbirni predmet/Elective course

Jeziki/Languages:

Predavanja/Lectures:	Slovenščina, Angleščina
Vaje/Tutorial:	Slovenščina, Angleščina

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:	**Prerequisites:**
Predmet sestavljata dva modula: *Od negotovosti h kakovosti prostorskih podatkov* ter *Kakovost digitalnega modela reliefa kot ploskve*. Študent lahko izbere vsak modul posebej ali oba skupaj. Za modul I je potrebno znanje s področja katerekoli smeri geodezije ali gradbeništva v obsegu 6 KT in za modul II je nujno znanje s področja kartografije in fotogrametrije v obsegu 6 KT oziroma ustrezna primerljiva znanja.	The course constitutes of two modules: From uncertainty towards quality of spatial data, and *Quality of digital terrain model as a surface*. Student can choose either one module or both. For module I it is necessary to have knowledge in the any course in civil engineering or geodesy of 6 ECTS, and for module II it is necessary to have knowledge in the field of cartography and photogrammetry of 6 ECTS, or adequate knowledge.

Vsebina:	**Content (Syllabus outline):**
MODUL I – Od negotovosti h kakovosti prostorskih podatkov Notranja/zunanja kakovost, semantična kakovost/negotovost podatkov, model kakovosti, ocena kakovosti/ocena negotovosti, abstrakcija, generalizacija/specializacija, elementi kakovosti, metapodatki in standardizacija, medopravilnost, simulacije negotovosti, stacionarnost/nestacionarnost polja negotovosti. Izdelava in uporaba simulacij negotovosti. Metode kontrole kakovosti. Kakovost v smislu časovne vrste. **MODUL II – Kakovost digitalnega modela reliefa kot ploskve** Konceptualni model DMR-ja, numerične in vizualne metode kontrole kakovosti in namen uporabe DMR-ja. »Klasični« in visokoločljivostni (lidarski) DMR in DMP. Interpolacija, filtriranje in vzorčenje podatkov. Klasifikacija napak DMR-ja glede na spremenljivke reliefa (naklon, ekspozicija, ukrivljenost ipd.).	**MODULE I – From uncertainty towards quality of spatial data** inner / outer quality, semantic quality / uncertainty of data, model of quality, quality assessment / evaluation of uncertainty, abstraction, generalization / specialisation, elements of quality, metadata and standardisation, interoperability, simulation of uncertainty, stationary / non-stationary uncertainty fields. Production and use of uncertainty simulations. Quality control methods. Quality in terms of time-series. **MODULE II – Quality of digital terrain model as a surface** Conceptual model of DTM, numerical and visual quality control methods and the use of DTM's. "Classical" and high-resolution (lidar) DTM and DMP. Interpolation, filtering and sampling of data. DTM errors classification according to the topographic variables (slope, aspect, curvature, etc.).

Temeljna literatura in viri/Readings:

Knjižni viri (izbrana poglavja) / Printed sources (selected contents):

- Burrough, P., McDonnell, R. (1998) Principles of Geographical Information Systems, Oxford.
- de Smith, M., Goodchild, M., Longley, P. (2006-2015) Geospatial Analysis - a comprehensive guide. SPLINT, 3rd edition.
- Foody, G.M., Atkinson, P. (eds.) (2002) Uncertainty in Remote Sensing and GIS. Chichester, UK: John Wiley, xviii + 307 p.
- Höhle, J., Höhle, M. (2009) Accuracy assessment of digital elevation models by means of robust statistical methods. ISPRS Journal of Photogrammetry and Remote Sensing 64, 398-406.
- Kimball, R., Caserta, J. (2004) The Data Warehouse ETL Toolkit: Practical Techniques for Extracting, Cleaning, Conforming, and Delivering Data, John Wiley & Sons, New York
- Lloyd, C.D. (2011) Local Models for Spatial Analysis. Second Edition. Boca Raton: CRC Press, 336 p.
- Olsen, J.E. (2003) Data Quality: The Accuracy Dimension, Morgan Kaufmann Publishers, New York.
- Oksanen J., Sarjakoski T. (2006) Uncovering the statistical and spatial characteristics of fine toposcale DEM error. International Journal of Geographical Information Science, 20(4): 345–369.
- Wilson, J.P., Gallant, J.C. (eds.) (2000) Terrain analysis – Principles and Applications. John Wiley & Sons, New York, 479 p.
- Monografije / Monographs Geografski informacijski sistemi v Sloveniji, Založba ZRC / ZRC Publishing (1991–2014).

Elektronski viri (izbrane vsebine) / Electronic sources (selected contents):

- http://www.spatial-accuracy.org/
- http://www.geodetski-vestnik.com
- http://www.solver.com/simulation/monte-carlo-simulation/index.html
- http://www.uncertweb.org/documents/presentations
- http://mucm.aston.ac.uk/toolkit/
- http://www.physics.nist.gov/cuu/index.html
- http://www.bipm.org/utils/common/documents/jcgm/JCGM_100_2008_E.pdf
- http://sapiens.revues.org/738
- http://meetingorganizer.copernicus.org/EGU2011/EGU2011-9504-3.pdf
- http://meetingorganizer.copernicus.org/EGU2012/EGU2012-12954-2.pdf
- http://onlinelibrary.wiley.com/doi/10.1111/j.1467-9671.2012.01335.x/abstract
- http://drugg.fgg.uni-lj.si/4593/1/gv57-4_sustersic_kd.pdf

Cilji in kompetence:	**Objectives and competences:**
Cilj predmeta je ponuditi študentom metodologijo, metode, tehnike in orodja za upravljanje s kakovostjo prostorskih podatkov in informacij: • Motivacija za sistematično obravnavo kakovosti in negotovosti prostorskih podatkov. • Umestitev konceptov kakovosti in negotovosti v okvir teorij prostora (realnost – konceptualni model – podatek – informacija). • Spoznati lastnosti prostorskih podatkov in pri tem natančneje digitalni model reliefa (DMR). DMR je vir informacij o prostoru, pridobljenih na osnovi različnih geomorfometričnih analiz. • Razumeti naravo napak DMR-ja kot ploskve, pri čemer gre praviloma za nestacionarno in hkrati avtokorelirano polje napak/negotovosti, ki ga je treba obravnavati drugače kot napake diskretnih vrednosti. • Oceniti kakovost podatkov na osnovi metapodatkov in analiz kakovosti. • Doseči in pridobiti dodatno vrednost podatkov, npr. na osnovi profiliranja ali čiščenja (prebiranja) podatkov, ETL-a ipd. • Spoznati možnosti upravljanja kakovosti na primerih priprave podatkov (npr. pri izdelavi karte	The goal of the course is offer to students the methodology, methods, techniques and tools for management of spatial data and information quality: • Motivation for systematic study of the spatial data quality and uncertainty. • Assigning of the quality and uncertainty conception within frame of the spatial theory (reality – conceptual model – data – information). • Comprehend the characteristics of spatial data and the more accurately the digital terrain model (DTM). The DTM is the source of information about the space acquired through a variety of geomorphometric analysis. • Understand the nature of the DTM errors as a surface, which is usually non-stationary and at the same time autocorrelated error field, and should be treated differently from errors as discrete values. • Assess the quality of the data based on metadata and analyses of quality. • Attain and acquire additional data value, for example based on profiling or data cleansing, ETL, etc. • Understand feasibility of quality management in cases of data preparation (e.g. in the production of

topografskih podatkov ali na podlagi integracije podatkov). • Razumeti in vrednotiti vlogo kakovosti pri uporabnosti podatkov in pri pridobivanju informacij v smislu zmanjševanja negotovosti.	topographic maps or based on data or data integration). • Understand and evaluate the role of quality and usefulness of the data in obtaining information in terms of reducing uncertainty.

Predvideni študijski rezultati:	**Intended learning outcomes:**
Znanje in razumevanje: • Znati ločiti napake izvornih (glede na metodologijo meritev, sprememb v naravi ipd.) in izvedenih podatkov (napake operacij med podatki). • Znati oceniti kakovost izbranih prostorskih podatkov na podlagi numeričnih in vizualnih metod, npr. znati ovrednotiti DMR pri uporabi različnih interpolacijskih metod. • Znati izvesti in analizirati izbrane simulacije napak kartografskega gradiva ali DMR-ja ter pri tem določiti pomen človeškega faktorja. • Razumeti zagotavljanje in izboljševanje kakovosti izbranih podatkov v smislu celovitega upravljanja (oz. kontrole) kakovosti. • V smislu sinteze izdelati konceptualizacijo izbranega prostorskega podatka, npr. DMR-ja za izbran namen uporabe in pri tem znati ločiti visokoločljivostni DMR od »klasičnega« ter DMR od DMP-ja. • Znati izbrati in vrednotiti podatke za določen namen v smislu izbire primernega koncepta, merila, ločljivosti, ter drugih elementov kakovosti podatkov.	Knowledge and understanding: • Ability to separate error sources (according to the methodology of measurement, changes in the nature, etc.) and derivative data (errors of operations between the datasets). • Ability to assess the quality of spatial data selected on the basis of numerical and visual methods, for example ability to evaluate the DTM using different interpolation methods. • Ability to perform and analyse simulations of selected cartographic material errors or DTM, and defining the importance of human factors. • Ability to understand quality assurance and improvement of selected data in terms of total quality management (or control). • In terms of synthesis elaborate the conceptualization of the selected spatial data, for example a DTM for the selected purpose, and in doing so able to separate a high resolution DTM from a "classic" DTM and from a DSM. • Ability to select and evaluate data for a particular purpose in terms of choice of a suitable concept, scale, resolution, and other elements of data quality.

Metode poučevanja in učenja:	**Learning and teaching methods:**
Predavanja in konzultacije, študij strokovne literature, uporaba (enostavnih) programskih orodij za modeliranje negotovosti, vključno z aplikacijami na spletu, prikaz uporabe modeliranja različnih modelov reliefa in drugih topografskih/prostorskih podatkov, terenska kontrola podatkov in modelov.	Lectures and consultations, study of professional literature, usage of (simple) programs for digital terrain models together with the web-based applications, presentation of different digital terrain models applications and other topographic/spatial data, field control of data and models.

Načini ocenjevanja:	**Delež/Weight**	**Assessment:**
Izdelava seminarske naloge ali prednostno objava v znanstveni periodiki.	100,00 %	Completion of a seminar work or preferably publication of a paper in scientific literature.

Reference nosilca/Lecturer's references:

Doc. dr. / Assist. Prof. Dr. Tomaž Podobnikar:

- Čeh, M., Smole, D., **Podobnikar, T.** 2013. Semantični splet in koncept globalne geo-ontologije = Semantic web and the concept of global geo-ontology. *Geodetski vestnik*, 57 (3), 513-522 [COBISS.SI-ID 6343009]
- Somodi, I., Čarni, A., Ribeiro, D., **Podobnikar, T.** 2012. Recognition of the invasive species Robinia pseudacacia from combined remote sensing and GIS sources. *Biological Conservation*, 150 (1), 59-67 [COBISS.SI-ID 34027053]
- Dorigo, W., Lucieer, A., **Podobnikar, T.**, Čarni, A. 2012. Mapping invasive Fallopia japonica by combined spectral, spatial, and temporal analysis of digital orthophotos. *ITC journal*, 19, 185-195 [COBISS.SI-ID 34327853]
- Smole, D., Čeh, M., **Podobnikar, T.** 2011. Evaluation of inductive logic programming for information extraction from natural language texts to support spatial data recommendation services. *International Journal of Geographical Information Science*, 25 (11), 1809-182 [COBISS.SI-ID 33178413]

- **Podobnikar, T.** 2010. Historical maps of Ljubljana for GIS applications. *Acta geod. geophys. Hung.*, 45 (1), 80-88 [COBISS.SI-ID 31117613]
- **Podobnikar, T.** 2009. Georeferencing and quality assessment of Josephine survey maps for the mountainous region in the Triglav National Park. *Acta geod. geophys. Hung.*, 44 (1), 49-66 [COBISS.SI-ID 29462061]

UČNI NAČRT PREDMETA/COURSE SYLLABUS

Predmet:	Urejanje vodnega režima
Course title:	Management of Water Regime

Študijski programi in stopnja	Študijska smer	Letnik	Semestri
Grajeno okolje, tretja stopnja, doktorski	Ni členitve (študijski program)		Letni, Zimski

Univerzitetna koda predmeta/University course code: 1122

Predavanja	Seminar	Vaje	Klinične vaje	Druge oblike študija	Samostojno delo	ECTS
20	20	0	0	85	0	5

Nosilec predmeta/Lecturer: Mitja Brilly

Vrsta predmeta/Course type: Izbirni predmet/Elective course

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

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:	**Prerequisites:**
Predmet je namenjen predvsem študentom, ki so končali študij gradbeništva ali okoljskega onženirstva, kakor tudi kandidatom, ki so končali študije geofozike, geologije in geografije. Za sodelovanje pri pouku je predvsem potrebno predhodno znanje hidrologije in politike do voda na nivoju magistrskega študija gradbeništva ali geofizike.	The course is meant primarily for graduates of master studies in Civil Engineering and Environmental Civil Engineering, as well as for graduates of some other master studies, such as Geophysics, Geology, and Geography, but for both modules it is essential good knowledge of hydrology and water policy on the level of the master studies in Civil Engineering, Environmental Civil Engineering or Geophysics.

Vsebina:	**Content (Syllabus outline):**
Analiza procesa odločanja pri izgradnji vodarskih objektov in vodenju vodarske politike. Sonaravno upravljanje z rečnimi koridorji ter soočanje s tveganji pri pojavu poplav in suš. Ugotavljanje interesov deležnikov, izdelava analize prednosti in pomanjkljivosti, strategija pogajanj in opredelitev tehničnih atributov. Ocena nevarnosti, opredelitev njenih lastnosti in možnih posledic. Nove tehnologije za napovedovanje in ugotavljanje posledic, razvoj ukrepov za zmanjšanje škode in vplivi socialnih dejavnikov.	Analysis of decision making process for construction of water structures and water policy management. Sustainable management of river corridors and deal with the risks associated with the occurrence of floods and droughts. Find out stakeholder interests; derive of straitening and weakness analysis, negotiation strategy and development of technical attributes. Hazard analysis, characteristics and possible consequences, New technologies for forecast and find out consequences, development of measures for damage management and social impacts.

Temeljna literatura in viri/Readings:

Cech T.V., (2003), Principles of Water Resources, John Wiley & Sons, str. 446
Stern N., (2006), The Economics of Climate Change, Cambrige Press, str. 692
Pahl-Wostl, C., Kabat, P., Möltgen, J. (2008) Adaptive and Integrated Water Management • Coping with Complexity and Uncertainty, Springer, Berlin, str. 440 str.
(Eds.),
Periodične publikecije vedici Springer, Berlin:
Water Resources Management • An International Journal

Water Resources Development and Management

Cilji in kompetence:	**Objectives and competences:**
Uvajanje kandidatov v izrazito interdisciplinarno področje urejanja vodnega režima. Seznanitev s stopnjo razvoja pri izvajanju vadarske politike in ne dovolj raziskanimi problemi. Povezovanje znanj s področij tehnike, naravoslovja in družboslovja v kompleksnih vodarskih problemih.	Introduction of candidates in highly interdisciplinary field of management of the water regime. Acquaintance with the level of development in the implementation of water policy and insufficiently investigated problems. Integrating knowledge in the fields of technology, science and social studies in complex water policy problems.

Predvideni študijski rezultati:	**Intended learning outcomes:**
Na podlagi razumevanja procesov v vodarstvu in problemov pri njihovem urejanju so kandidati usposobljeni, da izdelajo analizo problema in pripravijo program raziskav s katerimi lahko dobijo ustrezno rešitev. Študenti seznanijo z doseženo stopnjo razvoja in problemi, tako da so sposobni opredeliti svoje raziskave pri doseganju novih znanj.	Based on the understanding of the water policy and problems in their regulation, the candidates are qualified to carry out analyzes of the problem and develo program of research to gain an adequate solution. Students become familiar with the level of development and problems so that they are able to define their research in pursuit of new knowledge.

Metode poučevanja in učenja:	**Learning and teaching methods:**
Konzultacije, študij strokovne literature, analiza praktičnih primerov.	Consultations, study of professional literature, analysis of practical problems.

Načini ocenjevanja:	**Delež/Weight**	**Assessment:**
Izdelava seminarske naloge ali Objava v strokovni periodiki	100,00 %	Completion of a seminar work or Paper publication in professional periodicals

Reference nosilca/Lecturer's references:

1. Špitalar, M., C. Lutoff, J. J. Gourley, P. E. Kirstetter, M. Brilly, and N. Carr, 2014: Analysis of flash flood parameters and human impacts in the US. J. Hydrol. (in press).
2. ŠRAJ, Mojca, MIKOŠ, Matjaž, BRILLY, Mitja. Rainfall interception by deciduous mediterranean forests in Slovenia, Europe. V: DANIELS, Justin A. (ur.). Advances in environmental research, (Advances in Environmental Research, ISSN 2158-5717, 14). New York: Nova Science Publishers, cop. 2011, str. 153-182, ilustr. [COBISS.SI-ID 5626721]
3. BRILLY, Mitja. Danube river basin coding : Chapter 4. V: BRILLY, Mitja (ur.). Hydrological processes of the Danube river basin : perspectives from the Danubian countries. Dordrecht [etc.]: Springer, cop. 2010, str. 125-141, ilustr. [COBISS.SI-ID 5162849]

UČNI NAČRT PREDMETA/COURSE SYLLABUS

Predmet:	Verjetnostne metode v grajenem okolju
Course title:	Probability Methods in Built Environment Studies

Študijski programi in stopnja	Študijska smer	Letnik	Semestri
Grajeno okolje, tretja stopnja, doktorski	Ni členitve (študijski program)		Letni, Zimski

Univerzitetna koda predmeta/University course code: 1123

Predavanja	Seminar	Vaje	Klinične vaje	Druge oblike študija	Samostojno delo	ECTS
40	0	0	0	0	85	5

Nosilec predmeta/Lecturer: Goran Turk

Vrsta predmeta/Course type: Izbirni predmet/Elective course

Jeziki/Languages:

Predavanja/Lectures:	Angleščina, Slovenščina
Vaje/Tutorial:	Angleščina, Slovenščina

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:	Prerequisites:
Ni posebnih pogojev.	No special prerequisits.

Vsebina:	Content (Syllabus outline):
• Pomen zanesljivosti konstrukcij. Povezava med stohastičnimi in determinističnimi metodami. • Karakteristične vrednosti, definicija, določitev po različnih metodah. • Osnovni problem zanesljivosti konstrukcij, različne posplošitve. Metoda prvega reda drugega momenta; Metoda drugega reda – drugega momenta. • Metoda Monte Carlo. Generiranje vzorcev slučajnih spremenljivk in vektorjev. Metode zmanjševanje variance, generiranje po pomembnosti, antitetične spremenljivke, korelirene spremenljivke. • Zanesljivost sistemov: približne in točne metode. • Metoda odzivnih ploskev. Prednosti in slabosti metode. Izbira optimalnega načrta eksperimentov, izbira optimalne odzivne funkcije, analiza in interpretacija rezultatov. • Aplikacija stohastičnih metod pri oceni robustnosti konstrukcij in konstrukcijskih sklopov.	• The importance of reliability analysis, the relationship between stochastic and deterministic methods. • Basic analysis of structural safety: the definition of characteristic values, safety factors, reliability index and probability of failure. • Basic structural reliability problem: determination of probability of failure, First- order second-moment method, second order methods. • Monte Carlo methods, basic (naive) simulations, variance reduction techniques, e.g. importance sampling, correlated variables, antithetic variables, etc. • System reliability (serial and parallel systems), bounds on reliability of systems. • Response surface method. Advantages and disadvantages, the optimal experimental design, the optimal response function, the analysis and interpretation. • The application of stochastic methods in structural robustness assessment.

Temeljna literatura in viri/Readings:

1. Benjamin, J.R.; Cornell, C.A., 1970, Probability, Statistics, and Decision for Civil Engineers, McGraw-Hill.
2. R.Y. Rubinstein, 1981, Simulation and the Monte Carlo Method, John Wiley & Sons, New York.
3. Turk, G. 2012, Verjetnostni račun in statistika, 1. izd. Ljubljana: Fakulteta za gradbeništvo in geodezijo.
4. Thoft-Christensen, P; Baker, M.J., 1982, Structural Reliability Theory and its Applications, Spriger-Verlag.

5. Ellingwood, B.; Galambos, T.V.; MacGregor, J.G.; Cornell, C.A., 1980, Development of a Probability Based Load Criterion for ANS A58, NBS.
6. Melchers, R.E., 1987, Structural Reliability, Analysis and Prediction, John Wiley & Sons.
7. Blockley, D. (ed.), 1992, Engineering Safety, McGraw-Hill.
8. Madsen, H.O., Krenk, S., Lind, N.C., 1986, Methods of Structural Safety, Prentice- Hall.

Cilji in kompetence:	**Objectives and competences:**
Cilji: Spoznati pomen zanesljivostnih metod v konstruktivi. Razumeti prehod med stohastičnimi metodami in v praksi uporabljenimi determinističnimi metodami – pomen varnostnih faktorjev in karakterističnih vrednosti. Spoznavanje z različnimi naprednimi metodami zanesljivosti konstrukcij. Kompetence: Zna urediti in pripraviti podatke za analizo zanesljivosti konstrukcij. Zna uporabiti ustrezno programsko opremo za rešitev problema. Zna določiti varnostne faktorje na osnovi stohastične analize in aplicirati stohastične metode na analizo robustnosti konstrukcije.	To learn about the importance of reliability methods in structural engineering. To understand the relationship between stochastic methods in usually used deterministic methods. The significance of safety factors and characteristic values. The comprehension of modern reliability analysis methods. Capability to prepare and arrange the data for reliability analysis. Knowledge about the available software for reliability analysis. Capability of safety factor determination based on stochastic analysis, and application of stochastic methods on the determination of structural robustness.

Predvideni študijski rezultati:	**Intended learning outcomes:**
Znanje in razumevanje: Osvoji poglobljeno znanje in razumevanje o pomenu zanesljivosti konstrukcij ter o metodah določitve stopnje zanesljivosti.	Knowledge and understanding: Obtain a thorough knowledge of the importance of the reliability of structures as well as the methods for reliability assesment.

Metode poučevanja in učenja:	**Learning and teaching methods:**
Predavanja, priprava seminarske naloge in njena predstavitev.	Lectures, preparation of term-paper ant its presentation

Načini ocenjevanja:	**Delež/Weight**	**Assessment:**
Zagovor seminarske naloge	50,00 %	Presentation of term-paper
Pisni ali ustni izpit iz teme.	50,00 %	Oral or written examination

Reference nosilca/Lecturer's references:

1. SCHNABL, Simon, PLANINC, Igor, TURK, Goran. Buckling loads of two-layer composite columns with interlayer slip and stochastic material properties. Journal of engineering mechanics, ISSN 0733-9399, 2013, letn. 139, št. 8, str. 1124-1132.
2. VRANKAR, Leopold, LIBRE, Nicolas Ali, LING, Leevan, TURK, Goran, RUNOVC, Franc. Solving moving-boundary problems with the wavelet adaptive radial basis functions method. Computers & Fluids, ISSN 0045-7930. [Print ed.], 2013, vol. 86, str. 37-44.
3. VRANKAR, Leopold, KANSA, Edward J., LING, Leevan, RUNOVC, Franc, TURK, Goran. Moving-boundary problems solved by adaptive radial basis functions. Computers & Fluids, ISSN 0045-7930. [Print ed.], 2010, vol. 39, no. 9, p. 1480-1490.
4. SVENSSON, Staffan, TURK, Goran, HOZJAN, Tomaž. Predicting moisture state of timber members in a continuously varying climate. Engineering structures, ISSN 0141-0296. [Print ed.], 2011, letn. 33, št. 11, str. 3064-3070.
5. TURK, Goran. Verjetnostni račun in statistika. 1. izd. Ljubljana: Fakulteta za gradbeništvo in geodezijo, 2012. VI, 264 str.

UČNI NAČRT PREDMETA/COURSE SYLLABUS

Predmet:	Zajem in modeliranje zemeljskega površja pri ocenah tveganja
Course title:	Data Acquiring and Relief Modelling in Natural Risk Assessments

Študijski programi in stopnja	Študijska smer	Letnik	Semestri
Grajeno okolje, tretja stopnja, doktorski	Ni členitve (študijski program)		Letni, Zimski

Univerzitetna koda predmeta/University course code: 1709

Predavanja	Seminar	Vaje	Klinične vaje	Druge oblike študija	Samostojno delo	ECTS
35	0	0	5	0	85	5

Nosilec predmeta/Lecturer: Tomaž Podobnikar

Vrsta predmeta/Course type: Izbirni predmet/Elective course

Jeziki/Languages:

Predavanja/Lectures:	Slovenščina, Angleščina
Vaje/Tutorial:	Slovenščina, Angleščina

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:	**Prerequisites:**
Predmet sestavljata dva modula: *Zajemanje in modeliranje podatkov zemeljskega površja* ter *Modeli površja v ocenah naravnih tveganj*. Študent lahko izbere vsak modul posebej (5 ECTS) ali oba skupaj (10 ECTS). Modul I: znanje s področja kartografije in fotogrametrije v obsegu 6 ECTS. Modul II: znanje s področja naravnih tveganj ali naravnih procesov v obsegu 6 ECTS (npr. znanje predmeta *Pobočni procesi* z magistrskega študijskega programa *Okoljsko gradbeništvo*) oziroma ustrezna primerljiva znanja.	The course constitutes of two modules: *Data acquiring and Earth surface modelling*, and *Relief models in natural risk assessments*. Student can choose either one module (5 ECTS) or both (10 ECTS). Module I: knowledge in the field of cartography and photogrammetry of 6 ECTS. Module II: knowledge in the field of natural risks or natural processes of 6 ECTS (e.g. course in *Slope processes* from the master study program *Environmental civil engineering*), or adequate knowledge.

Vsebina:	**Content (Syllabus outline):**
MODUL I – ZAJEMANJE IN MODELIRANJE ZEMELJSKEGA POVRŠJA Izdelava in uporaba digitalnega modela reliefa (DMR). Metode za izdelavo DMR, modeli (načini) zapisa in možni problemi. Primerjava različnih metod izdelave DMR in samih modelov površja. Metapodatki, umazani podatki, metode kontrole kakovosti v povezavi z uporabnostjo DMR za različne namene. Aplikacije visoko-ločljivostnega (lidarskega oziroma laserskega) DMR (5 ECTS). **MODUL II – MODELI POVRŠJA V OCENAH NARAVNIH TVEGANJ** Analize naravnih tveganj, pri katerih je pomembno uporabljati modele površja (podori, plazovi, poplave). Uporaba modelov površja (oziroma digitalnega modela reliefa) različne kakovosti in ločljivosti za ocene naravnih tveganj. Analiza primernosti različnih modelov površja za določene ocene naravnih tveganj (5 ECTS).	**MODULE I – DATA ACQUIRING AND RELIEF MODELLING** Generating and use of digital terrain model (DTM). DTM production methods, record models (methods) and possible models. Comparison of different methods of DTM and surface models production. Metadata, dirty data, methods of quality control in relation to the usability of DTM for different purposes. Applications of high resolution (Lidar or laser) DTM (5 ECTS). **MODULE II – RELIEF MODELS IN NATURAL RISK ASSESSMENTS** Natural risk analyses for which usage of relief models is important (rock falls, landsliding, floods). The usage of relief models (resp. digital elevation models) of different qualities and resolution for natural risk assessments. Analysis of adequacy of different digital elevation models for selected natural risk assessments (5 ECTS).

Temeljna literatura in viri/Readings:

Knjižni viri (izbrana poglavja) / Printed sources (selected contents):

- Burrough, P., McDonnell, R. (1998). Principles of Geographical Information Systems, Oxford.
- de Smith, M., Goodchild, M., Longley, P. (20062009). Geospatial Analysis a comprehensive guide. SPLINT, 3rd edition
- Huggett, R., Cheesman, J. (2002). Topography and the Environment. Prentice Hall, Pearson Education, Harlow, 274 p.
- Lane, S., Richards, K., Chandler, J. (Eds.) (1998). Landform Monitoring, Modeling and Analysis, John Wiley & Sons, Chichester, 454 p.
- Olsen, J.E. (2003). Data Quality: The Accuracy Dimension, Morgan Kaufmann Publishers, New York
- Teeuw, R.M. (Ed.) (2007). Mapping Hazardous Terrain using Remote Sensing. The Geological Society, London, 169 p.
- Wilson, J.P., Gallant, J.C. (Eds.) (2000). Terrain analysis – Principles and Applications. John Wiley & Sons, New York, 479 p.
- Zborniki Geografski informacijski sistemi v Sloveniji, Založba ZRC (19971998, 19992000,
- 20012002, 20032004, 20052006, 20072008, 2009-2010, 2011-2012, 2013-2014)

Elektronski viri / Electronic sources:

- http://iaidq.org/main/glossary.shtml
- http://geomorphometry.org/content/proceedings-geomorphometry-2009-table-contents
- http://www.spatialanalysisonline.com/output
- http://www.gisdevelopment.net/glossary
- http://www.geodetski-vestnik.com
- http://www.springerlink.com/content/100512

Cilji in kompetence:	**Objectives and competences:**
•Spoznati prostorske topografske podatke in pri tem natančneje digitalni model reliefa (DMR). DMR je poleg posnetkov daljinskega zaznavanja osnova interpretacije različnih geomorfoloških značilnosti, ki se uporabljajo pri analizah naravnih tveganj. •Razumeti prednosti DMR pred metodami daljinskega zaznavanja zaradi večje objektivnosti pri interpretaciji raziskav in večje zmožnosti za avtomatizirane analize. •Spoznati pomanjkljivosti DMR, znati ovrednotiti statistično in geomorfološko kakovost, ki določa možnost interpretacije določenega modela, še posebej hidrološkega modela v ravninah. •Spoznati zmožnosti (pol)samodejnega procesiranja podatkov laserskega skeniranja za pridobivanje podatkov o topografiji, višini gozda, obliki stavb, daljnovodih in razumeti vlogo natančnosti podatkov v analizah naravnih tveganj (plazovi, podori, poplave itd.).	•Comprehend the spatial and topographic data, with stress to a digital terrain model (DTM) or digital elevation model (DEM). A DTM is beside to remote sensing imagery base for interpretation of the various geomorphological features, which are applicable in natural risks analysis. •Understand the advantages of the DTM methods prior to remote sensing methods for greater objectivity in interpreting research and better capabilities for automated analysis. •Realise the shortcomings of DTM, and ability to evaluate the statistical and geomorphological quality out of its interpretation of given model, particularly of the hydrological model in plains. •Ability to perceive (semi)automatic data processing laser scanning data for acquisition the data of topography, forest height, building shapes, power lines, and understanding the role of the data accuracy in the analysis of natural risks (landslides, falls, floods, etc.).

Predvideni študijski rezultati:	**Intended learning outcomes:**
Znanje in razumevanje: •Uporabljati DMR kot model površja, ki npr. vsebuje posebnosti naravnih elementov oziroma značilnosti (npr. gozd, rečna struga, erozijski klif) ali antropogenih objektov (npr. most, varovalni objekti). •Upoštevati primernost različnih izvedenk ali virov modela površja v povezavi z njihovo kakovostjo kot ključnega dejavnika pri samodejnih modeliranjih za analize naravnih tveganj.	**Knowledge and understanding:** •Use the DTM as a surface model that for example contains specific natural features or characteristics (e.g. forest, river bed, erosion cliff) or manmade objects (e.g. bridge, protection objects). •The appropriateness of different versions or resources of the surface model in relation to their quality as a key factor in automatic modelling for the analysis of natural risks.

•Znati uporabljati različne DMRje, tudi na osnovi laserskega skeniranja (velikostnega reda višinske natančnosti do 10 cm) za pridobivanje podrobnih informacij o geomorfologiji površja, o premikih splazelih gmot, eroziji in podobnih pojavih. •Znati kombinirati podatke o površju in objektih s podatki za oceno potencialne škode (npr. funkcija in vrednost stavb ter zemljišč) ter izvesti njihovo integracijo v model za oceno potencialne škode.	•The ability to use different DTMs, also based on laser scanning (in order size of height accuracy of up to 10 cm) to obtain detailed information on surface geomorphology, movement of landslide masses, erosion and related phenomena. •The ability to combine data on the surface and objects to assess the potential damage (e.g. function and value of buildings and land) and to carry out their integration in the model to assess potential damage.

Metode poučevanja in učenja:	**Learning and teaching methods:**
Predavanja in konzultacije, študij strokovne literature, uporaba (enostavnih) programskih orodij za modeliranje DMR-ja, prikaz uporabe modeliranja podorov, poplav in drobirskih tokov, uporaba različnih modelov reliefa in drugih topografskih/prostorskih podatkov, terenska kontrola podatkov in modelov.	Lectures and consultations, study of professional literature, usage of (simple) programs for digital elevation models, presentation of modelling rock falls, floods, and debris flows, usage of different digital elevation models and other topographic/spatial data, field control of data and models.

Načini ocenjevanja:	**Delež/Weight**	**Assessment:**
Objava v periodični publikaciji ali seminarska naloga.	100,00 %	Paper in a serial publication or a seminar coursework.

Reference nosilca/Lecturer's references:

1. Obu, J., Podobnikar, T., 2013. Algoritem za prepoznavanje kraških kotanj na podlagi digitalnega modela reliefa = Algorithm for karst depression recognition using digital terrain models. *Geodetski vestnik*, 57/2, 260-270 [COBISS.SI-ID 52248162]
2. Podobnikar, T., 201 Multidirectional visibility index for analytical shading enhancement. *The cartographic journal*, 49/3, 195-207 [COBISS.SI-ID 34724397]
3. Podobnikar, T., 2012. Detecting mountain peaks and delineating their shapes using digital elevation models, remote sensing and geographic information systems using autometric methodological procedures. *Remote sensing*, 4/3, 784-809 [COBISS.SI-ID 33877805]
4. Podobnikar, T., Vrečko, A., 2012. Digital Elevation Model from the Best Results of Different Filtering of a LiDAR Point Cloud. *Transactions in GIS*, 16/5, 603-617 [COBISS.SI-ID 5983329]
5. Podobnikar, T., Schöner, M., Jansa, J., Pfeifer, N. 2009. Spatial analysis of anthropogenic impact on karst geomorphology (Slovenia). *Environ. geol.* (Berl.), 58/2, 257-268 [COBISS.SI-ID 28838445]
6. Podobnikar, T., 2009. Methods for visual quality assessment of a digital terrain model. *S.A.P.I.EN.S*, 2/2, 15-24, [COBISS.SI-ID 32086061]
7. Sodnik, J., Podobnikar, T., Petje, U., Mikoš, M., 2013. Topographic data and numerical debris-flow modeling. V: Margottini, C., Canuti, P., Sassa, K. (Eds.). *Landslide Science and Practice. Vol. 1, Landslide Inventory and Susceptibility and Hazard Zoning*. Springer, Berlin, 573-578 [COBISS.SI-ID 6322017]
8. Sodnik, J., Vrečko, A., Podobnikar, T., Mikoš, M., 2012. Digitalni modeli reliefa in matematično modeliranje drobirskih tokov = Digital terrain models and mathematical modelling of debris flows. *Geodetski vestnik*, 56/4, 826-837 [COBISS.SI-ID 6109537]

UČNI NAČRT PREDMETA/COURSE SYLLABUS

Predmet:	Zajem in modeliranje zemeljskega površja pri ocenah tveganja
Course title:	Data Acquiring and Relief Modelling in Natural Risk Assessments

Študijski programi in stopnja	Študijska smer	Letnik	Semestri
Grajeno okolje, tretja stopnja, doktorski	Ni členitve (študijski program)		Letni, Zimski

Univerzitetna koda predmeta/University course code: 1710

Predavanja	Seminar	Vaje	Klinične vaje	Druge oblike študija	Samostojno delo	ECTS
70	0	0	10	0	170	10

Nosilec predmeta/Lecturer: Tomaž Podobnikar

Vrsta predmeta/Course type: Izbirni predmet/Elective course

Jeziki/Languages:

Predavanja/Lectures:	Slovenščina, Angleščina
Vaje/Tutorial:	Slovenščina, Angleščina

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:	**Prerequisites:**
Predmet sestavljata dva modula: *Zajemanje in modeliranje podatkov zemeljskega površja* ter *Modeli površja v ocenah naravnih tveganj*. Študent lahko izbere vsak modul posebej (5 ECTS) ali oba skupaj (10 ECTS). Modul I: znanje s področja kartografije in fotogrametrije v obsegu 6 ECTS. Modul II: znanje s področja naravnih tveganj ali naravnih procesov v obsegu 6 ECTS (npr. znanje predmeta *Pobočni procesi* z magistrskega študijskega programa *Okoljsko gradbeništvo*) oziroma ustrezna primerljiva znanja.	The course constitutes of two modules: *Data acquiring and Earth surface modelling*, and *Relief models in natural risk assessments*. Student can choose either one module (5 ECTS) or both (10 ECTS). Module I: knowledge in the field of cartography and photogrammetry of 6 ECTS. Module II: knowledge in the field of natural risks or natural processes of 6 ECTS (e.g. course in *Slope processes* from the master study program *Environmental civil engineering*), or adequate knowledge.

Vsebina:	**Content (Syllabus outline):**
MODUL I – ZAJEMANJE IN MODELIRANJE ZEMELJSKEGA POVRŠJA Izdelava in uporaba digitalnega modela reliefa (DMR). Metode za izdelavo DMR, modeli (načini) zapisa in možni problemi. Primerjava različnih metod izdelave DMR in samih modelov površja. Metapodatki, umazani podatki, metode kontrole kakovosti v povezavi z uporabnostjo DMR za različne namene. Aplikacije visoko-ločljivostnega (lidarskega oziroma laserskega) DMR (5 ECTS). **MODUL II – MODELI POVRŠJA V OCENAH NARAVNIH TVEGANJ** Analize naravnih tveganj, pri katerih je pomembno uporabljati modele površja (podori, plazovi, poplave). Uporaba modelov površja (oziroma digitalnega modela reliefa) različne kakovosti in ločljivosti za ocene naravnih tveganj. Analiza primernosti različnih modelov površja za določene ocene naravnih tveganj (5 ECTS).	**MODULE I – DATA ACQUIRING AND RELIEF MODELLING** Generating and use of digital terrain model (DTM). DTM production methods, record models (methods) and possible models. Comparison of different methods of DTM and surface models production. Metadata, dirty data, methods of quality control in relation to the usability of DTM for different purposes. Applications of high resolution (Lidar or laser) DTM (5 ECTS). **MODULE II – RELIEF MODELS IN NATURAL RISK ASSESSMENTS** Natural risk analyses for which usage of relief models is important (rock falls, landsliding, floods). The usage of relief models (resp. digital elevation models) of different qualities and resolution for natural risk assessments. Analysis of adequacy of different digital elevation models for selected natural risk assessments (5 ECTS).

Temeljna literatura in viri/Readings:

Knjižni viri (izbrana poglavja) / Printed sources (selected contents):

- Burrough, P., McDonnell, R. (1998). Principles of Geographical Information Systems, Oxford.
- de Smith, M., Goodchild, M., Longley, P. (20062009). Geospatial Analysis a comprehensive guide. SPLINT, 3rd edition
- Huggett, R., Cheesman, J. (2002). Topography and the Environment. Prentice Hall, Pearson Education, Harlow, 274 p.
- Lane, S., Richards, K., Chandler, J. (Eds.) (1998). Landform Monitoring, Modeling and Analysis, John Wiley & Sons, Chichester, 454 p.
- Olsen, J.E. (2003). Data Quality: The Accuracy Dimension, Morgan Kaufmann Publishers, New York
- Teeuw, R.M. (Ed.) (2007). Mapping Hazardous Terrain using Remote Sensing. The Geological Society, London, 169 p.
- Wilson, J.P., Gallant, J.C. (Eds.) (2000). Terrain analysis – Principles and Applications. John Wiley & Sons, New York, 479 p.
- Zborniki Geografski informacijski sistemi v Sloveniji, Založba ZRC (19971998, 19992000,
- 20012002, 20032004, 20052006, 20072008, 2009-2010, 2011-2012, 2013-2014)

Elektronski viri / Electronic sources:

- http://iaidq.org/main/glossary.shtml
- http://geomorphometry.org/content/proceedings-geomorphometry-2009-table-contents
- http://www.spatialanalysisonline.com/output
- http://www.gisdevelopment.net/glossary
- http://www.geodetski-vestnik.com
- http://www.springerlink.com/content/100512

Cilji in kompetence:	**Objectives and competences:**
- Spoznati prostorske topografske podatke in pri tem natančneje digitalni model reliefa (DMR). DMR je poleg posnetkov daljinskega zaznavanja osnova interpretacije različnih geomorfoloških značilnosti, ki se uporabljajo pri analizah naravnih tveganj. - Razumeti prednosti DMR pred metodami daljinskega zaznavanja zaradi večje objektivnosti pri interpretaciji raziskav in večje zmožnosti za avtomatizirane analize. - Spoznati pomanjkljivosti DMR, znati ovrednotiti statistično in geomorfološko kakovost, ki določa možnost interpretacije določenega modela, še posebej hidrološkega modela v ravninah. - Spoznati zmožnosti (pol)samodejnega procesiranja podatkov laserskega skeniranja za pridobivanje podatkov o topografiji, višini gozda, obliki stavb, daljnovodih in razumeti vlogo natančnosti podatkov v analizah naravnih tveganj (plazovi, podori, poplave itd.).	- Comprehend the spatial and topographic data, with stress to a digital terrain model (DTM) or digital elevation model (DEM). A DTM is beside to remote sensing imagery base for interpretation of the various geomorphological features, which are applicable in natural risks analysis. - Understand the advantages of the DTM methods prior to remote sensing methods for greater objectivity in interpreting research and better capabilities for automated analysis. - Realise the shortcomings of DTM, and ability to evaluate the statistical and geomorphological quality out of its interpretation of given model, particularly of the hydrological model in plains. - Ability to perceive (semi)automatic data processing laser scanning data for acquisition the data of topography, forest height, building shapes, power lines, and understanding the role of the data accuracy in the analysis of natural risks (landslides, falls, floods, etc.).

Predvideni študijski rezultati:	**Intended learning outcomes:**
Znanje in razumevanje: - Uporabljati DMR kot model površja, ki npr. vsebuje posebnosti naravnih elementov oziroma značilnosti (npr. gozd, rečna struga, erozijski klif) ali antropogenih objektov (npr. most, varovalni objekti). - Upoštevati primernost različnih izvedenk ali virov modela površja v povezavi z njihovo kakovostjo kot ključnega dejavnika pri samodejnih modeliranjih za analize naravnih tveganj.	Knowledge and understanding: - Use the DTM as a surface model that for example contains specific natural features or characteristics (e.g. forest, river bed, erosion cliff) or man-made objects (e.g. bridge, protection objects). - The appropriateness of different versions or resources of the surface model in relation to their quality as a key factor in automatic modelling for the analysis of natural risks.

- Znati uporabljati različne DMR-je, tudi na osnovi laserskega skeniranja (velikostnega reda višinske natančnosti do 10 cm) za pridobivanje podrobnih informacij o geomorfologiji površja, o premikih splazelih gmot, eroziji in podobnih pojavih. - Znati kombinirati podatke o površju in objektih s podatki za oceno potencialne škode (npr. funkcija in vrednost stavb ter zemljišč) ter izvesti njihovo integracijo v model za oceno potencialne škode.	- The ability to use different DTMs, also based on laser scanning (in order size of height accuracy of up to 10 cm) to obtain detailed information on surface geomorphology, movement of landslide masses, erosion and related phenomena. - The ability to combine data on the surface and objects to assess the potential damage (e.g. function and value of buildings and land) and to carry out their integration in the model to assess potential damage.

Metode poučevanja in učenja:	**Learning and teaching methods:**
Predavanja in konzultacije, študij strokovne literature, uporaba (enostavnih) programskih orodij za modeliranje DMR-ja, prikaz uporabe modeliranja podorov, poplav in drobirskih tokov, uporaba različnih modelov reliefa in drugih topografskih/prostorskih podatkov, terenska kontrola podatkov in modelov.	Lectures and consultations, study of professional literature, usage of (simple) programs for digital elevation models, presentation of modelling rock falls, floods, and debris flows, usage of different digital elevation models and other topographic/spatial data, field control of data and models.

Načini ocenjevanja:	**Delež/Weight**	**Assessment:**
Objava v periodični publikaciji ali seminarska naloga.	100,00 %	Paper in a serial publication or a seminar coursework.

Reference nosilca/Lecturer's references:

1. Obu, J., Podobnikar, T., 2013. Algoritem za prepoznavanje kraških kotanj na podlagi digitalnega modela reliefa = Algorithm for karst depression recognition using digital terrain models. Geodetski vestnik, 57/2, 260-270 [COBISS.SI-ID 52248162]
2. Podobnikar, T., 2012. Multidirectional visibility index for analytical shading enhancement. The cartographic journal, 49/3, 195-207 [COBISS.SI-ID 34724397]
3. Podobnikar, T., 2012. Detecting mountain peaks and delineating their shapes using digital elevation models, remote sensing and geographic information systems using autometric methodological procedures. Remote sensing, 4/3, 784-809 [COBISS.SI-ID 33877805]
4. Podobnikar, T., Vrečko, A., 2012. Digital Elevation Model from the Best Results of Different Filtering of a LiDAR Point Cloud. Transactions in GIS, 16/5, 603-617 [COBISS.SI-ID 5983329]
5. Podobnikar, T., Schöner, M., Jansa, J., Pfeifer, N. 2009. Spatial analysis of anthropogenic impact on karst geomorphology (Slovenia). Environ. geol. (Berl.), 58/2, 257-268 [COBISS.SI-ID 28838445]
6. Podobnikar, T., 2009. Methods for visual quality assessment of a digital terrain model. S.A.P.I.EN.S, 2/2, 15-24, [COBISS.SI-ID 32086061]
7. Sodnik, J., Podobnikar, T., Petje, U., Mikoš, M., 2013. Topographic data and numerical debris-flow modeling. V: Margottini, C., Canuti, P., Sassa, K. (Eds.). Landslide Science and Practice. Vol. 1, Landslide Inventory and Susceptibility and Hazard Zoning. Springer, Berlin, 573-578 [COBISS.SI-ID 6322017]
8. Sodnik, J., Vrečko, A., Podobnikar, T., Mikoš, M., 2012. Digitalni modeli reliefa in matematično modeliranje drobirskih tokov = Digital terrain models and mathematical modelling of debris flows. Geodetski vestnik, 56/4, 826-837 [COBISS.SI-ID 6109537]

UČNI NAČRT PREDMETA/COURSE SYLLABUS

Predmet:	Zanesljivost konstrukcij z uporabo v potresnem inženirstvu
Course title:	Reliability of Structures with Application in Earthquake Engineering

Študijski programi in stopnja	Študijska smer	Letnik	Semestri
Grajeno okolje, tretja stopnja, doktorski	Ni členitve (študijski program)		Letni, Zimski

Univerzitetna koda predmeta/University course code: 1124

Predavanja	Seminar	Vaje	Klinične vaje	Druge oblike študija	Samostojno delo	ECTS
20	10	10	0	0	85	5

Nosilec predmeta/Lecturer: Matjaž Dolšek

Vrsta predmeta/Course type: Izbirni predmet/Elective course

Jeziki/Languages:

Predavanja/Lectures:	Slovenščina, Angleščina
Vaje/Tutorial:	Slovenščina, Angleščina

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:	Prerequisites:
Vpis na doktorski študij »Grajeno okolje« ali na druge tehnične ali naravoslovne usmeritve.	Enrolment in PhD study Built Environment.

Vsebina:	Content (Syllabus outline):
Fizikalne, modelne in druge nezanesljivosti pri računu zanesljivosti konstrukcij s poudarkom na nezanesljivostih, ki se pojavljajo pri oceni potresnega tveganja Stratificirano vzorčenje slučajnih spremenljivk Izbor akcelerogramov za nelinearno dinamično analizo Osnove določevanja potresne nevarnosti Inkrementna dinamična analiza in njene izpeljanke (probabilistična IDA, progresivna IDA) Poenostavljene metode za določevanje potresnega tveganja (verjetnost prekoračitve mejnega stanja, ocena pričakovanih denarnih izgub)	Physical, modelling and other uncertainties important in the assessment of the seismic risk Stratified sampling of random variables Selection of ground motion records for nonlinear dynamic analysis Basics of the seismic hazard Incremental dynamic analysis (IDA), progressive IDA, probabilistic IDA Simplified methods for determination of the seismic risk (probability of exceedance of the limit state, estimation of the monetary losses)

Temeljna literatura in viri/Readings:

Pinto, PE, Giannini, R, Franchin, P (2004). Seismic reliability analysis of structures, IUSS Press, Pavia, 370 str.
Kramer, SL (1996). Geotechnical Earthquake Engineering, Prentice Hall, New Jersey, 653 str.
Walpole, RE, Myers, RH, Myers SL (1998). Probability and statistics for Engineers and Scientists, Prentice Hall, New Jersey,739 str.
Baker, JW (2008). An introduction to Probabilistic Seismic Hazard Analysis (PSHA), Stanford University, 76 str.
Melchers, RE (1999). Structural reliability analysis and prediction. John Wiley & Sons, New York, 437 str.
Ayyub BM (2003). Risk analysis in Engineering and Economics. Chapman & Hall, 571 str.
Dolšek M (2008). OS Modeler - User's Manual, UL-FGG, 79 str.
Dolšek M (2008). OS Modeler - Examples of Application, UL-FGG, 52 str.
CEN (2005). Eurocode 8: Design of structures for earthquake resistance. Part 3: Strengthening and repair of buildings, Brussels, March 2005.

Cilji in kompetence:	**Objectives and competences:**
Cilji: Spoznati osnove določevanja potresne nevarnosti in potresnega tveganja Naučiti študenta uporabe različnih metod za določevanje odnosa med potresno intenziteto in parametri potresnega odziva Seznanitev z modelnimi, fizikalnimi in drugimi nezanesljivostmi, ki se pojavljajo pri oceni potresnega tveganja Izdelava nelinearnih modelov v skladu z Eurokod 8, ki so primerni za simulacije	Objectives: Understands the basic principles of seismic hazard and risk assessment Knows to use different methods for determination of the relationship between the seismic intensity measure and seismic response parameter To learn student about the modelling, physical and other uncertainties, which are important in the process of estimation of the seismic risk Knows to develop nonlinear models of buildings, which are appropriate for simulations, and are in accordance with the Eurocode 8

Predvideni študijski rezultati:	**Intended learning outcomes:**
Znanje in razumevanje: Študent zna uporabljati programe za nelinearno statično in dinamično analizo in pripravite funkcije s katerimi avtomatizira določene procese pri oceni potresnega tveganja. Zna določiti odnos me potresno intenziteto in parametri potresnega odziva z različnimi metodami, jih povezati s potresno nevarnostjo in določiti potresno tveganje Zna vrednotiti rezultate potresnega tveganja.	Knowledge and understanding: Using of programs for nonlinear static and dynamic analysis and capability to extend programs with functions, which can be used for automatic determination of the seismic risk Capability of determination of the relationship between the seismic intensity measure and seismic response parameters by using different methods, combining it with the seismic hazard and determine seismic risk of structures Knowledge about the interpretation of the results of the seismic risk.

Metode poučevanja in učenja:	**Learning and teaching methods:**
Predavanja, konzultacije in laboratorijske vaje.	Lectures, consultation, seminar

Načini ocenjevanja:	**Delež/Weight**	**Assessment:**
Izdelava seminarske naloge, ki obsega teoretičen del, v katerem študent predstavi izbrano poglavje iz literature, in primer, v katerem določi potresno tveganje za izbrano konstrukcijo ali urbano okolje.	30,00 %	Presentation of seminar (theory and example)
Zagovor seminarske naloge	30,00 %	Defending seminar
Ustni izpit	40,00 %	Oral or written examination

Reference nosilca/Lecturer's references:

DOLŠEK, Matjaž. Simplified method for seismic risk assessment of buildings with consideration of aleatory and epistemic uncertainty. *Structure and infrastructure engineering*, ISSN 1573-2479, 2012, letn. 8, št. 10, str. 939-953.
DOLŠEK, Matjaž, VAMVATSIKOS, Dimitrios. Equivalent constant rates for performance-based seismic assessment of ageing structures. *Structural safety*, ISSN 0167-4730. [Print ed.], 2011, letn. 32, št. 1, str. 8-18.
DOLŠEK, Matjaž. Development of computing environment for the seismic performance assessment of reinforced concrete frames by using simplified nonlinear models. *Bulletin of earthquake engineering*, ISSN 1570-761X, 2010, letn. 8, št. 6, str. 1309-1329.
CELAREC, Daniel, DOLŠEK, Matjaž. The impact of modelling uncertainties on the seismic performance assessment of reinforced concrete frame buildings. *Engineering structures*, ISSN 0141-0296. [Print ed.], jul. 2013, letn. 52, št. , str. 340-354.
LAZAR, Nuša, DOLŠEK, Matjaž. A closed form solution for seismic risk assessment incorporating intensity bounds. *Engineering structures*, ISSN 0141-0296. [Print ed.], nov. 2014, letn. 78, str. 78-89.
BROZOVIČ, Marko, DOLŠEK, Matjaž. Envelope-based pushover analysis procedure for the approximate seismic response analysis of buildings. *Earthquake engineering & structural dynamics*, ISSN 0098-8847. [Print ed.], 2014, letn. 43, št. 1, str. 77-96.

UČNI NAČRT PREDMETA/COURSE SYLLABUS

Predmet:	Zanesljivost konstrukcij z uporabo v potresnem inženirstvu
Course title:	Reliability of Structures with Application in Earthquake Engineering

Študijski programi in stopnja	Študijska smer	Letnik	Semestri
Grajeno okolje, tretja stopnja, doktorski	Ni členitve (študijski program)		Letni, Zimski

Univerzitetna koda predmeta/University course code: 1283

Predavanja	Seminar	Vaje	Klinične vaje	Druge oblike študija	Samostojno delo	ECTS
40	20	20	0	0	170	10

Nosilec predmeta/Lecturer: Matjaž Dolšek

Vrsta predmeta/Course type: Izbirni predmet/Elective course

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

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:	**Prerequisites:**
Vpis na doktorski študij »Grajeno okolje« ali na druge tehnične ali naravoslovne usmeritve.	Enrolment in PhD study Built Environment.

Vsebina:	**Content (Syllabus outline):**
Fizikalne, modelne in druge nezanesljivosti pri računu zanesljivosti konstrukcij s poudarkom na nezanesljivostih, ki se pojavljajo pri oceni potresnega tveganja Stratificirano vzorčenje slučajnih spremenljivk Izbor akcelerogramov za nelinearno dinamično analizo Osnove določevanja potresne nevarnosti Inkrementna dinamična analiza in njene izpeljanke (probabilistična IDA, progresivna IDA) Poenostavljene metode za določevanje potresnega tveganja (verjetnost prekoračitve mejnega stanja, ocena pričakovanih denarnih izgub) Določevanje potresnega tveganje z metodo Monte Carlo Lista pomembnosti akcelerogramov za nelinearno dinamično analizo Določevanje potresnega tveganja z upoštevanjem degradacije konstrukcije	Physical, modelling and other uncertainties important in the assessment of the seismic risk Stratified sampling of random variables Selection of ground motion records for nonlinear dynamic analysis Basics of the seismic hazard Incremental dynamic analysis (IDA), progressive IDA, probabilistic IDA Simplified methods for determination of the seismic risk (probability of exceedance of the limit state, estimation of the monetary losses) Estimation of the seismic risk by using the Monte Carlo method Precedence list of ground motion records for nonlinear dynamic analysis Seismic risk assessment with consideration of capacity degradation over time Seismic risk of urban areas

Temeljna literatura in viri/Readings:

Pinto, PE, Giannini, R, Franchin, P (2004). Seismic reliability analysis of structures, IUSS Press, Pavia, 370 str.
Kramer, SL (1996). Geotechnical Earthquake Engineering, Prentice Hall, New Jersey, 653 str.
Walpole, RE, Myers, RH, Myers SL (1998). Probability and statistics for Engineers and Scientists, Prentice Hall, New Jersey,739 str.
Baker, JW (2008). An introduction to Probabilistic Seismic Hazard Analysis (PSHA), Stanford University, 76 str.
Melchers, RE (1999). Structural reliability analysis and prediction. John Wiley & Sons, New York, 437 str.

Ayyub BM (2003). Risk analysis in Engineering and Economics. Chapman & Hall, 571 str.
Dolšek M (2008). OS Modeler - User's Manual, UL-FGG, 79 str.
Dolšek M (2008). OS Modeler - Examples of Application, UL-FGG, 52 str.
CEN (2005). Eurocode 8: Design of structures for earthquake resistance. Part 3: Strengthening and repair of buildings, Brussels, March 2005.

Cilji in kompetence:	**Objectives and competences:**
Cilji: Spoznati osnove določevanja potresne nevarnosti in potresnega tveganja Naučiti študenta uporabe različnih metod za določevanje odnosa med potresno intenziteto in parametri potresnega odziva Seznanitev z modelnimi, fizikalnimi in drugimi nezanesljivostmi, ki se pojavljajo pri oceni potresnega tveganja Izdelava nelinearnih modelov v skladu z Eurokod 8, ki so primerni za simulacije Spoznati osnove določevanja potresnega tveganja z upoštevanjem časovne degradacije konstrukcije Seznaniti študenta s principi potresno-odpornega projektiranja za izbrano stopnjo zanesljivosti (določitev projektnega pospeška tal) Naučiti študenta določiti potresno tveganje za bolj kompliciranе objekte	Objectives: Understands the basic principles of seismic hazard and risk assessment Knows to use different methods for determination of the relationship between the seismic intensity measure and seismic response parameter To learn student about the modelling, physical and other uncertainties, which are important in the process of estimation of the seismic risk Knows to develop nonlinear models of buildings, which are appropriate for simulations, and are in accordance with the Eurocode 8 To learn student about the seismic risk estimation with consideration of capacity degradation over time Understands the basic principles of seismic resistance structural design for given reliability level (estimation of design peak ground acceleration) Teach student to estimate seismic risk of more complicated structural systems

Predvideni študijski rezultati:	**Intended learning outcomes:**
Znanje in razumevanje: Študent zna uporabljati programe za nelinearno statično in dinamično analizo in pripravite funkcije s katerimi avtomatizira določene procese pri oceni potresnega tveganja. Zna določiti odnos me potresno intenziteto in parametri potresnega odziva z različnimi metodami, jih povezati s potresno nevarnostjo in določiti potresno tveganje Zna vrednotiti rezultate potresnega tveganja. Študent zna določiti potresno tveganje konstrukcije z upoštevanjem degradacije konstrukcije Zna določiti projektni pospešek tal za izbrano stopnjo zanesljivosti konstrukcije Zna oceniti potresno tveganje za bolj zahtevne objekte	Knowledge and understanding: Using of programs for nonlinear static and dynamic analysis and capability to extend programs with functions, which can be used for automatic determination of the seismic risk Capability of determination of the relationship between the seismic intensity measure and seismic response parameters by using different methods, combining it with the seismic hazard and determine seismic risk of structures Knowledge about the interpretation of the results of the seismic risk. Knowledge about the seismic risk estimation with consideration of capacity degradation over time Capability of determination of the design peak ground acceleration for given level of structural reliability Knowledge of seismic risk estimation for complex structures

Metode poučevanja in učenja:	**Learning and teaching methods:**
Predavanja, konzultacije in laboratorijske vaje.	Lectures, consultation, seminar

Načini ocenjevanja:	**Delež/Weight**	**Assessment:**
Ustni izpit	40,00 %	Oral or written examination
Izdelava seminarske naloge, ki obsega teoretičen del, v katerem študent predstavi izbrano poglavje iz literature, in primer, v	30,00 %	Presentation of seminar (theory and example)

katerem določi potresno tveganje za izbrano konstrukcijo ali urbano okolje.		
Zagovor seminarske naloge	30,00 %	Defending seminar

Reference nosilca/Lecturer's references:

DOLŠEK, Matjaž. Simplified method for seismic risk assessment of buildings with consideration of aleatory and epistemic uncertainty. *Structure and infrastructure engineering*, ISSN 1573-2479, 2012, letn. 8, št. 10, str. 939-953.
DOLŠEK, Matjaž, VAMVATSIKOS, Dimitrios. Equivalent constant rates for performance-based seismic assessment of ageing structures. *Structural safety*, ISSN 0167-4730. [Print ed.], 2011, letn. 32, št. 1, str. 8-18.
DOLŠEK, Matjaž. Development of computing environment for the seismic performance assessment of reinforced concrete frames by using simplified nonlinear models. *Bulletin of earthquake engineering*, ISSN 1570-761X, 2010, letn. 8, št. 6, str. 1309-1329.
CELAREC, Daniel, DOLŠEK, Matjaž. The impact of modelling uncertainties on the seismic performance assessment of reinforced concrete frame buildings. *Engineering structures*, ISSN 0141-0296. [Print ed.], jul. 2013, letn. 52, št. , str. 340-354.
LAZAR, Nuša, DOLŠEK, Matjaž. A closed form solution for seismic risk assessment incorporating intensity bounds. *Engineering structures*, ISSN 0141-0296. [Print ed.], nov. 2014, letn. 78, str. 78-89.
BROZOVIČ, Marko, DOLŠEK, Matjaž. Envelope-based pushover analysis procedure for the approximate seismic response analysis of buildings. *Earthquake engineering & structural dynamics*, ISSN 0098-8847. [Print ed.], 2014, letn. 43, št. 1, str. 77-96.

UČNI NAČRT PREDMETA/COURSE SYLLABUS

Predmet:	Zaščita vodnega okolja
Course title:	Protection of Water Environment

Študijski programi in stopnja	Študijska smer	Letnik	Semestri
Grajeno okolje, tretja stopnja, doktorski	Ni členitve (študijski program)		Letni, Zimski

Univerzitetna koda predmeta/University course code: 1711

Predavanja	Seminar	Vaje	Klinične vaje	Druge oblike študija	Samostojno delo	ECTS
30	10	0	0	85	0	5

Nosilec predmeta/Lecturer: Jože Panjan

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:
Vpis v doktorski študij.	Enrollment in the doctoral study programme.

Vsebina:	Content (Syllabus outline):
- Masna bilanca snovi in osnove inženirske limnologije. - Naravni in antropogeni vplivi na vodno okolje. - Optimalni kriteriji za zaščito voda (količina vode, kakovostni parametri, kisik - Hranila v vodi kot so ogljik, dušik in fosfor. - Procesi samočiščenja v naravi, na čistilnih napravah, biofilm v kanalskih sistemih in njihova inženirska obravnava obravnava. - Osnove modeliranja kakovosti rek, jezer, morja, bilanca kisika, hranil, evtrofnost. - Modeliranje procesov sedimentacije v jezerih in akumulacijah. - Koloidi v vodnem okolju in možnosti njihovega izločanja.. - Inženirske metode povezovanja naravnih procesov z umetno vodenimi procesi čistilnih napravah in drugih umetno ustvarjenih sistemih - Problematika hidrodinamične disperzije polutantov v tekočih in mirujočih vodah. - Metode zaščite in bogatenja potalnice - Pomen vključevanja naravnih samočistilnih sposobnosti voda in zemljine pri načrtovanju vodovarstvenih del. - Obravnava in koncipiranje sistemov za zaščito voda in njihov vpliv na kakovost voda (razbremenjevanje, zadževanje, izpusti v morje, sanacija jezer in akumulacij).	- Mass balance and basics of engineering limnology. - Natural and anthropogenic impacts on the aquatic environment. - Optimal criteria for water protection (water quantity, quality, oxygen contentration, - Nutrients in water C, N, P. - Processes of autopurfication in nature, wast-ewater treatment plants, biofilm in sewage systems and their engineering evaluation. - Basic modelling for quality of rivers, lakes, seas, oxygen and nutrient balance, eutrophication. - Modelling the processes of sedimentation in lakes and reservoirs. Colloids in the aquatic environment and the possibilities of their elimination. - Engineering methods for connecting natural processes (natural autopurfication ability) with artificial conducted processes in wastewater treatment plants and other artificially created systems - Problems of hydro-dynamical dispersion of pollutants in flow and non flow waters - Protection methods and artificial enrichment of groundwater - Importance of incorporating natural water autopurfication ability and soil for planning water treatment works - Concepts of water protection and their influence on water quality (owerflow -discharge, retaining –

	stormwater tanks, outflow to the sea, sanatation of lakes and accumulations).

Temeljna literatura in viri/Readings:

- Takashi Asano & all, Water Reuse (2007), Metaclf&EDDY/AECOM, 1570 strani
- Juuti S. Petri,(2007), Environmental History of Water, IWA Publishing Cornwall, UK, 629 strani
- Gray F. N. Water technology – An Intrroduction for Environmental Scientists and Engineers, Arnold, London, Sydney, Auckland, 1999, 548 strani.
- Lee, C., C, (2007), Handbook of environmental engineering calculations, McGraw Hill, New York, 1770 strani (izbrane vsebine)
- Shamsi, U., M., (2005), GIS Application for Water, Wastewater and Stormwater Systems, Taylor&Francis Group, Boca Raton, London, New York, Singapure, 413 strani.
- Gerald, T.O. (1983), Mathematical Modelling of Water Quality, John Wiley & Sons, 518 str.
- Imhoff K., Imhoff K. R. (2009), Taschenbuch der Stadentwaesserung, 28. Auflage, Oldenbourg Verlag, Muenchen , Wien, 442 strani.
- Degremont, I. (2007), Water Tretment Handbook, Lavoisier Publishing, Paris, 1928 strani. (izbrane vsebine)
- Lee, C., C, (2007), Handbook of environmental engineering calculations, McGraw Hill, New York, 1770 strani (izbrane vsebine)
- Shamsi, U., M., (2005), GIS Application for Water, Wastewater and Stormwater Systems, Taylor&Francis Group, Boca Raton, London, New York, Singapure, 413 strani
- Hosang, W., Bischof, W., (1998), Abwassertechnik, B.G. Teubner Stuttgart, Leipzig, 724 strani.
- Gerald, T.O. (1983), Mathematical Modelling of Water Quality, John Wiley & Sons, 518 strani.
- Panjan, J., (2008) Zaščita voda (skripta), 128 strani.
- Panjan, J., (2008) Količinske in kakovostne lastnosti voda, skripta 95 strani.

Elektronski viri:

- spletne strani s podatkovnimi bazami, predvsem DIKUL, CTK in NUK, UL FGG in IZH v Power Point in pdf. Svetovni splet.

Cilji in kompetence:	**Objectives and competences:**
• seznanitev s temeljnimi načeli, osnovnimi metodami, modeli in tehnikami zaščite hidrosfere • spoznavanje metode ekološkega modeliranja in prognoziranja kakovostnih sprememb v rekah, jezerih, morju in podtalnici zaradi antropogenih in naravnih vplivov. • optimiziranje ekološke odločitve in rešitve. • zna uporabljati baze podatkov, in drugo področja okolja pri izdelavi disertacije.	• Acquaintance with basic principles, methods, techniques and models for protection of hydrosphere • Acquaintance with method of ecological modelling and forecast of quality changes in rivers, lakes, sea and groundwater due to anthropogenic and natural influences • Optimizing ecological decisions and solutions

Predvideni študijski rezultati:	**Intended learning outcomes:**
Znanje in razumevanje: • da študent razume pogoje in zakonitosti in zna zasnovati rešitve in predlagati najboljše variante. • zna izdelati in uporabljati matematične modele, pripraviti osnutek rešitev in jih zna komentirati in inženirsko ovrednotiti.	Knowledge and understanding: • Student understands the conditions and laws and is capable to design solutions and propose the best variants. • Student is qualified to produce and use mathematical models, prepare drafts of solutions and is capable to comment them and provide their engineering evaluation.

Metode poučevanja in učenja:	**Learning and teaching methods:**
Uvodn(o)a predavanja, seminarske vaje za utrditev vsebine predavanj in s praktičnimi primeri dela, ter izdelava individualne seminarske naloge na izbrano temo.	Lectures, exercises with practical examples. Preparation of seminar with selected topic

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

Zagovor seminarske naloge na izbrano temo.	50,00 %	Seminar
Ustni izpit, ki obsega teoretični in praktični del (vsebino predavanj ter obvezne in priporočene literature), ko študent ne opravi prvič zagovora seminarske naloge s pozitivno oceno.	50,00 %	Oral exam

Reference nosilca/Lecturer's references:

1. KOLBL, Sabina, PALOCZI, Attila**, PANJAN, Jože,** STRES, Blaž. Addressing case specific biogas plant tasks : industry oriented methane yields derived from 5 l Automatic Methane Potential Test Systems in batch or semi-continuous tests using realistic inocula, substrate particle sizes and organic loading. **Bioresource technology** 153 (2014), str. 180-188, ISSN 0960-8524, http://www.sciencedirect.com/ science/article/pii/S0 960852413018270, doi: 10.1016/j.biortech. 2013.12.010.
2. Maslo A., **PANJAN, J.**, ŽAGAR, D., Large-scale oil spill simulation us-ing the lattice Boltzmann method, validation on the Lebanon oil spill case **Marine Pollution Bulletin** 84 (2014), str. 225-235, 6603105], [JCR, SNIP].
3. ILIĆ, Darijo, **PANJAN, Jože.** The load of pollution of the hydrosphere with phosphorus and nitrogen originating from farming land in the Goričko Landscape Park, **Acta geographica** Slovenia, sprejeto v objavo ID 6437729].
4. DREV, Darko, **PANJAN, Jože.** Hydrophobic and olephobic membrane usage and produ-ction processes. **Materiali in tehnologije,** Nekaj možnih postopkov izdelave hidrofobnih in oleofobnih polimernih membran ter njihova uporaba, ISSN 1580-2949. 2010, letn. 44, št. 2, str. 51-57, ilustr. http://www.imt.si/Revija/. [ID 4903009], [JCR, SNIP, WoS]
5. DREV, Darko, SLANE, Mitja, **PANJAN, Jože**. Die Bewertung der Belastungen des Sees Cerknica durch Stickstoff und Phosphor. Assesment Load in Lake Cerknica with Nitrogen and Phosphorus, **Wasserwirtschaft,** ISSN 0043-0978, 2009, letn. 99, št. 12, str. 32-37, ilustr.[ID 4818785], [JCR, SNIP].
6. KRZYK, Mario, PANJAN, Jože, DREV, Darko. Recikliranje tekstilnog odpada. *Tekstil*, ISSN 0492-5882, 2014, letn. XX, št XX, str. 1-23. [COBISS.SI-ID 6446177],