FGG UNIVERZA V LJUBLJANI
Fakulteta za gradbeništvo in geodezijo

Učni načrti

Magistrski študijski program druge stopnje

STAVBARSTVO (MA)

Course Syllabi

2nd Cycle Master Study

BUILDINGS (MA)

Velja od 2026/2027 | Valid from 2026/2027

Veljavni študijski program na dan 1.10.2026 | Valid study programme from 01/10/2026

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DIFERENCIALNE ENAČBE Z NUMERIČNIMI METODAMI

UČNI NAČRT PREDMETA/COURSE SYLLABUS

Predmet:	Diferencialne enačbe z numeričnimi metodami
Course title:	Differential equations with numerical methods
Članica nosilka/UL Member:	UL FGG

Študijski programi in stopnja	Študijska smer	Letnik	Semestri	Izbirnost
Stavbarstvo, druga stopnja, magistrski	Ni členitve (študijski program)	1. letnik	1. semester	obvezni

Univerzitetna koda predmeta/University course code:	0035043
Koda učne enote na članici/UL Member course code:	1737

Predavanja /Lectures	Seminar /Seminar	Vaje /Tutorials	Klinične vaje /Clinical tutorials	Druge oblike študija /Other forms of study	Samostojno delo /Individual student work	ECTS
45	0	30	0	0	75	5

Nosilec predmeta/Lecturer:	Nik Stopar
Vrsta predmeta/Course type:	obvezni strokovni/obligatory professional

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

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

Vsebina:	Content (Syllabus outline):
• Navadne diferencialne enačbe: linearne DE višjega reda s konstantnimi koeficienti, sistemi linearnih DE, robni problemi in Fourierove vrste. • Parcialne diferencialne enačbe: reševanje v okviru navadnih DE, separacija	• Ordinary differential equations: higher order linear DEs with constant coefficients, systems of linear DEs, boundary value problems and Fourier series. • Partial differential equations: solving by means of ordinary DEs, separation of

spremenljivk, valovna enačba in toplotna enačba. • Numerično integriranje: trapezno pravilo, Simpsonovo pravilo. • Numerično reševanje NDE: Eulerjeva metoda, Runge-Kutta metode, DE višjega reda, sistemi DE. • Robni problemi za DE 2. reda: strelska metoda, metoda končnih diferenc. • Numerično reševanje PDE: metoda končnih diferenc, metoda končnih elementov.	variables, wave equation and heat equation. • Numerical integration: trapezoidal rule, Simpson's rule. • Numerical solutions to ODEs: Euler's method, Runge-Kutta methods, higher order DE, systems of DE. • Boundary value problems for DE of order 2: shooting method, finite difference method • Numerical solutions to PDEs: finite difference method, finite element method

Temeljna literatura in viri/Readings:

Dobovišek, M. (2011). *Nekaj o diferencialnih enačbah.* DMFA - založništvo.
Mencinger, M. (2011). *Uvod v parcialne diferencialne enačbe.* Fakulteta za gradbeništvo.
Braun, M. (1993). *Differential Equations and Their Applications*, Springer-Verlag.
Pinchover, Y., Rubinstein, J. (2005). *An Introduction to Partial Differential Equations*, Cambridge University Press.
Plestenjak, B. (2015). *Razširjen uvod v numerične metode.* DMFA - založništvo.
Kozak, J. (2008). *Numerična analiza.* DMFA - založništvo.
Gerald, C. F., Wheatley, P. O. (1994). *Applied numerical analysis.* Addison-Wesley.

Cilji in kompetence:	**Objectives and competences:**
Cilji: • Omogočiti razumevanje matematičnega aparata, ki ga uporabljajo strokovni predmeti. • Predstaviti različne oblike diferencialnih enačb in matematičnih postopkov za njihovo reševanje. • Zagotoviti pregled in razumevanje osnovnih numeričnih metod za reševanje diferencialnih enačb. • Seznaniti z uporabo računalniških orodij za numerično reševanje diferencialnih enačb. • Vpeljati v samostojno in timsko projektno orientirano delo. Pridobljene kompetence: • Zmožnost prepoznavanja diferencialne enačbe in izbire ustreznega orodja za iskanje rešitev. • Sposobnost reševanja problemov s kombiniranjem znanja matematike in računalništva. • Sposobnost izbire ustrezne numerične metode za reševanje začetnih in robnih problemov. • Pridobitev ustrezne literature/podpore.	Objectives: • To enable understanding of mathematical tools used by engineering courses. • To present different types of differential equations and mathematical procedures for solving them. • To ensure an overview and understanding of basics numerical methods for solving differential equations. • To get acquainted with the application of computer software for numerical solving of differential equations. • To introduce project-based working, individually as well as in a team. Gained competences: • To be capable to recognize the differential equation and to choose the appropriate tools for seeking the solutions. • To be able to combine mathematical and computational knowledge to solve problems. • To be able to choose an appropriate numerical method to solve initial and boundary value problems. • Skills in acquirement of the appropriate literature.

Predvideni študijski rezultati:	Intended learning outcomes:
• Uporaba diferencialnih enačb pri modeliranju inženirskih problemov. • Poglobljeno razumevanje numeričnih pristopov k reševanju izbranih problemov. • Obvladovanje matematičnega aparata do stopnje, ko se lahko suvereno uporablja zmogljiv računalniški program. • Sposobnost kritične presoje dobljenih računalniških rezultatov.	• Application of differential equations for modelling of problems in engineering. • In-depth understanding of numerical approaches to solving selected problems. • Mastering theoretical knowledge to be able to use an efficient computational tool. • Capability of a critical judgement of the obtained numerical results.

Metode poučevanja in učenja:	Learning and teaching methods:
Predavanja, vaje, domače naloge, seminarske naloge.	Lectures, tutorials, homework, seminar assignments.

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

Ocenjevalna lestvica:	Grading system:
5 - 10, pri čemer velja, da je pozitivna ocena od 6 - 10	5 - 10, a student passes the exam if he is graded from 6 to 10

Reference nosilca/Lecturer's references:

OMLADIČ, Matjaž, STOPAR, Nik, Multivariate imprecise Sklar type theorems. Fuzzy sets and systems : international journal of soft computing and intelligence, 428 (2022), 80-101.

ĐURIĆ, Alen, JEVĐENIĆ, Sara, STOPAR, Nik. Compressed zero-divisor graphs of matrix rings over finite fields, Linear and Multilinear Algebra, 69 (2021), 2012-2039.

OMLADIČ, Matjaž, STOPAR, Nik, Final solution to the problem of relating a true copula to an imprecise copula. Fuzzy sets and systems : international journal of soft computing and intelligence, 393 (2020), 96-112.

STOPAR, Nik, Rank of elements of general rings in connection with unit-regularity, Journal of Pure and Applied Algebra, 224 (2020), 106211 (11 str.).

DNEVNA SVETLOBA

UČNI NAČRT PREDMETA/COURSE SYLLABUS

Predmet:	Dnevna svetloba
Course title:	Daylight
Članica nosilka/UL Member:	UL FGG

Študijski programi in stopnja	Študijska smer	Letnik	Semestri	Izbirnost
Stavbarstvo, druga stopnja, magistrski (od študijskega leta 2026/2027 dalje)	Ni členitve (študijski program)	1. letnik	1. semester	obvezni

Univerzitetna koda predmeta/University course code:	0035044
Koda učne enote na članici/UL Member course code:	1259

Predavanja /Lectures	Seminar /Seminar	Vaje /Tutorials	Klinične vaje /Clinical tutorials	Druge oblike študija /Other forms of study	Samostojno delo /Individual student work	ECTS
30	0	45	0	0	75	5

Nosilec predmeta/Lecturer:	Mitja Košir
Vrsta predmeta/Course type:	obvezni strokovni/obligatory professional

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

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

Vsebina:	Content (Syllabus outline):
Predavanja: Osnove fotometrije, kolorometrije ter vpliva dnevne svetlobe na oblikovanje in zasnovo stavb. Prostorske lastnosti z gledišča dnevne svetlobe (lokacija, stanje neba, solarna geometrija in osončenost). Človek (psiho-fiziološke potrebe človeka, vizualni in nevizualni	Lectures: Fundamentals of photometry, colorimetry and the impact of daylight on building design. Spatial properties from the point of daylight (location, sky conditions, solar geometry, and insolation). Humans (psycho-physiological human needs visual and non-visual effects of

vplivi svetlobe). Obravnava lokacije (določitev potenciala). Načrtovanje stavbe (notranji prostor in ovoj). Konfiguracija vplivnih faktorjev (dnevna svetloba, osončenje, bleščanje). Metode za izračun in preverjanje osončenja in dnevnega osvetljevanja. Podnebno pogojene metrike za določitev svetlobnih lastnosti v grajenem okolju. Komponente: stekla, zasteklitve, senčila, nadzorni sistemi. Strategije za oblikovanje bivalnega in delovnega okolja v skladu z dnevno svetlobo. Vaje: Izvajanje meritev v realnem okolju (osvetljenost, osončenost, bleščanje). Uporaba znanja na konkretnem primeru načrtovanja stavbe – konceptualizacija, faktorska analiza, optimizacija sistema. Oblikovanje primerne načrtovalske rešitve s pomočjo simulacijskih orodij za določitev osvetljenosti, osončenosti in bleščanja.	light). Site analysis (determining potential). Building design (indoor environment, building envelope). Configuration of influential factors (daylight, insolation, glare). Methods for the calculation and verification of insolation and daylight. Climate-based metrics for evaluation of luminous properties in the built environment. Components: glass, glazing, shading devices, control systems.. Strategies for the design of living and working environment in accordance with daylight. Tutorial: Implementation of measurements in a real environment (illuminance, insolation, glare). Use of theoretical knowledge in a specificbuilding design case, conceptual design, factor analysis, system optimization. Formation of a suitable design solution using simulation tools to determine illumination, insolation, and glare.

Temeljna literatura in viri/Readings:

Brandi, U. 2006. Lighting design : principles, implementation, case studies. Basel, Birkhäuser.
Szokolay, S.V. 2014. Introduction to architectural science: the basis of sustainable design. 3rd edn. New York, NY, Routledge.
Muneer, T., Gueymard, C., Kambezidis, H. 2004. Solar radiation and daylight models. 2nd edn. Burlington, Elsevier.
McMullan, R. 2007. Environmental science in building. New York, Palgrave Macmillan.
Weller B., Härth K., Tasche S., Unnewehr S. 2009. Glass in Building : principles, applications, examples. DETAIL Practice. Birkhäuser, Basel, Boston, Berlin.
Licht U. B. ., Unnewehr S. 2009. Lighting Design. DETAIL Practice. Birkhäuser, Basel, Boston, Berlin.
Študijsko gradivo dostopno na: e-učilnici UL FGG

Cilji in kompetence:	**Objectives and competences:**
Cilji: • Izboljšanje kakovosti grajenega okolja. • Zmanjševanje negativnih vplivov grajenega okolja na naravo in družbo. • Učinkovita izraba virov. • Pridobivanje znanja, tehničnih spretnosti in oblikovanje inovacijske sposobnosti za dvig kakovosti projektov. Pridobljene kompetence: • Obvlada prenos sistema zunanje okolje-ovoj- notranje okolje-človek v konceptualizacijo realne stavbe (navezovanje na ostale gradbeno-fizikalne vplive).	Objectives: • The main objectives of the course are to improve the quality of the built environment. • Reducing the negative impacts of the built environment on nature and society. • Efficient use of natural resources. • To acquire knowledge and technical skills for improving the quality of building projects. Gained competences: • Mastering the transfer of the analysed system: outdoor environment-building envelope-indoor environment-human (in

• Razume značilnosti in delovanje sistemov transparentnih delov stavbnega ovoja. • Sposoben je zasnovati in optimizirati sistem svetlobnih odprtin na stavbnem ovoju. • Sposoben je uporabljati računske metode in programsko opremo za področje dnevnega osvetljevanja in osončenja. • Sposoben je kritično oceniti in interpretirati pridobljene podatke (rezultate). • Obvlada veljavno zakonodajo in standarde za področje dnevnega osvetljevanja in osončenja stavb.	the framework of real building case; linking daylight design to other fields of building physics). • Understanding the main characteristics and functioning of transparent building envelope elements. • Ability to design and optimize a proposed system of transparent building enevelope. • Ability to use calculation methods and computer software for daylight illuminance and building insolation analyses. • Critical evaluation and interpretation of results. • Proficiency in applicable legislation and standards for the field of daylighting and insolation of buildings.

Predvideni študijski rezultati:	**Intended learning outcomes:**
• Razumevanje delovanja transparentnih delov stavbnega ovoja, zasnova in analiza vplivov osončenja in zajema dnevne svetlobe v stavbi, sposobnost ocene odziva stavbe na direktno in difuzno komponento dnevne svetlobe. • Uporaba računskih metod in programske opreme za analizo obravnavanih elementov svetlobnega in (posredno) toplotnega odziva stavbe oziroma prostora. • Sposobnost samostojne ocene položaja in vloge obravnavnih elementov v kontekstu interakcije med uporabniki, stavbo in okoljem. • Identifikacija medsebojnih povezav. • Spretnosti uporabe domače in tuje literature in drugih virov, zbiranja in interpretiranja podatkov, identifikacija. • Reševanje problemov, kritična analiza, sinteza, delo v skupini.	• Understanding the functioning of transparent building enevelope, design and analysis of the effects of insolation and daylight in the buildings, ability to assess the building response to the direct and difuse components of dayligt. • Application of calculation methods and computer software simulations to analyse the evaluated elements with regard to daylighting and indirectly also to thermal response of a building and its indoor spaces. • Ability to evaluate the status and the role of the analysed elements the context of interactions between occupants, buildings and environmnet. • Skills for review of relevant literature sources and other references (national, international), data collecting and interpreting, problem identification, problem solving, critical analysis, synthesis, group work.

Metode poučevanja in učenja:	**Learning and teaching methods:**
Predavanja, seminarske in laboratorijske vaje.	Lectures, tutorial, laboratory work.

Načini ocenjevanja:	**Delež/Weight**	**Assessment:**
pisni izpit	40,00 %	Written exam
Ocena izdelka vaj	60,00 %	Tutorial and laboratory work

Ocenjevalna lestvica: **Grading system:**

5 - 10, pri čemer velja, da je pozitivna ocena od 6 - 10	5 - 10, a student passes the exam if he is graded from 6 to 10

Reference nosilca/Lecturer's references:

POTOČNIK, Jaka, KOŠIR, Mitja. Influence of geometrical and optical building parameters on the circadian daylighting of an office. Journal of building engineering. [Online ed.]. okt. 2021, letn. 42, 19 str., ilustr. ISSN 2352-7102., DOI: 10.1016/j.jobe.2021.102402.
POTOČNIK, Jaka, KOŠIR, Mitja. Influence of commercial glazing and wall colours on the resulting non-visual daylight conditions of an office : 106627. Building and environment. [Print ed.]. mar. 2020, št. 106627, letn. 171, str. 1-14, ilustr. ISSN 0360-1323., DOI: 10.1016/j.buildenv.2019.106627.
KOŠIR, Mitja, IGLIČ, Nataša, KUNIČ, Roman. Optimisation of heating, cooling and lighting energy performance of modular buildings in respect to locations climatic specifics. Renewable energy, ISSN 0960-1481. [Print ed.], 2018, letn. 129, dec., str. 527-539, ilustr., doi: 10.1016/j.renene.2018.06.026.

PROJEKTIRANJE NOSILNIH KONSTRUKCIJ STAVB I

UČNI NAČRT PREDMETA/COURSE SYLLABUS

Predmet:	Projektiranje nosilnih konstrukcij stavb I
Course title:	Design of building structures I
Članica nosilka/UL Member:	UL FGG

Študijski programi in stopnja	Študijska smer	Letnik	Semestri	Izbirnost
Stavbarstvo, druga stopnja, magistrski (od študijskega leta 2026/2027 dalje)	Ni členitve (študijski program)	1. letnik	1. semester	obvezni

Univerzitetna koda predmeta/University course code:	0106926
Koda učne enote na članici/UL Member course code:	1776

Predavanja /Lectures	Seminar /Seminar	Vaje /Tutorials	Klinične vaje /Clinical tutorials	Druge oblike študija /Other forms of study	Samostojno delo /Individual student work	ECTS
50	25	75	0	0	150	10

Nosilec predmeta/Lecturer:	izr. prof. dr. Boštjan Pulko, izr. prof. dr. Sebastjan Bratina, prof. dr. Matjaž Dolšek

Vrsta predmeta/Course type:	Obvezni strokovni/obligatory professional

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

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:	Prerequisites:
Obveznih pogojev ni, vendar je delo študenta pri predmetu zelo oteženo, če nima osnovnega znanja statike, geotehnike, potresnega inženirstva in dimenzioniranja armiranobetonski elementov.	There are no mandatory prerequisites, however the work of the student will be very difficult without the basic knowledge of statics, geotechnics, earthquake engineering, and dimensioning of reinforced concrete structural elements.

Vsebina:	Content (Syllabus outline):
Predavanja:	Lectures:

Predavanja potekajo v več delih: Dolšek: Potresnoodporno projektiranje stavb; Bratina: Projektiranje betonskih stavb; Pulko: Geotehnično projektiranje. Potresnoodporno projektiranje stavb: Uvod v projektiranje stavb na potresnih območjih, zasnova in osnovna načela za potresnoodporno projektiranje stavb, osnove projektne potresne obtežbe, Osnovne metode potresne analize stavb (dinamična in modalna analiza), Zagotavljanje duktilnosti in principe načrtovanja nosilnosti potresno odpornih stavb, teoretične osnove programske opreme za analizo in dimenzioniranje stavb. Projektiranje betonskih stavb: Načela snovanja in projektiranja masivnih konstrukcij; pregled osnovnih skupin elementov nosilnih konstrukcij masivnih stavb s pripadajočimi značilnostmi glede nosilnosti in deformabilnosti ter konstrukcijskih posebnosti; ključna merila za smotrno izbiro tipa konstrukcijskega sistema; projektna obtežba; prevedba nosilnega sistema konstrukcije v ustrezen računski model; dimenzioniranje karakterističnih elementov armiranobetonske nosilne konstrukcije na mejna stanja; konstruiranje armature in detajlov. Geotehnično projektiranje: Osnovne zahteve pri temeljenju stavb. Plitvo in globoko temeljenje objektov. Osnovni postopki projektiranja temeljev ob upoštevanju interakcije med temeljnimi tlemi in objektom. Vaje in seminar: Pri posameznih temah se najprej izdela nekaj preprostih domačih nalog, ki podajo oziroma utrdijo znanja iz konstruiranja. Nato sledi seminarska naloga, ki obsega analizo in dimenzioniranje tipične armiranobetonske stavbe.	Lectures are composed of three basic parts/courses: Dolšek: Earthquake resistant design of buildings; Bratina: Design of Concrete Buildings; Pulko: Geotechnical Design. Earthquake-resistant design of buildings: Introduction into design of building structures against seismic actions, conceptual design and basic principles of earthquake-resistant buildings, basis of design seismic action, basic methods of seismic analysis of buildings (response history and spectrum analysis), Ductility and capacity design for earthquake-resistant structures, theoretical background for the introduced computer programs. Design of reinforced concrete buildings: Principles of the design of concrete structures; Overview of basic groups of structural members for concrete buildings, related properties regarding ultimate resistance and deformability as well as structural specifics; key criteria for effective selection of the type of structural system; design loads of concrete structures; translation of load-bearing system of a structure into appropriate computational model; design of the characteristics elements of reinforced concrete load-bearing structure to the limit states; design and detailing of reinforcement. Geotechnical design: Basic requirements for the foundation design. Shallow and deep foundations of structures. Basic methods for the foundation design based on soil-structure interaction. Tutorials and seminar: Some simple tutorials will be made to enhance the knowledge related to specific topics of analysis and design of building structures. Then follow seminar work that includes analysis and dimensioning of typical reinforced concrete building.

Temeljna literatura in viri/Readings:

IZS 2009. Priročnik za projektiranje gradbenih konstrukcij po Evrokod standardih (ur. Beg, D., Pogačnik, A), poglavja 0: Evrokod 0 – Osnove projektiranja (110 str.), poglavje 2: Evrokod 2 -

Projektiranje betonskih konstrukcij (137 str.), poglavje 7: Evrokod 7 – Geotehnično projektiranje (110 str.), poglavje 8: Evrokod 8 – Projektiranje potresnoodpornih konstrukcij (219 str.). EASY (Earthquake Engineering Slide Information System), IKPIR FGG, CD ali www.ikpir.fgg.uni-lj.si/EASY.

Cilji in kompetence:	**Objectives and competences:**
Cilji: • Razložiti in naučiti standardne postopke za potresno analizo in principe za zagotavljanje mehanske odpornosti in stabilnosti konstrukcij stavb iz različnih materialov (betona, jekla, lesa, zidov). • Razložiti in naučiti postopke za zagotavljanje mehanske odpornosti in stabilnosti armiranobetonskih stavb. • Razložiti in naučiti standardne postopke za zagotavljanje mehanske odpornosti in stabilnosti temeljev. Pridobljene kompetence: • Poznavanje in razumevanje odziva stavb na potresne in druge vplive ter s tem povezane zasnove konstrukcijskega sistema. • Razumevanje mehanizmov prenosa obtežbe preko konstrukcijskih sklopov v temeljna tla in osnovnih principov zagotavljanja potresne odpornosti konstrukcij stavb. • Sposobnost uporabe računskih metod in programske opreme za projektiranje nosilnih konstrukcij stavb in njihovih temeljev. • Poznavanje sodobnih IT podprtih orodij v projektiranju.	Objectives: • To explain and teach the procedures for analysis and concepts for ensuring earthquake-resistance of building structures made of different materials (concrete, steel, timber, masonry). • To explain and teach the procedures for ensuring mechanical resistance and stability of reinforced concrete buildings. • To explain and teach standard procedures for ensuring the mechanical resistance and stability of foundations. Gained competences: • The knowledge and understanding of response of building structures on seismic and other actions and related optimal selection of structural system. • The competence of understanding the load transfer through the structure into the foundation soil. • The competence of understanding the basic factors contributing to earthquake resistance of structures. • The ability to use computer software in the design of structural systems of buildings. • The ability to use the IT supported tools in design.

Predvideni študijski rezultati:	**Intended learning outcomes:**
• Razumevanje delovanja konstrukcijskih sklopov in konstrukcije kot celote ter prenosa obtežbe v temeljna tla. • Znanje določitve optimalnega sistema temeljenja. • Razumevanje dejavnikov za zagotavljanje duktilnosti in nosilnosti potresno odpornih konstrukcij in znanje oblikovanja ustreznih konstrukcijskih detajlov. • Sposobnost uporabe računskih metod in programske opreme za projektiranje nosilnih konstrukcij stavb in njihovih temeljev.	• Understanding the role of the structure and its subassemblies in the transfer of loads into the foundation soil. • The knowledge, how to choose a suitable foundation system. • Understanding of the key factors contributing to the ductility and strength of earthquake resistant structures. • The knowledge to choose and produce suitable structural details. • The use of the design methods and computer software for structural systems (including foundations).

• Sposobnost identifikacije in kvantifikacije kritičnih obtežb. • Kompetentna uporaba evropskih standardov za projektiranje potresnoodpornih konstrukcij, armiranobetonskih stavb in temeljev v skladu s standardom Evrokod. • Identifikacija in reševanje problemov, kritična analiza, argumentirana izbira med več možnostmi, sinteza, delo v skupini.	• The knowledge to identify and quantify critical loads on structures. • The knowledge of the competent use of the European standards (Eurocode) for the earthquake-resistant design of structures, for design of reinforced concrete structures and foundations. • Transferable skills include: identification and solving of problems; critical assessment and analysis; argued choice between several options; ability of the synthesis; and working in a group.

Metode poučevanja in učenja:	**Learning and teaching methods:**
Predavanje, vaje in seminarska naloga. Predmet temelji na sodobnih metodah poučevanja, kot so projektno učenje, timsko delo in individualno delo med učiteljem in študentom, poučevanje s poudarkom na interesu študentov.	Lectures, tutorials and seminar. The course is based on up-to-date teaching methods – project based learning, team work and individual work between teacher and student, student centred teaching and just-in-time lectures.

Načini ocenjevanja:	**Delež/Weight**	**Assessment:**
Individualno delo (vaje, seminar) med letom	50,00 %	Individual work during the course
Izpit (računski in teoretičen del)	50,00 %	Exam (computational and theoretical part)

Ocenjevalna lestvica:	**Grading system:**
5 - 10, pri čemer velja, da je pozitivna ocena od 6 - 10	5 - 10, a student passes the exam if he is graded from 6 to 10

Reference nosilca/Lecturer's references:

LAZAR SINKOVIĆ, Nuša, BROZOVIČ, Marko, DOLŠEK, Matjaž. Risk-based seismic design for collapse safety. Earthquake engineering & structural dynamics, ISSN 0098-8847. [Print ed.], [in press] 2016, letn. XX, št. X, str. 1-21.
ŽIŽMOND, Jure, DOLŠEK, Matjaž. Evaluation of factors influencing the earthquake-resistant design of reinforced concrete frames according to Eurocode 8. Structure and infrastructure engineering, ISSN 1573-2479, 2015, letn. 12, št. 10, str. 1326-1341.
DOLŠEK, Matjaž, LAZAR SINKOVIĆ, Nuša, ŽIŽMOND, Jure. IM-based and EDP-based decision models for the verification of the seismic collapse safety of buildings. Earthquake engineering & structural dynamics, ISSN 0098-8847. [Print ed.], dec. 2017, letn. 46, št. 15, str. 2665-2682, ilustr., doi: 10.1002/eqe.2923.

MARKOVIČ, Mojca, KRAUBERGER, Nana, SAJE, Miran, PLANINC, Igor, BRATINA, Sebastjan. Non-linear analysis of pre-tensioned concrete planar beams. Engineering structures, ISSN 0141-0296. [Print ed.], jan. 2013, letn. 46, str. 279-293.
KRAUBERGER, Nana, BRATINA, Sebastjan, SAJE, Miran, SCHNABL, Simon, PLANINC, Igor. Inelastic buckling load of a locally weakened reinforced concrete column. Engineering structures, ISSN 0141-0296. [Print ed.], 2012, letn. 34, št. 1, str.

BAJC, Urška, BRATINA, Sebastjan, SAJE, Miran, PLANINC, Igor. Nelinearna analiza razpokane armiranobetonske natezne palice - primerjava numeričnih metod = Nonlinear analysis of cracked tensile reinforced concrete bar - comparison of numerical methods. Gradbeni vestnik, ISSN 0017-2774, maj 2013, letn. 62, str. 105-116.

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 : Journal of the international consortium on landslides, ISSN 1612-510X. [Print ed.], 2014, letn. 11, št. 1, str. 81-91.
PULKO, Boštjan. Primerjava metod za statično analizo temeljnih plošč = Comparision of methods for static analysis of mat foundations. Gradbeni vestnik : glasilo Zveze društev gradbenih inženirjev in tehnikov Slovenije, ISSN 0017-2774. [Tiskana izd.], sep. 2012, letn. 61, št. 9, str. 198-205.
PULKO, Boštjan, KILAR, Vojko, LOGAR, Janko. Geotechnical design of the reconstruction of the Bloudek jumping hill in Planica = Conception geotechnique de la reconstruction du tremplin de saut a ski Bloudek a Planica. V: Geotechnical engineering for infrastructure and development : conference proceedings, 13-17 september 2015, Edinburgh. Edinburgh: British Geotechnical Association. 2015, str. 4161-4166.

VODENJE PROJEKTOV

UČNI NAČRT PREDMETA/COURSE SYLLABUS

Predmet:	Vodenje projektov
Course title:	Project Management
Članica nosilka/UL Member:	UL FGG

Študijski programi in stopnja	Študijska smer	Letnik	Semestri	Izbirnost
Gradbeništvo, druga stopnja, magistrski	Gradbene konstrukcije (smer)	2. letnik	1. semester	obvezni
Gradbeništvo, druga stopnja, magistrski	Nizke gradnje (smer)	2. letnik	1. semester	obvezni
Stavbarstvo, druga stopnja, magistrski	Ni členitve (študijski program)	1. letnik	1. semester	obvezni

Univerzitetna koda predmeta/University course code:	0034966
Koda učne enote na članici/UL Member course code:	1496

Predavanja /Lectures	Seminar /Seminar	Vaje /Tutorials	Klinične vaje /Clinical tutorials	Druge oblike študija /Other forms of study	Samostojno delo /Individual student work	ECTS
30	0	30	0	0	60	4

Nosilec predmeta/Lecturer:	doc. dr. Robert Klinc
Vrsta predmeta/Course type:	Obvezni strokovni v/Obligatory professional

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

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

Vsebina:	**Content (Syllabus outline):**
Predavanja Projekt kot sistem, cilji projekta, komponente in relacije v projektu, odnos z okoljem. Organizacija izvajanja projektov, stalna in nestalna projektna organiziranost. Področja projektnega vodenja. Specifika in faze projektov v gradbeništvu. Strukturiranje projekta, matrika odgovornosti. Planiranje in spremljanje projektov. Oblikovanje projektnega tima. Upravljanje s tveganji. Vaje Izdelava lastnega projekta od zasnove do generalnega plana. Modeliranje tveganj pri projektih v gradbeništvu in simulacija vplivov.	Lectures Project as a system, project goals, project components and their relationships, project environment interaction. Project execution organisation, permanent and temporary project organisation. Areas of project management. Specific features and project phases in construction projects. Project structuring, responsibility matrix. Project planning and monitoring. Formation of a project team. Risk management Tutorial Preparation of a case study. Risk simulation in construction projects, impact simulation.

Temeljna literatura in viri/Readings:

- Rant, M., Jeraj, M., & Ljubič, T. (1998). Vodenje projektov: projektni pristop, projektna organizacija, vodenje projektov, projektni proces, terminsko planiranje projektov, mrežno planiranje (2. izd.). POIS.
- Česen, A., Kern, T., Bajec, M. (2008). Vodnik po znanju projektnega vodenja, 3. Izdaja. Založba Moderna organizacija
- Golob, K. (2021). Investicijski procesi in vodenje projektov: [gradivo za strokovne izpite]. 2. ponatis. Ljubljana: Inženirska zbornica Slovenije.
- Project Management Institute, ed. The Standard for Project Management and a Guide to the Project Management Body of Knowledge (PMBOK Guide). Seventh edition. Newtown Square, Pennsylvania: Project Management Institute, Inc, 2021.

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

Predvideni študijski rezultati:	Intended learning outcomes:
- Osvojeno znanje s področja projektnega vodenja (proces, udeleženci, medsebojni odnosi, oblike sodelovanja), - Sposobnost uporabe računalniških orodij za vodenje projektov.	- Acquired knowledge from the field of project management (process, stakeholders, participants' relations), - Ability to use computer – supported project management tools.

Metode poučevanja in učenja:	Learning and teaching methods:
Predavanja, seminarske vaje, lab.vaje. 30 ur laboratorijskih vaj.	Lectures, tutorial. 30 hours of laboratory exercises.

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

Ocenjevalna lestvica:	Grading system:
5 - 10, pri čemer velja, da je pozitivna ocena od 6 - 10	5 - 10, a student passes the exam if he is graded from 6 to 10

Reference nosilca/Lecturer's references:

KLINC, Robert, TURK, Žiga. Construction 4.0 - digital transformation of one of the oldest industries. *Economic and business review*. 2019, vol. 21, no. 3, str. 393-410, ilustr. ISSN 1580-0466. http://ojs.ebrjournal.net/ojs/index.php/ebr/article/view/786/pdf_163, https://repozitorij.uni-lj.si/IzpisGradiva.php?id=114085&lang=slv, DOI: 10.15458/ebr.92. [COBISS.SI-ID 9010017]

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

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

POŽARNA VARNOST V STAVBAH

UČNI NAČRT PREDMETA/COURSE SYLLABUS

Predmet:	Požarna varnost v stavbah
Course title:	Fire safety in buildings
Članica nosilka/UL Member:	UL FGG

Študijski programi in stopnja	Študijska smer	Letnik	Semestri	Izbirnost
Stavbarstvo, druga stopnja, magistrski	Ni členitve (študijski program)	1. letnik	1. semester	obvezni

Univerzitetna koda predmeta/University course code:	0106910
Koda učne enote na članici/UL Member course code:	1470

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

Nosilec predmeta/Lecturer:	prof. dr. Tomaž Hozjan
Vrsta predmeta/Course type:	Obvezni strokovni /Obligatory professional

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

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

Vsebina:	Content (Syllabus outline):
Predavanja: Splošno o požarnem inženirstvu. Pregled osnovnih pojmov. Evropski standardi in predpisi. Požarna obtežba. Modeli standardnih in realnih požarov. Načrtovanje požarne varnosti skladno s tehničnimi smernicami. Ukrepi aktivne požarne zaščite. Evakuacijske poti, sistemi za javljanje in gašenje. Ukrepi	Lectures: Introduction to fire engineering. Overview of basic concepts. European standards and regulations. Fire load. Models of standard and real fires. Design of fire safety in accordance with technical guidelines. Measures of active fire protection. Evacuation routes, fire detection and fire fighting. Measures of passive fire protection. Influence of high temperatures

pasivne požarne zaščite. Vpliv visoke temperature na lastnosti materialov. Temperaturno polje konstrukcije. Računsko ugotavljanje požarne odpornosti lesenih, armiranobetonskih in jeklenih nosilnih konstrukcij. Vaje: Računsko reševanje osnovnih nalog, obisk požarnega laboratorija, izdelava načrta požarne varnosti za enostaven objekt.	on material behavior. Determination of temperature field in a structure. Computing determination of the fire resistance of timber, reinforced concrete and steel structures. Tutorial: Laboratory exercises (solving of basic tasks, visit of the fire laboratory). Seminar exercises (design of fire study for a simple building).

Temeljna literatura in viri/Readings:

Buchanan, A. H. 2005. Structural design for fire safety. John Wiley & sons ltd.
Wald F. et al. 2004. Vypočet požarni odolnosti stavebnih konstrukci, Tehniška univerza v Pragi.
Direktiva o gradbenih proizvodih, CPD 89/106, Bistvena zahteva št.2 “Požarna varnost”.
Evrokod EN 1991-1-2 in požarni deli Evrokodov za lesene, armiranobetonske in jeklene konstrukcije.
Učno gradivo v spletni učilnici.

Cilji in kompetence:	**Objectives and competences:**
Cilji: • Nadgraditi osnovno znanje stavbarstva in konstrukterstva z načeli projektiranja požarno varnih stavb. • Podati osnovne ugotovitve o nastanku, razvoju in poteku požarov v zgradbah in naravnem okolju. • Seznaniti študente z modeli požarne obtežbe skladno z Evrokodom EN 1991-1-2 in z ukrepi aktivne in pasivne požarne zaščite. • Privzgojiti občutek za pomen ukrepov požarne zaščite v luči sociooloških, naselitvenih, ekonomskih in drugih faktorjev. • Povezati znanja iz drugih predmetov s požarnimi problemi. • Vpeljati osnovna načela požarno varnega projektiranja lesenih, armiranobetonskih in jeklenih konstrukcij. Pridobljene kompetence: • Sposobnost ocene požarne ogroženosti objekta ter načrtovanja ukrepov požarne zaščite. • Sposobnost izbire primernega modela požarne obtežbe. Sposobnost uporabe poenostavljenih računskih metod za oceno	Objectives: • To upgrade the basic knowledge of architecture and design with principles of fire- resistant buildings. • To provide the basic knowledge on the growth, development and progress of fires in buildings and natural environment. • To familiarize students with models of fire load in accordance with EN 1991-1-2 standard and measures of active and passive fire protection. • To obtain a sense of the importance of fire. • Safety measures in the light of sociological, urban, economic and other factors. • To relate knowledge from other courses with • Fire problems. • To introduce the basic principles of fire safety design of timber, reinforced concrete and steel structures. Gained competences: • Ability to perform the fire safety assessment of a building and design fire protection measures • Ability of selecting an appropriate fire load model. Ability to use the simplified calculation methods for the assessment of

požarne odpornosti enostavnih nosilnih konstrukcij. • Sposobnost izdelave načrta požarne varnosti za preproste objekte.	fire resistance of simple load-bearing structures. • Ability to design fire study for simple buildings.

Predvideni študijski rezultati:	**Intended learning outcomes:**
• Razumevanje pomena požarnega inženirstva. Razumevanje fizikalnih osnov nastanka in razvoja požara ter vpliva visokih temperatur na materiale in konstrukcije. • Znanje osnovnih metod in ukrepov aktivne in pasivne požarne zaščite. • Uporaba pridobljenega znanja pri pripravi magistrskega dela in pri samostojnem ali skupinskem reševanju požarnih problemov na delovnem mestu v praksi. • Povezava pridobljenega znanja z različnih področij naravoslovja in tehnike s problemi požarnega inženirstva. Kritično ovrednotenje računskih modelov in poenostavitev v okviru standardov in predpisov. • Uporaba domače in tuje literature ter evropskih standardov in predpisov s področja požarnega inženirstva. Pridobivanje podatkov s svetovnega spleta, uporaba domačih in tujih baz podatkov. • Izdelava in uporaba preprostih računalniških orodij za reševanje požarnih problemov. • Uporaba razpoložljive programske opreme.	• Understanding the importance of fire safety engineering. Understanding the physical basis of the growth and evolution of fire and influence of high temperatures on materials and structures. • Knowledge of basic methods and measures of • Active and passive fire protection. • Using the knowledge gained at this course in the preparation of the master thesis and when solving practical fire issue problems individually or in a group in practice. • Link of the acquired knowledge from different fields of science and technology with the problems of fire engineering. Critical evaluation of computational models and simplification in the context of standards and regulations. • Use of a domestic and foreign literature and European standards and regulations in the field of fire engineering. • Obtaining information from the World Wide Web, use of domestic and foreign databases. Development and use of simple computational tools for solving fire problems. • Use of the available software.

Metode poučevanja in učenja:	**Learning and teaching methods:**
Predavanja, laboratorijske vaje, seminarske vaje.	Lectures, laboratory exercises, seminar exercises.

Načini ocenjevanja:	**Delež/Weight**	**Assessment:**
Ustni izpit	50,00 %	Oral exam
Samostojno izdelana naloga	50,00 %	Seminar work

Ocenjevalna lestvica:	**Grading system:**
5 - 10, pri čemer velja, da je pozitivna ocena od 6 - 10	5 - 10, a student passes the exam if he is graded from 6 to 10

Reference nosilca/Lecturer's references:

PEČENKO, Robert, PLANINC, Igor, SVENSSON, Staffan, HOZJAN, Tomaž. Implementing coupled heat and moisture transfer model in the fire analysis of timber beams. Fire safety journal. [Print ed.]. jul. 2019, letn. 107, str. 170-178, ilustr. ISSN 0379-7112. DOI: 10.1016/j.firesaf.2018.11.007.
HOZJAN, Tomaž, KEMPNA, Kamila, SMOLKA, Jan. Simulation and modelling in fire safety - virtual reality for smart firefighting. V: ŘEHÁK, David (ur.). Safety and security issues in technical infrastructures. Hershey: IGI Global, 2020. Str. 232-262
KEMPNA, Kamila, SMOLKA, Jan, HOZJAN, Tomaž, et al. Fire safety protection assessment of industrial technologies. V: Material behavior in fire. Bristol: IOP, 2018. Str. 1-7, ilustr. Journal of physics, vol. 1107. ISSN 1742-6596.

PRAKTIČNO USPOSABLJANJE

UČNI NAČRT PREDMETA/COURSE SYLLABUS

Predmet:	Praktično usposabljanje
Course title:	Practical training
Članica nosilka/UL Member:	UL FGG

Študijski programi in stopnja	Študijska smer	Letnik	Semestri	Izbirnost
Stavbarstvo, druga stopnja, magistrski	Ni členitve (študijski program)	1. letnik	1. semester	obvezni

Univerzitetna koda predmeta/University course code:	0106912
Koda učne enote na članici/UL Member course code:	1262

Predavanja /Lectures	Seminar /Seminar	Vaje /Tutorials	Klinične vaje /Clinical tutorials	Druge oblike študija /Other forms of study	Samostojno delo /Individual student work	ECTS
6	0	0	0	80	34	4

Nosilec predmeta/Lecturer:	Andreja Istenič Starčič
Vrsta predmeta/Course type:	Obvezni strokovni/Obligatory professional

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

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

Vsebina:	Content (Syllabus outline):
Študent se seznani in opravlja delo, ki ga opravlja diplomant tega študija v praksi. Predvsem: se seznani z organizacijsko strukturo in tehnologijo gradbenega podjetja, se seznani s predpisi o varstvu pri delu in njihovi izvedbi v praksi, de seznani se z aktualnim dogajanjem v gradbenem podjetju, spozna menedžerski vidik dela v podjetju, dela na terenu – aktualnem gradbišču, oziroma v pisarni - samostojno opravi	Student is introduced to the performance of work done by graduate in practice. Especially, students are: aware of the organizational structure and technology of building companies, familiar with the regulations about safety at work and their implementation in practice, familiar with current developments in a construction company, introduced to executive aspect of work when undertaking

dela na aktualnem projektu pod vodstvom mentorja, razvija uporabo znanstvenoraziskovalnih metod v širšem spektru problemov v stroki, razvija kritične refleksije, socialne in komunikacijske zmožnosti za vodenje skupinskega dela, pokaže iniciativnost in samostojnost pri vodenju najzahtevnejših delovnih sistemov pod nadzorom mentorja.	field work - current site, or in office - self-performed work on current project under the guidance of a mentor; they develop the use of scientific research methods in a broad spectrum of problems in the profession, develop critical reflection, social and communication skills for teamwork management, show initiative and independence in the management of most complex work systems under the supervision of mentor.

Temeljna literatura in viri/Readings:

Viri so izbrani v sodelovanju z mentorjem praktičnega usposabljanja glede na vsebine, ki so predpisane in z njimi razpolaga organizacija, ki izvaja praktično usposabljanje. /
Resources are selected in collaboration with the supervisor of practical training in relation to the contents prescribed and disposed of by the organization conducting the practical training.
Interna in druga gradiva v delovni organizaciji.
Smernice za praktično usposabljanje na Univerzi v Ljubljani. 2007. Ljubljana, UL. Dostopno na spletu.
Govekar, Okoliš et.al. 2010. Praktično usposabljanje študentov v delovnih organizacijah in primeri dobrih praks. Ljubljana, UL FF, Center za pedagoško izobraževanje.
Učno gradivo v spletni učilnici.

Cilji in kompetence:	**Objectives and competences:**
Cilji: • Študent v okviru praktičnega usposabljanja spozna operativno delo v ciljnih poklicih in organizacijsko strukturo subjektov na področju gradbeništva. • Praksa, izvedena med izobraževalnim procesom, ima tudi motivacijski cilj ter namen. • Študent spozna dejavnike kariernega načrtovanja in razvoja in procese povezane s kariernim razvojem. • Študentu se omogoči samoevalvacijo kompetenc in dejavnikov, ki podpirajo procese poklicne identifikacije v povezavi akademskega okolja in delovnih okolij. • Študent spozna značilnosti učenja na delovnem mestu in značilnosti delovnih okolij ter značilnosti opazovanja in registriranja delovnih procesov. Pridobljene kompetence: • Obvladovanje uporabe in prenosa teoretičnih znanj, ki jih študent pridobi med študijem pri predavanjih, vajah ter seminarjih, v inženirsko prakso.	Objectives: • In the context of practical training student learns about operational work in targeted occupations and organizational structure of entities in the construction field. • The practice during the educational process has also motivational goal and purpose. • Students learn about the elements of career planning and development and processes related to career development. • Student is facilitated to do self-evaluation of competences and factors that support the processes of professional identification in relation to academic environment and working environments. • Students learn about the characteristics of workplace learning and the characteristics of working environments and the characteristics of observation of workflows. Gained competences: • Control of the application and transfer of theoretical knowledge acquired while studying in academic environment (lectures, tutorials and seminars) to

• Sposobnost za povezovanje teorije in dela v praksi.	engineering practice. Ability to integrate theory and practical work.

Predvideni študijski rezultati:	**Intended learning outcomes:**
• Študent pridobi praktična znanja in izkušnje na področju nalog in storitev gradbene stroke. • Pridobljena znanja mu koristijo pri izdelavi magistrskega dela. • Študent se po opravljeni praksi lažje in hitreje uvaja v delo po končanem študiju, razume različne gradbene subjekte in njihovo vlogo v družbi. • Študent se na podlagi sinteze pridobljenih znanj tekom študija lahko sooči z aktualnimi delovnimi nalogami oz. uporabi aktualna znanja in pripomočke pri izpolnjevanju nalog, ki jih opravlja organizacija, v kateri poteka praktično usposabljanje. • Pridobljena znanja in spretnosti pripomorejo h kakovostnejšemu razumevanje vsebin posameznih predmetov v študijskem procesu, tudi pri izdelavi magistrskega dela, kakor tudi kasneje pri uvajanju na prvo delovno mesto. Študent zna ovrednotiti svoje delo glede na zastavljene in dosežene cilje. Strokovno delo reflektira na osnovi zbranih informacij. Študent razvija kompetence za načrtovanje lastne kariere in samoevalvacijo znanja in kompetenc.	• Students will acquire practical knowledge and experience in the field of tasks and services of the construction field. • Obtained knowledge will be useful in the preparation of master thesis. • During the practice students are more efficiently introduced to the work needed after completing their studies, understand various construction entities and their role in society. • Synthesis of knowledge acquired during the study may be confronted with the actual work and tasks through the application of core knowledge and tools in fulfilling the tasks carried out by the organization in which the practical training takes place. • Knowledge and skills to help achieve higher quality of comprehension of the content of individual courses in the study process, also in the writing of master thesis, as well as later in the introduction to the first employment. • Student is able to evaluate work against the objectives and targets achieved. Professional work is reflected on the basis of the information collected. Students develop competences for career planning and self-assessment of knowledge and competencies.

Metode poučevanja in učenja:	**Learning and teaching methods:**
Terensko delo, mentorstvo, demonstracije, konzultacije, pisanje in vodenje dnevnika in portfolia prakse.	Field work, mentoring, demonstrations, consultations, writing and keep a diary and portfolio of practices.

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

Ocenjevalna lestvica:	**Grading system:**

Reference nosilca/Lecturer's references:

ISTENIČ STARČIČ, Andreja. Students' perception of field placement in professional competency and identity construction : transdisciplinary study in education, health and engineering. V: MILLWATER, Jan (ur.), EHRICH, Lisa Catherine (ur.), BEUTEL, Denise (ur.). Practical experiences in professional education : a transdisciplinary approach. Mt Gravatt: Post Pressed, 2011, str. 155-170, tabele.
ŠUBIC KOVAČ, Maruška, ISTENIČ STARČIČ, Andreja. Kompetence diplomantov gradbeništva - evropski raziskovalni projekt TUNING = Competences of graduates in civil engineering - the European Research Project TUNING. Gradb. vestn., julij 2006, letn. 55, str. 178-186, ilustr.
FOUCHAL, Farid, HASSAN, Tarek M., BLEICHER, David, ISTENIČ STARČIČ, Andreja. Industrialised, Integrated, Intelligent Construction Training Concept. V: WALLIS, Ian (ur.). Industrialised, Integrated, Intelligent Construction : I3con, Handbook 1. Berkshire: Bsria: I3con, 2009, str. 184-193.

INFORMACIJSKO MODELIRANJE STAVB

UČNI NAČRT PREDMETA/COURSE SYLLABUS

Predmet:	Informacijsko modeliranje stavb
Course title:	Building information modelling
Članica nosilka/UL Member:	UL FGG

Študijski programi in stopnja	Študijska smer	Letnik	Semestri	Izbirnost
Stavbarstvo, druga stopnja, magistrski (od študijskega leta 2026/2027 dalje)	Ni členitve (študijski program)	1. letnik	2. semester	obvezni

Univerzitetna koda predmeta/University course code:	0035048
Koda učne enote na članici/UL Member course code:	1260

Predavanja /Lectures	Seminar /Seminar	Vaje /Tutorials	Klinične vaje /Clinical tutorials	Druge oblike študija /Other forms of study	Samostojno delo /Individual student work	ECTS
30	0	30	0	0	60	4

Nosilec predmeta/Lecturer:	izr. prof. dr. Tomo Cerovšek
Vrsta predmeta/Course type:	obvezni strokovni/obligatory professional

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

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

Vsebina:	Content (Syllabus outline):
Predavanja: Uvod v informacijsko modeliranje stavb (BIM). Metode planiranja uporabe in uvajanja BIM 03. Metode sodelovalnega dela in upravljanja BIM. Metode modeliranja konstruktivnih in nekonstruktivnih elementov stavb za različne potrebe po fazah projekta. Metode modelne	Lectures: Introduction to building information model. BIM execution planning and implementation. BIM collaboration and management. Methods of modelling load-bearing and non-load bearing elements. BIM for Sustainable Design. Methods of modelling Building Systems. QA procedures

analize za trajnostno projektiranje. Metode modeliranja sistemov stavb. Zagotavljanje kakovosti ter odpravljanje ovir pri uporabi BIM ter pregled aspektnih modelov ter ogrodij BIM. OpenBIM in protokoli za izmenjavo BIM 09. Standardizacija BIM pri projektih PAS, IFC, CIS2. Napredne tehnike parametrizacije BIM. Vaje: BIM (Building information model) Informacijsko modeliranje stavb: konstrukcijski elementi, sestavi, izvlečki za potrebe različnih analiz. Izdelava študij izvedljivosti in analiza variant izvedbe na osnovi informacijskih modelov stavb. Izdelava parametričnih modelov in analiza Green Bim, študije na osnovi informacijskih modelov stavb (za preverbo količin, analizo materialov, energetsko analizo).	in BIM and overview of BIM aspect and framework models. OpenBIM protocols for exchange of BIM. Standardization: BS 1192, IFC, CIS, IFD10. Advanced BIM parameterization techniques. Tutorial: Development of BIM, structural and non-structural elements, composites, schedules. Development of design alternatives and 3D coordination based on BIM. Development of parametrical models and libraries, and analysis of Green BIM and various applications of BIM Uses.

Temeljna literatura in viri/Readings:

Eastman, C.M. 2008. BIM Handbook, A Guid to Building Information Modelling. Boca Raton, CRC.
Krygiel E., Bnies, B. 2008. Green BIM, Practice Integrated Sustainable Design with BIM. John Wiley & Sons, Inc.
Levy, F. 2012. BIM in small-scale sustainable design. John Wiley & Sons, Inc.
Učno gradivo v spletni učilnici.

Cilji in kompetence:	**Objectives and competences:**
Cilji: • Pojasniti osnovne koncepte informacijskega modeliranja stavb. • Pripraviti študente na uvajanje in uporabo informacijskih modelov stavb. • Pripraviti študente na analize informacijskih modelov za trajnostno gradnjo stavb. Pridobljene kompetence: • Izdelati shemo informacijskih modelov stavb. • Izdelati konkreten informacijski model in pridobiti ustrezne podatke. • Uporaba informacijskih modelov stavb za vizualizacijo, dokumentacijo in analize. • Analitično obravnavati izmenjavo informacijskih modelov in vlogo pri komunikaciji. • Sposobnost sodelovanja z deležniki v projektu, ki temelji na informacijskih modelih stavb.	Objectives: • Student shall understand major concept relevant for building information modelling. • Student shall be capable to independently plan and implement BIM on small scale projects. • Student shall be capable to perform sustainable design and analysis based on BIM. Gained competences: • Understand and develop small BIM schema. • Independently develop and evolve BIM and gain appropriate data. • Understand and plan various BIM uses, including visualization, documentation, analysis. • Analytically observe the exchange BIM models and their role in project communication. • Capability to collaborate with different project stakeholders using BIM technologies.

Predvideni študijski rezultati:	Intended learning outcomes:
• Poznavanje teoretičnih osnov in standardov za BIM. • Poznavanje zahtev in postopkov za trajnostno projektiranje z BIM. • Razumevanja pomena in potenciala BIM. • Razumevanje kritičnih vsebin in elementov pri implementaciji BIM. • Sposobnost planiranja uporabe in implementacije BIM. • Sposobnost kritične presoje uvajanja BIM glede na zrelost sodelujočih in konkreten projekt. • Sposobnost analizirati in odpraviti ovire za interoperabilnost BIM. Izdelki študentov: • delni informacijski modeli stavb s standardno, • določenimi elementi, • analize za trajnostno projektiranje na osnovi BIM, • integriran projekt BIM z vsemi bistveni elementi in izmenjavami modelnih vsebin.	• Theoretical background and standards for BIM. • Special requirements and procedures for sustainable design supported by BIM. • Importance and potential of BIM. • Critical digital content and elements for successful implementation of BIM. • Planning and implementation of BIM. • BIM assessments in terms of capability and capacity for implementation on a BIM project. • Analysis of interoperability issues and the related barriers. Students shall produce: • partial BIM models with standards elements and BIM libraries, • analysis for sustainable design based on BIM, • integrated BIM project with all essential load- bearing and non-load-bearing elements.

Metode poučevanja in učenja:	Learning and teaching methods:
Predavanja sledijo problemsko naravnanemu delu na konkretnem projektu. Vsebine so delno posredovane v obliki multimedijskih gradiv.	Learning is supported by online learning content of management systems with interactive content. Student work is individual as well as in groups.

Načini ocenjevanja:	Delež/Weight	Assessment:
Sprotno delo: oddaja nalog	50,00 %	Course work and home-works
Pisni teoretični izpit	30,00 %	Written theoretical exam
Projekt	20,00 %	BIM Project

Ocenjevalna lestvica:	Grading system:
5 - 10, pri čemer velja, da je pozitivna ocena od 6 - 10	5 - 10, a student passes the exam if he is graded from 6 to 10

Reference nosilca/Lecturer's references:

CEROVŠEK, Tomo. A review and outlook for a 'Building Information Model' (BIM) : a multi-standpoint framework for technological development. Advanced engineering informatics, ISSN 1474-0346, 2011, letn. 25, št. 2, str. 224-244, ilustr., doi: 10.1016/j.aei.2010.06.003.
CEROVŠEK, Tomo, ZUPANČIČ-STROJAN, Tadeja, KILAR, Vojko. Framework for model-based competency management for design in physical and virtual worlds. Journal of information

technology in construction, ISSN 1874-4753, 2010, vol. 15, str. 1-22, ilustr. http://www.itcon.org/2010/1.
CEROVŠEK, Tomo. BIM lifecycle // BIM FM. V: ANTÓNIO RUIVO, Meireles (ur.). 1st BIM International Conference : BIM Forum Portugal, 20. -21. 6. 2013. Porto: S. n., 2013, str. 1-57,ilustr.

GRADBENA FIZIKA

UČNI NAČRT PREDMETA/COURSE SYLLABUS

Predmet:	Gradbena fizika
Course title:	Building physics
Članica nosilka/UL Member:	UL FGG

Študijski programi in stopnja	Študijska smer	Letnik	Semestri	Izbirnost
Stavbarstvo, druga stopnja, magistrski (od študijskega leta 2026/2027 dalje)	Ni členitve (študijski program)	1. letnik	2. semester	obvezni

Univerzitetna koda predmeta/University course code:	0035046
Koda učne enote na članici/UL Member course code:	1258

Predavanja /Lectures	Seminar /Seminar	Vaje /Tutorials	Klinične vaje /Clinical tutorials	Druge oblike študija /Other forms of study	Samostojno delo /Individual student work	ECTS
60	0	120	0	0	180	12

Nosilec predmeta/Lecturer:	doc. dr. Jure Kokalj, prof. dr. Zvonko Jagličić
Vrsta predmeta/Course type:	obvezni strokovni/obligatory professional

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

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

Vsebina:	Content (Syllabus outline):
Predavanja: Difuzijska enačba, robni pogoji in odzivni dinamični parametri ovojnega sklopa zgradb. Podrobna analiza toplotnih mostov in konvekcija. Prenos toplote s sevanjem med posameznimi segmenti ovojnega sklopa in sevalne karakteristike materialov	Lectures: Diffusion equation, boundary and initial conditions, and dynamical response parameters of building envelope. Detailed analysis of thermal bridges and Convection. Thermal radiation heat transfer between structural components of building

(absorptivnost, emisivnost in sipanje). Kondenzacija in transport vlage ter njen vpliv na termodinamske karakteristike ovojnega sklopa zgradbe. Vidna svetloba, svetlobni tok ter razširjanje, odboj in absorpcija svetlobe na posameznih elementih ovojnega sklopa. Zvok v zaprtih prostorih, hrup in kontrola hrupa, merilni instrumenti in merilne metode v akustiki in analizi hrupa. Vaje: Računska analiza izbranih primerov iz prakse s pomočjo analitičnih metod. Uporaba računalniških programov za reševanje problemov iz prakse. Laboratorijske vaje: Uporaba merilnih inštrumentov, obdelava in analiza izmerjenih podatkov ter modeliranje preko enostavnih fizikalnih modelov.	envelope and radiation characteristics of the corresponding materials (absorptivity, emissivity, and scattering cross-sections). Condensation, moisture transport and its influence on thermodynamic properties of the building envelope. Light, radiation flux, propagation, reflection and absorption of light on various surfaces of structural components forming the building envelope. Sound in enclosed spaces, noise and noise control, measuring equipment and measurement techniques in acoustics and noise analysis. Exercises: Solving practical engineering problems using analytical methods. Application of computer programs to solve problems encountered in engineering practice Laboratory exercises: Usage of measuring instruments, analysis of measured data and modeling via simple physical models.

Temeljna literatura in viri/Readings:

Kladnik, R. 1983. Nestacionarni temperaturni pojavi v ovojnem sklopu zgradbe, FAGG.
Luikov, A.V. 1975. Heat and mass transfer in capillary porous bodies. Oxford, Pergamon.
Biess, D.A., Hansen, C.H. 2003. Engineering Noise Control, Theory and Practice, 3rd edition. Spon Press.
Siegel, R., Howell, J.R. 1972. Thermal Radiation Heat Transfer. McGraw-Hill.
Peternelj, J., Jagličić, Z. 2014. Osnove gradbene fizike. UL, FGG.

Cilji in kompetence:	**Objectives and competences:**
Cilji: • Nadgraditi osnovno znanje nestacionarne termodinamike, zvočnih pojavov in svetlobnih pojavov z znanjem, ki je specifično za te pojave v grajenem okolju. • Podati poglobljeno znanje prenosa toplote z prevajanjem, konvekcijo in sevanjem, ter zvočnih in svetlobnih pojavov v gradbeništvu. • Podati matematične metode reševanja difuzijske in valovne enačbe z upoštevanjem robnih pogojev karakterističnih za zgradbe in druge gradbene objekte. • Podati pregled računalniških orodij primernih za numerično reševanje konkretnih problemov.	Objectives: • To expand knowledge and acquire new skills in applications of non-stationary thermodynamics, acoustics and photometry specific to buildings and urban environment. In particular this includes: • In-depth analysis of heat transfer via conduction, convection and radiation. • Sound and light effects in buildings and civil engineering in general. • Mathematical methods used for the solution of diffusion and wave equations subject to particular initial and boundary conditions. • Overview of available computer programs to solve the above problems.

Pridobljene kompetence:	Gained competences:
• Sposobnost fizikalno-matematične formulacije praktičnih problemov na teh področjih. • Pravilna izbira matematičnega orodja.	• Ability to formulate engineering problems using appropriate physical and mathematical methods in order to obtain quantitative results.

Predvideni študijski rezultati:	**Intended learning outcomes:**
• Pridobljeno poglobljeno znanje o prenosu toplote, vlage in zvoku ter hrupu v zaprtih prostorih. • Razumevanje matematičnih metod za opis in analizo fizikalnih procesov povezanih s toplotnimi in zvočnimi pojavi v zgradbah. • Osvojene računske spretnosti za analitično in numerično reševanje konkretnih problemov. • Doseženo znanje uporabljajo pri izdelavi diplomskega dela oz. v inženirski praksi. • Dobro razumevanje toplotnih in akustičnih pojavov v zgradbah je osnova za varčno rabo energije in primerno izbiro materialov za konstrukcijske sklope. • Sposobnost fizikalno-matematične formulacije procesov v ovojnem sklopu zgradbe. • Sposobnost izbire primernega matematičnega orodja za analizo praktičnih problemov. • Seznanitev z osnovnimi merilnimi metodami in inštrumenti.	• In-depth knowledge of heat and moisture transport across structural components in buildings, sound effects and noise in enclosures. • Understanding of physical processes involved in these phenomena and ability to use appropriate mathematical methods used for their analysis. • Application of the above skills in actual solving of practical problems or for writing research proposals. • Good understanding of heat and acoustic phenomena leads to economic use of energy in buildings and, in addition, to proper choice of materials for structural components. • Ability of exact physical and mathematical formulation of processes taking place in the building envelope. Selection of appropriate mathematical methods and tools for the analysis of practical problems. • Getting to know basic measuring methods and instruments.

Metode poučevanja in učenja:	**Learning and teaching methods:**
Predavanja, računski zgledi na vajah in uporaba računalniških programov za izračun prenosa toplote in vlage skozi konstrukcijske sklope.	Lectures and problem solving classes Application of a computer programs designed for solving heat and moisture transport problems.

Načini ocenjevanja:	**Delež/Weight**	**Assessment:**
Računske domače naloge	30,00 %	Computational home assignments
Poročila laboratorijskih vaj	30,00 %	Reports for laboratory excercises
Pisni izpit z ustnim zagovorom	40,00 %	Written exam with oral examination

Ocenjevalna lestvica:	**Grading system:**
5 - 10, pri čemer velja, da je pozitivna ocena od 6 - 10	5 - 10, a student passes the exam if he is graded from 6 to 10

Reference nosilca/Lecturer's references:

M. Ulaga, J. Mravlje and J. Kokalj, *Thermoelectric effect on diffusion in the two-dimensional Hubbard model*, Phys. Rev. B 108, 155118 (2023)
J. Kokalj, *Bad-metallic behavior of doped Mott insulators*, Phys. Rev. B 95, 041110(R) (2017)
M. Ulaga, J. Mravlje, P. Prelovsek and J. Kokalj, *Thermal conductivity and heat diffusion in the two-dimensional Hubbard model*, Phys. Rev. B 106, 245123 (2022)
D. Antolinc, K. Černe, Z. Jagličić, Risk of using capillary active interior insulation in a cold climate, Energies 14, 6890 (2021) .
J. Luzar, A. Padovnik, P. Štukovnik, M. Marinšek, Z. Jagličić, V. Bokan-Bosiljkov, J. Dolinšek, NMR spectroscopy-supported design and properties of air lime-white cement injection grouts for strengthening of historical masonry buildings, Construction & building materials 250, 1-11 (2020).
W. Oh, S. Hajra, S. Divya, S. Panda, Y. Oh, Z. Jagličić, P. Pakawanit, T. H. Oh, H. J. Kim, Contact electrification of porous PDMS-nickel ferrite composites for effective energy harvesting. Materials science & engineering. B, Solid-state materials for advanced technology 292, 1-7 (2023).

PROJEKTIRANJE NOSILNIH KONSTRUKCIJ STAVB II

UČNI NAČRT PREDMETA/COURSE SYLLABUS

Predmet:	Projektiranje nosilnih konstrukcij stavb II
Course title:	Design of building structures II
Članica nosilka/UL Member:	UL FGG

Študijski programi in stopnja	Študijska smer	Letnik	Semestri	Izbirnost
Stavbarstvo, druga stopnja, magistrski (od študijskega leta 2026/2027 dalje)	Ni členitve (študijski program)	1. letnik	2. semester	obvezni

Univerzitetna koda predmeta/University course code:	0106927
Koda učne enote na članici/UL Member course code:	1777

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

Nosilec predmeta/Lecturer:	doc. dr. Drago Saje, izr. prof. dr. Primož Može
Vrsta predmeta/Course type:	obvezni strokovni/obligatory professional

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

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:	**Prerequisites:**
Obveznih pogojev ni, vendar je delo študentov zelo oteženo, če nimajo osnovnega znanja statike, trdnosti in dimenzioniranja jeklenih ter lesenih elementov.	There are no mandatory prerequisites however the work of the student will be very difficult without the basic knowledge how to calculate internal forces and how to proportion the steel elements.

Vsebina:	**Content (Syllabus outline):**
Predavanja: Predavanja potekajo v dveh delih: Može: Projektiranje jeklenih stavb;	Lectures: Lectures are composed of two basic parts/courses:

Saje: Projektiranje lesenih in zidanih stavb; Projektiranje jeklenih stavb: Posebnosti zasnove jeklenih stavb (zasnove konstrukcijskih sistemov za prenos vertikalne in horizontalne obtežbe, zasnove stropov, načini zagotavljanje stabilnosti elementov in sistemov), Globalna analiza jeklenih okvirjev (metode, začetne nepopolnosti, modeliranje, dimenzioniranje elementov, presoja rezultatov), Posebnosti potresnoodpornega projektiranja jeklenih stavb (zasnova, duktilnost, ukrepi za zagotavljanje potresne odpornosti jeklenih stavb). Projektiranje lesenih in zidanih stavb: Posebnosti zasnove lesenih in zidanih stavb (zasnove konstrukcijskih sistemov za prenos vertikalne in horizontalne obtežbe, zasnove strehe, stropov, načini zagotavljanja stabilnosti elementov in sistemov). Analiza in dimenzioniranje nosilnih elementov stavbe (ostrešje, stropovi, stopnice, stebri, stene, temelji). Vaje in seminar: Pri posameznih temah se najprej izdela nekaj preprostih domačih nalog, ki podajo oziroma utrdijo znanja iz konstruiranja. Sledi seminarska naloga, ki obsega analizo in dimenzioniranje tipične jeklene eno-etažne stavbe (industrijska) in lesene/zidane stavbe, kjer študent obdela glavne konstrukcijske sisteme.	Može: Design of Steel Buildings; Saje: Design of Timber and Masonry Buildings; Design of Steel Buildings: Characteristics of the design of steel buildings (design of structural systems for the transfer of vertical and horizontal loads, the design of floor structural systems, ensuring stability of elements and systems), Global analysis of steel frames (methods, initial imperfections, modeling, design of elements, assessment of results), Particularities of earthquake design of steel buildings (design, ductility , measures to ensure earthquake resistance of steel buildings). Design of Timber and Masonry buildings: Characteristics of the design of timber and masonry buildings (design of structural systems for the transfer of vertical and horizontal loads, the design of roof structural system, the design of floor structural systems, ensuring stability of elements and systems), Analysis and design of load-bearing elements of the building (roof, floors, stairs, columns, walls, foundations). Tutorials and seminar: Some simple tutorials will be made to enhance the knowledge related to specific topics of analysis and design of building structures. Then follow seminar work, which includes analysis and design of typical one-storey steel building (industrial) and timber/masonry building, where the student processes the main construction systems.

Temeljna literatura in viri/Readings:

D. Beg, A. Pogačnik. 2009. Priročnik za projektiranje gradbenih konstrukcij po evrokod standardih. Ljubljana, IZS.
ESDEP - The European Steel Design Education Programme, spletna učilnica UL FGG.
Luís Simões da Silva, Rui Simões, Helena Gervásio. 2016. Design of Steel Structures: Eurocode 3: Design of
Steel Structures, Part 1-1 – General Rules and Rules for Buildings. ECCS – European Convention for Constructional Steelwork
Thelanderson, S., Larsen, H.J. (urednika). 2003. Timber Engineering. John Wiley & Sons Inc.

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

• Razložiti in naučiti standardne postopke za zagotavljanje mehanske odpornosti in stabilnosti jeklenih, lesenih in zidanih konstrukcij stavb iz različnih materialov. Pridobljene kompetence: • Poznavanje prednosti uporabe posameznih konstrukcijskih materialov, oziroma njihove kombinacije pri izbiri optimalne zasnove konstrukcijskega sistema. • Razumevanje mehanizmov prenosa obtežbe preko konstrukcijskih sklopov v temeljna tla in osnovnih principov zagotavljanja potresne odpornosti konstrukcij stavb. • Sposobnost uporabe računskih metod in programske opreme za projektiranje nosilnih konstrukcij stavb in njihovih temeljev. • Poznavanje sodobnih IT podprtih orodij v projektiranju.	• To present, explain and teach the procedures providing mechanical resistance and stability of building structures made of steel, timber or masonry. Gained competences: • The ability to choose the “optimum” structural system considering the advantages of different materials and their combinations. • The competence of understanding the load transfer through the structure into the foundation soil. • The competence of understanding the basic factors contributing to earthquake resistance of structures. • The ability to use computer software in the design of structural systems of buildings. • The ability to use the IT supported tools in design.

Predvideni študijski rezultati:	**Intended learning outcomes:**
• Razumevanje delovanja konstrukcijskih sklopov in konstrukcije kot celote ter prenosa obtežbe v temeljna tla. • Razumevanje dejavnikov za zagotavljanje duktilnosti in nosilnosti potresno odpornih konstrukcij in znanje oblikovanja ustreznih konstrukcijskih detajlov. • Sposobnost uporabe računskih metod in programske opreme za projektiranje nosilnih konstrukcij stavb in njihovih temeljev. • Sposobnost identifikacije in kvantifikacije kritičnih obtežb. • Kompetentna uporaba evropskih standardov za projektiranje konstrukcij Eurokod. • Identifikacija in reševanje problemov, kritična analiza, argumentirana izbira med več možnostmi, sinteza, delo v skupini.	• Understanding the role of the structure and its subassemblies in the transfer of loads into the foundation soil. • Understanding of the key factors contributing to the ductility and strength of earthquake resistant structures. • The knowledge to choose and produce suitable structural details. • The use of the design methods and computer software for structural systems (including foundations). • The knowledge to identify and quantify critical loads on structures. • The knowledge of the competent use of the European standards for the design of structures – Eurocodes. • Identification and solving of problems; critical assessment and analysis; argued choice between several options; ability of the synthesis; and working in a group.

Metode poučevanja in učenja:	**Learning and teaching methods:**
Predmet temelji na več sodobnih metodah poučevanja, kot so projektno učenje, delo v skupini, poučevanje s poudarkom na interesu študentov in podajanje vsebin v času, ko so potrebne za delo.	The course is based on several up-to-date teaching methods – project based learning, team work, student centred teaching and just-in-time lectures.

Načini ocenjevanja:	Delež/Weight	Assessment:
Sprotno delo: delo na seminarski nalogi in domačih nalogah	50,00 %	Course work and home-works
Zagovor izdelanih nalog	50,00 %	Presentation and argumentation of the project work.
Študentje, ki pri tem ne uspejo, imajo možnost poprave v obliki (pisnega) izpita		Unsuccessful students have an additional option in the form of a written exam.

Ocenjevalna lestvica:	Grading system:
5 - 10, pri čemer velja, da je pozitivna ocena od 6 - 10	5 - 10, a student passes the exam if he is graded from 6 to 10

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.
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.
ČERMELJ, Blaž, SINUR, Franc, MOŽE, Primož, BEG, Darko. Ciklično obnašanje varjenih ojačanih spojev prečka-steber, eksperimentalni testi = Cyclic behaviour of welded stiffened beam-to-column joints, experimental tests. Gradbeni vestnik : glasilo Zveze društev gradbenih inženirjev in tehnikov Slovenije, ISSN 0017-2774. [Tiskana izd.], maj 2015, letn. 64, str. 114-122, ilustr.

LOPATIČ, Jože, SAJE, Drago, SAJE, Franc. Creep of timber structures. International journal for engineering modelling, ISSN 1330-1365, 2005, vol. 18, no. 1/2, str. 1-10.
SAJE, Drago, BANDELJ, Branko, ŠUŠTERŠIČ, Jakob, LOPATIČ, Jože, SAJE, Franc. Shrinkage of polypropylene fibre reinforced high performance concrete. Journal of materials in civil engineering, ISSN 0899-1561, 2011, vol. 23, iss. 7, str. 941-952.
SAJE, Drago, SAJE, Franc. Sanacija cerkve v Šentjurju na Dolenjskem. V: SAJE, Franc (ur.), LOPATIČ, Jože (ur.). Zbornik 18. zborovanja gradbenih konstruktorjev Slovenije, Bled,

ENERGIJSKA UČINKOVITOST STAVB

UČNI NAČRT PREDMETA/COURSE SYLLABUS

Predmet:	Energijska učinkovitost stavb
Course title:	Energy efficiency of buildings
Članica nosilka/UL Member:	UL FGG

Študijski programi in stopnja	Študijska smer	Letnik	Semestri	Izbirnost
Stavbarstvo, druga stopnja, magistrski (od študijskega leta 2026/2027 dalje)	Ni členitve (študijski program)	2. letnik	1. semester	obvezni

Univerzitetna koda predmeta/University course code:	0035052
Koda učne enote na članici/UL Member course code:	1471

Predavanja /Lectures	Seminar /Seminar	Vaje /Tutorials	Klinične vaje /Clinical tutorials	Druge oblike študija /Other forms of study	Samostojno delo /Individual student work	ECTS
45	15	75	0	0	135	9

Nosilec predmeta/Lecturer:	Mitja Košir
Vrsta predmeta/Course type:	obvezni strokovni/obligatory professional

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

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

Vsebina:	Content (Syllabus outline):
Predavanja: Vloga energije in energijske učinkovitosti v grajenem okolju. Bioklimatske možnosti in priložnosti. Inženirski pristopi za zagotavljanje energijske učinkovitosti stavb. Metodologije za izračunavanje integrirane energijske učinkovitosti stavb: postopki, dimenzioniranje	Lectures: The role of energy and energy efficiency in the built environment. Bioclimatic possibilities and opportunities. Engineering approaches for energy-efficient buildings. Methodology for the calculation of integrated energy performance of buildings: methods, design of thermal insulation

toplotne izolacije: stavba, konstrukcijski sklopi, transparentni elementi. Toplotni mostovi. Uporaba minimalnih zahtev glede energijske učinkovitosti novih in prenovljenih stavb. Strategije, ukrepi in tehnologije za zagotavljanje energijske učinkovitosti na nivoju konstrukcijskih sklopov in stavbe kot celote. Zaščita stavb pred pregrevanjem. Načini uporabe sončne energije v stavbah. Pravni in strateški okviri učinkovite rabe energije v stavbah. Energetska certifikacija stavb. Vaje: Analiza podnebnih danosti, vključno z upoštevanjem globalnega segrevanja. Potencial energije sončnega sevanja stavbnega ovoja. Zasnova netransparentnega in transparentnega stavbnega ovoja. Računske metode za stacionarno in dinamično toplotno analizo konstrukcijskih sklopov, oken in stavb. 2D analiza temperaturnega polja fasadnega pasu in toplotni mostovi. Energijsko modeliranje stavb. Dinamične simulacije toplotnega odziva stavb (urna metoda). Primerjalne analize toplotnega odziva na izbranih stavbah, z uporabo ustrezne programske opreme.	on the level of building and individual building envelope component. Thermal bridges. Application of minimum energy performance requirements for new and retrofitted buildings. Strategies, measures and technologies to ensure energy efficiency at the level of building envelope components and the building as a whole. Overheating protection of buildings. Solar energy utilization in buildings. Legal and strategic frameworks for efficient energy use in buildings. Energy certification of buildings. Tutorial: Analysis of climate data, including consideration of global warming. Solar radiation energy potential of the building envelope. Design of opaque and transparent building envelope. Computational methods for stationary and transient thermal analysis of building envelope components, windows and buildings. 2D analysis of the thermal field and thermal bridges in building envelope. Building energy modelling. Dynamic simulations of building thermal response (hourly method). Comparative analyses of thermal response on selected buildings, using appropriate software.

Temeljna literatura in viri/Readings:

Szokolay, S.V. 2014. Introduction to architectural science: the basis of sustainable design. 3rd edn. New York, NY, Routledge.DeKay, M., Brown, G. Z. 2014. Sun, wind & light. Hoboken, Wiley.
Košir, M., 2019. Climate Adaptability of Buildings: Bioclimatic Design in the Light of Climate Change, ISBN 978-3-030-18455-1, Springer.
La Roche, P. 2017. Carbon-neutral architectural design, ISBN 978-1-4987-1429-7, Taylor & Francis.
Lechner, N. 2014. Heating, cooling, lighting : sustainable design methods for architects. New York, John Wiley & Sons.
Athienitis, A. K. 2015. Modeling, design, and optimization of net-zero energy buildings. Berlin, Ernst & Sohn.
Schittich, C. (urednik.). 2003. Solar Architecture: Strategies, Visions, Concepts. Birkhauser.
Medved, S., Arkar C., Domjan, S. 2019. Sustainable technologies for nearly-zero energy buildings: Design and evaluation methods, ISBN 978-3-030-02822-0, Springer.
Področna zakonodaja.
Študijsko gradivo dostopno na: e-učilnici UL FGG

Cilji in kompetence:	**Objectives and competences:**
Cilji: • Regulacija in optimizacija potrebne energije za ogrevanje stavb. • Regulacija in optimizacija potrebne energije za hlajenje stavb.	Objectives: • To regulate and optimise heating energy need in buildings. • To regulate and optimise cooling energy need in buildings.

• Upoštevanje vplivov lokacije stavbe, orientacije in geometrije ter lastnosti stavbnega ovoja na rabo energije. • Končni cilj je omogočiti učinkovito rabo energije v grajenem okolju z obzirom na uporabnika in lokacijske danosti. Pridobljene kompetence: • Obvladanje projektiranja in dimenzioniranja toplotne zaščite in zaščite pred pregrevanjem stavb. • Sposobnost uporabe predpisov in standardov s področja energijske učinkovitosti stavb. • Sposobnost modeliranja energijskih modelov stavb in izvedbe dinamičnih simulacij. • Sposobnost uporabe ustreznih orodij za optimizacijo rabe energije na ravni stavbe in njenega ovoja.	• Consideration of the effects of building location, orientation, geometry and building envelope properties on the energy use. • The final objective is to enable efficient energy use in the built environment, considering occupants and local conditions. Gained competences: • Students will master the design process regarding thermal protection and protection against overheating of buildings. • Ability to apply and use relevant rules and standards in the field of energy efficiency of buildings. • Ability to model building energy models and perform dynamic simulations. • Ability to use appropriate tools for the optimization of energy performance of the entire building as well as its components.

Predvideni študijski rezultati:	**Intended learning outcomes:**
• Sposobnost identifikacije vplivnih faktorjev, ki oblikujejo toplotni odziv stavbe in njenih konstrukcijskih sklopov z uporabo sodobnih metod načrtovanja, dimenzioniranja, izbora tehnologij in materialov. Razumevanje povezav med njimi in stopnje njihovih pomembnosti. • Učinkovita koordinacija razpoložljivih materialov in tehnologij , ki vplivajo na porabo toplotne energije pri načrtovanju energijsko učinkovitih stavb. • Sposobnost samostojne ocene položaja in vloge obravnavnih elementov v sistemu okolje/človek/stavba in identifikacija medsebojnih povezav. • Spretnosti uporabe domače in tuje literature in drugih virov. • Zbiranja in interpretiranja podatkov. • Identifikacija in reševanje problemov, kritična analiza, sinteza, delo v skupini.	• Ability to identify influential factors that shape the thermal response of the building and its components using contemporary methods of design, dimensioning, choice of technologies and materials. Understanding the links between them and their relative level of importance. • Effective coordination between available materials and technologies, which affect the use of heating energy in the design of energy-efficient buildings. • Ability to assess the situation and the role of individual elements in the environment/man/building system, as well as identification of interrelations. • Ability to use national and international relevant literature and other sources. • Collecting and interpreting data. • Identification of problems and their solving, critical analysis, synthesis, group work.

Metode poučevanja in učenja:	**Learning and teaching methods:**
Predavanja, laboratorijske vaje in seminarske vaje. Projektni pristop.	Lectures, laboratory exercises and seminar exercises. Project oriented approach.

Načini ocenjevanja:	**Delež/Weight**	**Assessment:**
Ocena izdelka vaj	70,00 %	Project executed during tutorial and lab work

Pisni izpit	30,00 %	Written exam

Ocenjevalna lestvica:	**Grading system:**
5 - 10, pri čemer velja, da je pozitivna ocena od 6 - 10	5 - 10, a student passes the exam if he is graded from 6 to 10

Reference nosilca/Lecturer's references:

PAJEK, Luka, JEVRIĆ, Marija, ĆIPRANIĆ, Ivana, KOŠIR, Mitja. A multi-aspect approach to energy retrofitting under global warming : a case of a multi-apartment building in Montenegro. Journal of building engineering. [Online ed.]. jan. 2023, art. 105462, letn. 63, 19 str., ilustr. ISSN 2352-7102., doi: 10.1016/j.jobe.2022.105462.
PAJEK, Luka, KOŠIR, Mitja. Strategy for achieving long-term energy efficiency of European single-family buildings through passive climate adaptation. Applied energy. 2021, letn. 297 - 117116, str. 1-15, ilustr. ISSN 0306-2619., doi: 10.1016/j.apenergy.2021.117116.
KOŠIR, Mitja, IGLIČ, Nataša, KUNIČ, Roman. Optimisation of heating, cooling and lighting energy performance of modular buildings in respect to locations climatic specifics. Renewable energy, ISSN 0960-1481. [Print ed.], 2018, letn. 129, dec., str. 527-539, ilustr., doi: 10.1016/j.renene.2018.06.026. [COBISS.SI-ID 8491361]

KAKOVOST NOTRANJEGA OKOLJA

UČNI NAČRT PREDMETA/COURSE SYLLABUS

Predmet:	Kakovost notranjega okolja
Course title:	Indoor environmental quality
Članica nosilka/UL Member:	UL FGG

Študijski programi in stopnja	Študijska smer	Letnik	Semestri	Izbirnost
Stavbarstvo, druga stopnja, magistrski (od študijskega leta 2026/2027 dalje)	Ni členitve (študijski program)	2. letnik	1. semester	obvezni

Univerzitetna koda predmeta/University course code:	0035053
Koda učne enote na članici/UL Member course code:	1345

Predavanja /Lectures	Seminar /Seminar	Vaje /Tutorials	Klinične vaje /Clinical tutorials	Druge oblike študija /Other forms of study	Samostojno delo /Individual student work	ECTS
45	15	75	0	0	135	9

Nosilec predmeta/Lecturer:	Mateja Dovjak
Vrsta predmeta/Course type:	obvezni strokovni/obligatory professional

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

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

Vsebina:	Content (Syllabus outline):
Predavanja Definicija vplivnih faktorjev sistema »uporabnik-stavba-tehnološki sistemi-lokacija« na zdrave in udobne razmere v stavbah; Vitruvijevi principi. Problematika necelovitega načrtovanja stanovanskih in nestanovanjskih stavb (študije primerov); pomen transdiciplinarne obravnave.	Lectures Definition of influencing factors of the system "user-building-technical systems-location" on healthy and comfortable conditions; the Vitruvian Triad. Problems of nonholistic design of residential and non-residential buildings

Mednarodne in nacionalne zakonske zahteve in priporočila na področju higiene, zdravja in okolja z Uredbo (EU) 2021/241 o vzpostavitvi Mehanizma za okrevanje in odpornost in Novim evropskim Bauhausom (EC, 2021). Fiziologija človeka: fiziološki procesi, homeostaza, pomen optimalnih razmer za zdravje, udobje in storilnost uporabnika stavbe. Toplotno udobje: toplotna bilanca človeškega telesa in parametri toplotnega okolja, metode vrednotenja toplotnega okolja in adaptivni modeli parametrov notranjega okolja. Psihrometrična karta. Medsebojen vpliv okolje/človek/stavba. Kakovost zunanjega in notranjega zraka: onesnaževala, viri, mejne vrednosti, metode vrednotenja kakovosti zraka in prezračevanje. Zvočna zaščita stavb: zvočna izolirnost zunanjih in notranjih elementov, prostorske akustika, hrup obratovalne opreme, metode vrednotenja. Sindrom bolne stavbe, bolezni povezane s stavbami, dejavniki tveganja, metode preprečevanja. Seminar Gradbeni proizvodi in možni vplivi na zdravje. Morfologija načrtovanja in tehnologije kot podpora za človekovo delovanje, dobro počutje in zdravje posameznika. Vaje Uporaba znanja na konkretnem primeru v stavbi z poslabšano kakovostjo notranjega okolja: meritve in simulacije izbranih parametrov kakovostnih notranjih razmer, analiza stanja in določitev ukrepov.	(case studies); the importance of transdisciplinary approach. International and national legal requirements and recommendations on hygiene, health and environment with Regulation (EU) 2021/241 establishing the Recovery and Resilience Facility and New European Bauhaus (EC, 2021). Human physiology: physiological processes and homeostasis, the importance of optimal conditions for health, comfort and productivity. Thermal comfort: human body heat balance and thermal environment parameters, evaluation methods and adaptive models of indoor environmental parameters. Psychrometric chart. Environment/human/building interactions. Indoor and outdoor air quality: pollutants, sources, limit values, air quality evaluation methods and ventilation. Sound insulation of buildings: external and internal elements, room acoustics, the noise of operating equipment, evaluation methods. Sick building syndrome, building-related illness, risk factors, prevention methods. Seminar Construction products and potential health effects. Morphology of design and technology as a support for human performance, wellbeing and individual health. Tutorial Apply knowledge on a concrete example in a building with a deteriorated indoor environmental quality: measurements and simulations of selected parameters of indoor envionmental quality, analysis of the situation and determination of measures.

Temeljna literatura in viri/Readings:

McMullan, R. 2007. Environmental science in building. New York, Palgrave Macmillan.
Dovjak, M., Kukec, A. 2019. Creating healthy and sustainable buildings: an assessment of health risk factors. Cham: Springer Open.
Yassi, A., Kjellstrom, T., de Kok. T., Guidotti, T.L. 2001. Basic Environmental Health. Oxford: Oxford University.
Pheasant, S., 1991. Ergonomics, work and health. London, MacMillan Press.
Uredba (EU) 2021/241 Evropskega parlamenta in Sveta z dne 12. februarja 2021 o vzpostavitvi Mehanizma za okrevanje in odpornost.
COM(2021) 573 final, 2021. Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions Empty. New European Bauhaus. Brussels, European Commission.

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. e-učilnica UL FGG/e-classroom UL FGG.

Cilji in kompetence:	**Objectives and competences:**
Cilji: • Poznati in razumeti posledice necelovitega načrtovanja stavb na zdravje, udobje in storilnost uporabnikov. • Poznati in razumeti vplivne faktorje lokacije, stavbe, tehnoloških sistemov in uporabnika na kakovostno notranje okolje. • Poglobiti in dopolniti splošna teroretična znanja z naprednimi specifičnimi znanji, ki združujejo inženirske vede, vedenjske znanosti in okoljsko zdravje (terminologija). • Poznati metodološke pristope vrednotenja kakovostnih notranjih razmer po področjij glede na raznolikost stavb in uporanikov. • Podati pregled možnih rešitev za zdrave in udobne stavbe. Pridobljene kompetence: • Razumevanje procesov delovanja posameznih vplivnih faktorjev sistema stavbe in človeka in njihovo interaktivnost. • Sposoben je uporabljati računske metode in programsko opremo za področje oblikovanja notranjega okolja. • Obvlada prenos sistema zunanje okolje-ovoj-notranje okolje človek v konceptualizacijo realne stavbe (navezovanje na ostale gradbeno-fizikalne vplive). • Sposobnost koncipiranja naprednih rešitev za stavbo in širše grajeno okolje na osnovi odločitvene analize v morfologiji načrtovanja stavb.	Objectives: • To understand the consequences of nonholistic building design on users' health, comfort, and productivity. • To know and understand the factors that influence the location, the building, technological systems, and the user on the quality of the indoor environment. • To deepen and supplement general theoretical knowledge with advanced specific knowledge that combines engineering sciences, behavioural sciences and environmental health (terminology). • To know the methodological approaches of evaluating the indoor environmental quality by area according to the variety of buildings and occupants. • Give an overview of possible solutions for healthy and comfortable buildings. Gained competences: • Understanding the influencing factors inside the »building and user« system and their interactivity. • Understanding the interactive impacts of defined influencing factors. • Ability to use calculation methods and computer software to design a healthy and comfortable indoor environment. • Student masters the transfer between analyzed systems: "outdoor environment-building envelope-indoor environment-human wellbeing" (in the framework of conceptualization of specific building case; link to other building physics parameters). • Ability to conceive advanced solutions for the building and broader built environment based on decision analysis in the morphology of building design.

Predvideni študijski rezultati:	**Intended learning outcomes:**
Znanje in razumevanje: študent pridobi in poglobi znanje in razumevanje za:	Knowledge and understanding: the student acquires and deepens knowledge and understanding for:

• Delovanje posameznih vplivnih faktorjev notranjega okolja na počutje, zdravje in storilnost uporabnikov, sposobnost ocene odziva stavbe in uporabnikov na predlagane ukrepe. • Uporabo računskih metod in programske opreme za analizo obravnavanih elementov kakovosti notranjega okolja. • Samostojno oceno položaja in vloge obravnavnih elementov v sistemu okolje/človek/stavba. • Identifikacijo medsebojnih povezav v sistemu okolje/človek/stavba. • Spretnost uporabe domače in tuje literature in drugih virov. • Zbiranje in interpretiranjo podatkov. • Identifikacijo in reševanje problemov na podlagi zananstvenih dokazov, kritična analiza, sinteza, delo v skupini.	• Understanding the functioning of the influencing factors of the internal environment on user health, comfort, and productivity, as well as the ability to evaluate the building and user response to the implemented measures. • Application of calculation methods and computer software to analyze the evaluated elements of indoor environmental quality. • Ability to evaluate the status and role of analyzed elements in the system "environment/human/building". • Identification of connections in the system "environment/human/building". • Skills for the review of relevant literature sources and other references (national, international). • Collecting and interpreting the data. • Problem identification, problem-solving with an evidenced-based approach, critical analysis, synthesis, and teamwork.

Metode poučevanja in učenja:	**Learning and teaching methods:**
Predavanja, seminarji, laboratorijske vaje.	Lectures, seminars, clinical tutorials.

Načini ocenjevanja:	**Delež/Weight**	**Assessment:**
Ocena izdelka vaj	70,00 %	Seminar and laboratory work.
Pisni izpit	50,00 %	Written exam

Ocenjevalna lestvica:	**Grading system:**
5 - 10, pri čemer velja, da je pozitivna ocena od 6 - 10	5 - 10, a student passes the exam if he is graded from 6 to 10

Reference nosilca/Lecturer's references:

DOVJAK, Mateja, SHUKUYA, Masanori, KRAINER, Aleš. User-centred healing-oriented conditions in the design of hospital environments: 2140. International journal of environmental research and public health. [Print ed.]. 2018, letn. 15, št. 10, str. 1-28, ilustr. ISSN 1661-7827. DOI: 10.3390/ijerph15102140. [COBISS.SI-ID 8537441]
DOVJAK, Mateja, VIRANT, Barbara, KRAINER, Aleš, ŠIJANEC-ZAVRL, Marjana, VAUPOTIČ, Janja. Determination of optimal ventilation rates in educational environment in terms of radon dosimetry. International journal of hygiene and environmental health. maj 2021, vol. 234, 113742, str. 1-11 + [13], ilustr. ISSN 1438-4639. DOI: 10.1016/j.ijheh.2021.113742. [COBISS.SI-ID 59477251]
SCHWEIKER, Marcel, KOLARIK, Jakub, DOVJAK, Mateja, SHUKUYA, Masanori. Unsteady-state human-body exergy consumption rate and its relation to subjective assessment of dynamic thermal environments. Energy and buildings. [Print ed.]. 15. mar. 2016, letn. 116, str. 164-180, ilustr. ISSN 0378-7788. [COBISS.SI-ID 7618145]

VODNO UČINKOVITE STAVBE IN NASELJA

UČNI NAČRT PREDMETA/COURSE SYLLABUS

Predmet:	Vodno učinkovite stavbe in naselja
Course title:	Water-efficient buildings and cities
Članica nosilka/UL Member:	UL FGG

Študijski programi in stopnja	Študijska smer	Letnik	Semestri	Izbirnost
Stavbarstvo, druga stopnja, magistrski (od študijskega leta 2026/2027 dalje)	Ni členitve (študijski program)	2. letnik	1. semester	obvezni

Univerzitetna koda predmeta/University course code:	0109793
Koda učne enote na članici/UL Member course code:	1778

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

Nosilec predmeta/Lecturer:	izr. prof. dr. Nataša Atanasova
Vrsta predmeta/Course type:	obvezni strokovni/obligatory professional

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

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

Vsebina:	Content (Syllabus outline):
Predavanja: V okviru tega predmeta so prikazani najnovejši pristopi/koncepti za ravnanje z viri (predvsem z vodo in hranili v vodi) v stavbah in na nivoju naselij.	**Lectures:** This course presents the latest approaches/concepts for resource management (especially water and nutrients in water) in buildings and at neighborhood scale. 1. Impact of the urban environment/cities on natural resources: the urban metabolism.

1. Vpliv urbanega okolja/mest na stanje naravnih virov: metabolizem mest. Prevladujoči koncepti ravnanja z naravnimi viri. 2. Urbani vodni krog in urbana vodna infrastruktura. Prevladujoči koncepti ravnanja z vodo v mestih, lastnosti in karakteristike (linearne) vodne infrastrukture. 3. Količinske in kakovostne značilnosti pitne, odpadne in padavinske vode. Osnovni pojmi za vrednotenje masnih tokov: voda in hranila. 4. Zasnova decentralizacije urbane vodne infrastrukture: pomen, prednosti in težave. Integracija in povezava vodne in zelene infrastrukture. Sonaravne rešitve. Voda v krožnem gospodarstvu. Standardi na področju. 5. Primerni koncepti ravnanja z vodo v različnih tipih stavb. Alternativni vodni viri: sistemi za rabo deževnice, sistemi za ločevanje na viru in ponovno uporabo sive vode. Potencial črne vode. Osnove za dimenzioniranje tehnologij za primerno čiščenje vode in za obnovo in ponovno rabo virov: voda in hranila v stavbah. 6. Primerni koncepti za padavinsko vodo na nivoju naselja: zadrževanje, ponikanje, evapotranspiracija. Dimenzioniranje ukrepov: deževni vrtovi, infiltracijski elementi, suhi in mokri zadrževalniki. 7. Dodatne možnosti in koristi ponovne uporabe vode in hranil v stavbah: urbano kmetijstvo, zelene strehe in stene, evaporativno hlajenje. **Seminar:** Študentje izberejo določen objekt (hiša, hotel, industrijsko poslopje) ali skupino objektov in izdelajo zasnovo za zbiranje, obdelavo in ponovno rabo vode in/ali hranil oz. zasnovo, ki pelje k učinkovitemu zapiranju snovnih tokov.	Prevailing concepts of natural resource management. 2. Urban water cycle and urban water infrastructure. Predominant urban water management concepts, Characteristics of (linear) water infrastructure. 3. Quantity and quality of drinking water, wastewater and rainwater. Basic concepts for the evaluation of mass flows: water and nutrients. 4. Decentralisation of urban water infrastructure: importance, advantages and problems. Integration and linking of water and green infrastructure. Nature based solutions. Water in the circular economy. Standards in the field of source separation and reuse. 5. Water management concepts in different building types. Alternative water sources include rainwater harvesting systems, source separation systems, and reuse of greywater. The potential of black water. Design of technologies for appropriate water treatment and for resource recovery and reuse: water and nutrients in buildings. 6. Concepts for rainwater management at neighborhood level: retention, sinking, evapotranspiration. Designing of measures: rain gardens, infiltration elements, dry and wet retention ponds. 7. Additional benefits of water and nutrient reuse in buildings: urban agriculture, green roofs and walls, evaporative cooling. **Seminary work:** Students select a building (a house, hotel, industrial complex) or a group of buildings and propose collection, treatment and reuse of water and/or nutrients i.e. a closed-loop concept for water management.

Temeljna literatura in viri/Readings:

Knjižni viri (izbrana poglavja):

Malcolm J. Brandt; K. Michael Johnson; Andrew J. Elphinston; Don D. Ratnayaka (2016) Twort's Water Supply, Seventh Edition. Butterworth-Heinemann, 2016.
Larsen, T. A., Kai M. Udert and Judit Lienert, Editors. Source Separation and Decentralization for Wastewater Management, 2013, IWA Publising. Izbrana poglavja.
Metcalf & Eddy, Inc. Wastewater Engineering : Treatment and Reuse. Boston :McGraw-Hill, 2003. Print. Izbrana poglavja.
MASI, Fabio, LANGERGRABER, Günter, SANTONI, Marcello, ISTENIČ, Darja, ATANASOVA, Nataša, BUTTIGLIERI, Gianluigi. Possibilities of nature-based and hybrid decentralized solutions for reclaimed water reuse. V: VERLICCHI, Paola (ur.). *Wastewater treatment and reuse - present and*

future perspectives in technological developments and management issues. Cambridge [etc.]: Elsevier: Academic Press, 2020. Str. 145-187, ilustr. Advances in Chemical Pollution, Environmental Management and Protection, Vol. 5. ISBN 978-0-12-820170-1, ISBN 978-0-12-820171-8. ISSN 2468-9289. https://www.sciencedirect.com/science/article/pii/S2468928920300046, DOI: 10.1016/bs.apmp.2020.07.004. [COBISS.SI-ID 29088771]
PINEDA-MARTOS, Rocío, ANDREUCCI, Maria-Beatrice, ATANASOVA, Nataša, BAGANZ, Gösta F. M., CALHEIROS, Christina S. C., CASTELLAR, Joana A. C., ĐOLIĆ, Maja, ISTENIČ, Darja, LORENZO LÓPEZ, Antonia María, RIBEIRO, Ana Rita L., LANGERGRABER, Günter. How nature-based solutions can contribute to enhance circularity in cities : chapter 19. V: VASCONCELOS, Clara (ur.), CALHEIROS, Christina S. C. (ur.). *Enhancing environmental education through nature-based solutions*. Cham: Springer, 2022. Str. 313-343, ilustr. Integrated science (Online), 4. ISBN 978-3-030-91843-9. ISSN 2662-947X. https://link.springer.com/chapter/10.1007/978-3-030-91843-9_19, DOI: 10.1007/978-3-030-91843-9_19. [COBISS.SI-ID 98265091].
Woods Ballard, B., Wilson, S., Udale-Clarke, H., Illman, S., Scott, T., Ashley, R., Kellagher, R., Martin, P., Jefferies, C., Bray, R., Shaffer, P., 2015. The SUDS manual. CIRIA, London, UK, London. https://doi.org/London C697

Cilji in kompetence:	**Objectives and competences:**
Cilji: Cilj predmeta je študentom dati dodatna znanja in spretnosti pri reševanju najbolj kompleksnih okoljskih problemov. **Kompetence:** Študent se nauči prepoznavati kdaj je primerno ravnanje z viri (voda in hranila) po principu zapiranja zank. Pozna koncepte in nekatere tehnologije, ki to omogočajo na nivoju stavbe in/ali naselja. Pozna koncepte in rešitve za ločevanje na viru in ponovno uporabo sive vode v stavbah. Pozna koncepte in rešitve za učinkovito rabo padavinske vode. Zna ovrednotiti rešitve v širšem kontekstu, glede na lokalne pogoje.	**Goals:** Introduce students to additional knowledge and skills for solving complex environmental problems. **Competences:** Students will learn to estimate the applicability of closed-loop management of resources (water and nutrients) in a building and/or cities. The student is familiar with the technologies for closed loop management at the building and/or settlement level. The student knows (1) concepts and solutions for source separation and reuse of grey water in buildings, (2) concepts and solutions for the efficient management and use of rainwater (3) how to evaluate solutions in a broader context, taking into account local conditions.

Predvideni študijski rezultati:	**Intended learning outcomes:**
Znanje in razumevanje: Razumevanje materialnih tokov (voda in hranila) in uporaba konceptov in tehnologij za njihovo optimizacijo. **Prenosljive spretnosti:** Izvajanje projektov za učinkovito rabo vode po principu zapiranja snovnih tokov.	**Knowledge and understanding:** Understanding of material (water-nutrients) flows and concepts and technologies for closing the loop. **Skills:** Implementation of projects for water efficient buildings following the closed-loop principle.

Metode poučevanja in učenja:	**Learning and teaching methods:**
Predavanja, terenski ogledi in uporaba pridobljenih znanj pri individualnih seminarskih vaj.	Lectures and use of knowledge in elaborating seminary work.

Načini ocenjevanja:	Delež/Weight	Assessment:
Način (pisni izpit, ustno izpraševanje, naloge, projekt):		Type (examination, oral, coursework, project):
Vaje	30,00 %	Exercises
Seminarska naloga	30,00 %	Project Report
Izpit	40,00 %	Exam

Ocenjevalna lestvica:	Grading system:
5 - 10, pri čemer velja, da je pozitivna ocena od 6 - 10	5 - 10, a student passes the exam if he is graded from 6 to 10

Reference nosilca/Lecturer's references:

ATANASOVA, Nataša, ISTENIČ, Darja, LANGERGRABER, Günter, et al. Nature-based solutions and circularity in cities. *Circular economy and sustainability*. 17 March 2021, str. 1-14, ilustr. ISSN 2730-5988. https://link.springer.com/article/10.1007/s43615-021-00024-1, https://repozitorij.uni-lj.si/IzpisGradiva.php?id=127153&lang=slv, DOI: 10.1007/s43615-021-00024-1. [COBISS.SI-ID 57776131]

NIKA, Elisa, GUSMAROLI, Lucia, GHAFOURIAN, Matia, ATANASOVA, Nataša, BUTTIGLIERI, Gianluigi, KATSOU, Evina. Nature-based solutions as enablers of circularity in water systems - a review on assessment methodologies, tools and indicators. *Water research*. 2020, letn. 183, št. sept. 115988, str. 1-19, ilustr. ISSN 0043-1354. https://www.sciencedirect.com/science/article/pii/S004313542030525X?via%3Dihub, DOI: 10.1016/j.watres.2020.115988. [COBISS.SI-ID 23012099]

LANGERGRABER, Günter, CASTELLAR, Joana A. C., PUCHER, Bernhard, BAGANZ, Gösta F. M., MILOŠEVIĆ, Dragan, ANDREUCCI, Maria-Beatrice, KEARNEY, Katharina, PINEDA-MARTOS, Rocío, ATANASOVA, Nataša. A framework for addressing circularity challenges in cities with nature-based solutions. *Water*. 2021, letn. 13, št. 17, art. 2355, [31] str., ilustr. ISSN 2073-4441. https://www.mdpi.com/2073-4441/13/17/2355, https://repozitorij.uni-lj.si/IzpisGradiva.php?id=133435, DOI: 10.3390/w13172355. [COBISS.SI-ID 85625091]

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

RADINJA, Matej, COMAS, Joaquim, COROMINAS, Lluis, ATANASOVA, Nataša. Assessing stormwater control measures using modelling and a multi-criteria approach. *Journal of environmental management*. 2019, letn. 243, št. avg., str. 257-268, ilustr. ISSN 0301-4797. https://www.sciencedirect.com/science/article/pii/S0301479719305699, DOI: 10.1016/j.jenvman.2019.04.102.

BREZEMISIJSKE IN PAMETNE STAVBE

UČNI NAČRT PREDMETA/COURSE SYLLABUS

Predmet:	Brezemisijske in pametne stavbe
Course title:	Zero-emission and smart buildings
Članica nosilka/UL Member:	UL FGG

Študijski programi in stopnja	Študijska smer	Letnik	Semestri	Izbirnost
Stavbarstvo, druga stopnja, magistrski (od študijskega leta 2026/2027 dalje)	Ni členitve (študijski program)	2. letnik	2. semester	obvezni

Univerzitetna koda predmeta/University course code:	0038003
Koda učne enote na članici/UL Member course code:	1760

Predavanja /Lectures	Seminar /Seminar	Vaje /Tutorials	Klinične vaje /Clinical tutorials	Druge oblike študija /Other forms of study	Samostojno delo /Individual student work	ECTS
30	0	60	0	0	90	6

Nosilec predmeta/Lecturer:	izr. prof. dr. Mitja Košir
Vrsta predmeta/Course type:	Obvezni strokovni /Obligatory professional

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

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

Vsebina:	Content (Syllabus outline):
Predavanja: Principi trajnostnega inženirskega načrtovanja. Trajnost, odpornost in pametnost stavb kot vodila načrtovanja stavb. Življenjski cikel stavb ter ocenjevanje življenjskega cikla (LCA) stavb. Okoljski kazalniki vpliva stavb. Ekonomski, okoljski in sociološki aspekti trajnosti stavb.	Lectures: Principles of sustainable engineering design. Sustainability, resilience and smartness of buildings as guidelines for building design. Life cycle of buildings and life cycle assessment (LCA) of buildings. Environmental indicators of the impact of buildings. Economic,

Okoljske deklaracije proizvodov (EPD). Utelešeni in operativni okoljski vplivi stavb. Razogljičenje stavbnega sektorja in načrtovanje brezemisijskih stavb. Uporaba zmogljivostnega načrtovanja za doseganje ciljev brezemisijskih in pametnih stavb. Prilagodljivi stavbni ovoji in njihov pomen v procesu načrtovanja brezemisijskih in pametnih stavb. Pomen pametnega načrtovanja in pametnih stavbnih sistemov za doseganje ciljev trajnosti grajenega okolja. Učinkovitostni kriteriji, kontekstualizacija in interpretacija rezultatov. Vaje: Uporaba zmogljivostnega, večkriterijskega načrtovanja stavb za dosego ciljev brezemisijkskih in pametnih stavb. Uporaba metode LCA za oceno vseživljenjskih okoljskih vplivov stavb in grajenega okolja. Računske metode za določitev okoljskih vplivov stavb. Načrtovanje pametnih, prilagodljivih in brezemisijskih stavbnih ovojev in stavb. Certifikacija stavb s pomočjo metod vrednotenja trajnosti stavb (npr. Level(s), LEED, DGNB itd.).	environmental and sociological aspects of building sustainability. Environmental Product Declarations (EPD). Embodied and operational environmental impacts. Decarbonisation of the building sector and design of zero-emission buildings. Using performance-based design to achieve zero-emission and smart building goals. Adaptable building envelopes and their importance for zero-emission and smart buildings. The importance of smart design and smart building systems for achieving the goals of sustainability of the built environment. Performance criteria, contextualization and interpretation of results. Tutorial: Application of performance-based, multi-criteria building design to achieve zero-emission and smart building goals. Using the LCA method to assess the lifetime environmental impacts of buildings and the built environment. Computational methods for determining the environmental impact of buildings. Design of smart, adaptable and emission-free building envelopes and buildings. Certification of buildings using building sustainability evaluation methods (e.g. Level(s), LEED, DGNB, etc.).

Temeljna literatura in viri/Readings:

Pacheco F., Eco Efficient Construction and Building Materials, Life Cycle Assesment (LCA), Eco Labelling and Case Studies, Woodhead Publishing, 2014
Leffers, M.R., Sustainable Construciton and Design – Pearson Education Prentice Hall, 2010
Mequignon M., H. Ait Haddou, Lifetime Environmental Impact of Buildings, Springer, 2014
El Khouli S., John V., Zeumer M., Sustainable construction techniques: from structural design to interior fit-out: assessing and improving the environmental impact of buildings, Institut für internationale Architektur-Dokumentation, 2015
Ploix S., Amayri M., Bouguila N. (ur.), Towards Energy Smart Homes: Algorithms, Technologies, and Applications, Springer, 2021
Roggema R., Roggema R., Smart and Sustainable Cities and Buildings, Springer, 2020
König H., Kohler N., Kreißig J., Lützkendorf T., A life cycle approach to buildings: principles, calculations, design tools, Institut für internationale Architektur-Dokumentation, 2010
Študijsko gradivo dostopno na: e-učilnici UL FGG

Cilji in kompetence:	**Objectives and competences:**
Cilji: • Vključiti vseživljenjsko oceno (utelešenih in operativnih) okoljskih vidikov v proces načrtovanja stavb.	Objectives: • Incorporate whole life-cycle assessment of (embodied and operational) environmental aspects into the building design process.

• Izboljšati trajnostne lastnosti grajenega okolja z načrtovanjem brezemisijskih in pametnih stavb. • Izboljšanje kakovosti gradbenih projektov s smiselno uporabo pametnih tehnologij in pristopov gradnje z nižjimi okoljskimi vplivi. • Končni cilj je načrtovanje stavb z uvidom cilja EU za razogljičenje gradbenega sektorja do 2050. Pridobljene kompetence: • Obvladanje zmogljivostnega in večkriterijskega načrtovalskega pristopa pri načrtovanju brezemisijskih in pametnih stavb. • Sposobnost načrtovanja gradbenih elementov, komponent in stavb s čim manjšim vplivom na okolje ob upoštevanju celotnega življenjskega cikla stavbe/proizvoda. • Sposobnost uporabe načrtovalskih orodji in metod (npr. LCA) za oceno vseživljenjskih okoljskih vplivov stavbe. • Sposobnost smiselne integracije pametnih tehnologij z namenom izboljšanja kakovosti in trajnosti stavb. • Sposobnost razpoznavanja prednosti trajnostne gradnje in uporabe stavb.	• Improve the sustainability of the built environment through design of zero-emission and smart buildings. • Improving the quality of construction projects through the sensible use of smart technologies and construction approaches with lower environmental impacts. • The final goal is the design of buildings that will enable the EU goal of decarbonizing the construction sector by 2050. Acquired competences: • Students will master the performance-based and multi-criteria design approach of zero-emission and smart buildings. • Ability to design construction elements, components and buildings with as little impact on the environment as possible, considering the entire life cycle of the building/product. • Ability to use design tools and methods (e.g. LCA) to assess the lifetime environmental impacts of a buildings. • Ability to meaningfully integrate smart technologies in order to improve the quality and sustainability of buildings. • Ability to recognize the benefits of sustainable construction and building use.

Predvideni študijski rezultati:	**Intended learning outcomes:**
• Sposobnost koncipiranja načrtovalskih rešitev v pogledu zniževanja okoljskih vplivov skozi celoten življenjski cikel stavbe. • Sposobnost uporabe pristopa zmogljivostnega načrtovanja za doseganje optimiziranih načrtovalskih rešitev, predvsem v situaciji s kontradiktornimi zahtevami. • Sposobnost optimizacije zasnove stavb z gledišča trajnostnih aspektov gradnje. • Spretnosti uporabe relevantne strokovne in znanstvene literature in drugih virov. • Zbiranje, identifikacija, analiza in kontekstualizacija podatkov ter njihova uporaba za doseganje načrtovalskih rešitev.	• The ability to conceive design solutions with reduced environmental impacts throughout the building's entire life cycle. • Ability to use a performance-based design approach to achieve optimized solutions, particularly in situations with conflicting requirements. • Ability to optimize building design from the point of view of sustainability. • Skills in using relevant professional and scientific literature and other sources. • Collection, identification, analysis and contextualization of data and their use to achieve design solutions.

Metode poučevanja in učenja:	**Learning and teaching methods:**
Predavanja, seminarske naloge, laboratorijske vaje.	Lectures, seminar assignments, laboratory exercises.

Načini ocenjevanja:	Delež/Weight	Assessment:
Ocena izdelka vaj	50,00 %	Project executed during tutorial and lab work
Pisni izpit	50,00 %	Written exam

Ocenjevalna lestvica:	Grading system:
5 - 10, pri čemer velja, da je pozitivna ocena od 6 - 10	5 - 10, a student passes the exam if he is graded from 6 to 10

Reference nosilca/Lecturer's references:

BOŽIČEK, David, ALMEZERAANI, Youssef, KOŠIR, Mitja. Making sense of LCA results when evaluating multiple building designs – comparison of interpretation concepts. Building research and information. 2024, vol. 52, iss. 1-2, str. 129-147, ilustr. ISSN 0961-3218., doi: 10.1080/09613218.2023.2236254.

PAJEK, Luka, POTOČNIK, Jaka, KOŠIR, Mitja. The effect of a warming climate on the relevance of passive design measures for heating and cooling of European single-family detached buildings. Energy and buildings. [Print ed.]. 15 apr. 2022, št. čl.111947, letn. 261, [21] f., ilustr. ISSN 0378-7788., doi: 10.1016/j.enbuild.2022.111947

BOŽIČEK, David, KUNIČ, Roman, KOŠIR, Mitja. Interpreting environmental impacts in building design - application of a comparative assertion method in the context of the EPD scheme for building products. Journal of cleaner production. [Print ed.]. 2021, št. 123399, letn. 10 jan., str. 1-17, ilustr. ISSN 0959-6526., doi: 10.1016/j.jclepro.2020.123399.

NAPREDNI ELEMENTI STAVBNEGA OVOJA

UČNI NAČRT PREDMETA/COURSE SYLLABUS

Predmet:	Napredni elementi stavbnega ovoja
Course title:	Advanced building envelope elements
Članica nosilka/UL Member:	UL FGG

Študijski programi in stopnja	Študijska smer	Letnik	Semestri	Izbirnost
Stavbarstvo, druga stopnja, magistrski	Ni členitve (študijski program)	2. letnik	2. semester	obvezni

Univerzitetna koda predmeta/University course code:	0578748
Koda učne enote na članici/UL Member course code:	1469

Predavanja /Lectures	Seminar /Seminar	Vaje /Tutorials	Klinične vaje /Clinical tutorials	Druge oblike študija /Other forms of study	Samostojno delo /Individual student work	ECTS
30	0	0	30	0	60	4

Nosilec predmeta/Lecturer:	izr. prof. dr. Mateja Dovjak
Vrsta predmeta/Course type:	obvezni strokovni/obligatory professional

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

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

Vsebina:	Content (Syllabus outline):
Predavanja Definicija visokoučinkovitih in inteligentnih elementov stavbnega ovoja; zgodovinski razvoj in transdiscipliranost področja. Korelacija med gradniki, strukturo in mehanizmom delovanja na mikro, mezo in makro skali (intrinzične, ekstrinzične napredne lastnosti). Bionika: razvoj naprednih materialov, sistemov in tehnologij, ki posnemajo zglede iz narave (npr. lotosovi listi,	Lectures: Definition of high-performance and advanced building envelope elements; historical development and transdisciplinarity of the field. Correlation between composition, structure and mechanism of action on the micro, meso and macro scales (intrinsic, extrinsic properties). Bionics: development of advanced materials, systems and technologies that mimic examples

koža morskega psa, krila kačjega pastirja, itd.) in uporaba v stavbah. Primeri naprednih materialov in elementov stavbnega ovoja s pregledom proizvodnje, načina vgradnje, delovanja, varnosti in okoljskega vpliva: vakuumsko izolacijski paneli, aerogeli, fazno spremenljivi materiali, multifunkcijske površine, hladne barve, fotokromni, elektrokromni, termokromni, mehanokromni materiali, sistemi in tehnologije. Pregled testnih metod in tehnologij za ugotavljanje obstojnosti materialov. Napredni stavbni sistemi za ogrevanje, hlajenje in prezračevanje: kibernetsko-fizični sistem 5.0. Vaje Pregled eksperimentalnih postopkov za opredeljevanje lastnosti materialov. Spoznavanje razvoja, testiranja in proizvodnje na primerih naprednih elementov stavbnega ovoja in tehnologij (terenske vaje). Simulacije delovanja fazno spremenljivih materialov na modelnih stavbah. Uporaba bioloških metod in sistemov iz narave kot zgled za reševanje aktualnih problemov v grajenem okolju. Odločitvena analiza v morfologiji načrtovanja stavb in napredne rešitve.	from nature (e.g. lotus leaves, shark skin, dragonfly wings) and examples of building applications. Examples of advanced materials and building envelope elements with an overview of production, installation, operation, safety and environmental impact: vacuum insulation panels, aerogels, phase-change materials, multifunctional surfaces, cool paintings, photochromic, electrochromic, thermochromic, mechanochromic materials, systems and technologies. An overview of test methods and technologies for determining the durability of materials. Advanced building systems for heating, cooling and ventilation: cyber-physical system 5.0. Tutorial Review of experimental procedures defining properties of materials. Learning about development, testing and production using examples of advanced building envelope elements and technologies (filed tutorials). Simulations of the performance of phase-change materials on model buildings. Applying biological methods and systems from nature is an example of solving current problems in the built environment. Decision analysis in building design morphology and advanced solutions.

Temeljna literatura in viri/Readings:

Addington, M., Schodek, D, 2005. Smart Materials and New Technologies, Elsevier.
Orel, B., Šurca Vuk, A., Slemenik Perše, L. 2008. Sončni sprejemniki za pridobivanje sončne toplote: učno gradivo. Ljubljana: Kemijski inštitut.
Granqvist, C. G. (urednik). 1991. Materials science for solar energy conversion systems. Pergamon Press.
Peternelj, J., Jagličić, Z. 2014. Osnove gradbene fizike. UL, FGG.
Karer, G., Škrjanc, I. 2013. Predictive approaches to control of complex systems (Studies in computational intelligence, 454). Heidelberg: Springer.
Campbell, G. S., 1977: An Introduction to Environmental Biophysics. New York: Springer.
Študijsko gradivo dostopno na: e-učilnici UL FGG
Tekoča periodika: Advanced Materials, Sustainable Cities and Society, International Journal of Heat and Mass Transfer, Energy & Buildings, Building & Environment

Cilji in kompetence:	**Objectives and competences:**
Cilji: • Poznati in razumeti vlogo transdicilinarnega pristopa pri razvoju in aplikaciji naprednih elementov stavbnega ovoja. • Nadgraditi osnovno znanje o naprednih materialih in elementih stavbnega ovoja ter njihovem odzivu na okoljske stimuluse	Objectives: • To know and understand the role of a transdisciplinary approach in developing and applying advanced building envelope elements. • Upgrade basic knowledge about advanced materials and building envelope elements

(toploto, svetlobno okolje, akustika) za doseg visokoučinkovitih stavb. • Podati pregled njihovih fizikalno-kemijskih lastnosti v povezavi s strukturo materiala in napredno funkcijo. • Nadgraditi znanje o njihovi uporabi z namenom načrtovanja večfunkcionalnih rešitev. • Podati pregled možnih rešitev v modernih stavbah. Pridobljene kompetence: • Razumevanje in sposobnost prepoznavanja prednosti naprednih materialov in tehnologij na osnovi njihovih fizikalno-kemijskih lastnosti in strukture. • Sposobnost koncipiranja naprednih rešitev za stavbo in širše grajeno okolje na osnovi odločitvene analize v morfologiji načrtovanja stavb.	and their response to environmental stimuli (thermal and light environments, acoustics) to achieve high-performance buildings. • To give an overview of physical-chemical properties concerning the structure of materials and advanced function. • Upgrade knowledge about their use to design multifunctional solutions. • To give an overview of possible solutions in modern buildings. Gained competences: • Understanding and recognising the advantages of advanced materials and technologies based on their physical and chemical properties and structure. • Ability to conceive advanced solutions for the building and broader built environment based on decision analysis in the morphology of building design.

Predvideni študijski rezultati:	**Intended learning outcomes:**
Znanje in razumevanje: študent pridobi in poglobi znanje in razumevanje za: • Vlogo strukture materialov na lastnosti in odziv na okoljske stimuluse za doseg visokoučinkovitih stavb. • Uporabo programske opreme za analizo delovanja naprednih elementov stavbnega ovoja na toplotni odziv stavbe oziroma prostora. • Samostojno oceno položaja in vloge obravnavnih elementov v sistemu okolje/človek/stavba in identifikacija medsebojnih povezav. • Uporabo domače in tuje literature in drugih virov, zbiranja in interpretiranja podatkov, identifikacija. • Reševanje problemov, kritična analiza, sinteza, delo v skupini.	Knowledge and understanding: the student acquires and deepens knowledge and understanding for: • The role of structure on properties and response to environmental stimuli to achieve high-performance buildings. • Application of computer software simulations for analysis of the performance of advanced building envelope elements on the thermal response of the buildings and surroundings. • Ability to independently evaluate the status and the role of the analysed elements in the system: environment/human/building, and identification of mutual interconnections. • Skills for reviewing relevant literature sources and other references (national, international), collecting and interpreting the data, and problem identification. • Problem-solving, critical analysis, synthesis, and group work.

Metode poučevanja in učenja:	**Learning and teaching methods:**
Predavanja, laboratorijske vaje.	Lectures, laboratory exercises.

Načini ocenjevanja:	**Delež/Weight**	**Assessment:**
Laboratorijske vaje	50,00 %	Laboratory work
Pisni izpit	50,00 %	Written exam

Ocenjevalna lestvica:	Grading system:
5 - 10, pri čemer velja, da je pozitivna ocena od 6 - 10	5 - 10, a student passes the exam if he is graded from 6 to 10

Reference nosilca/Lecturer's references:

DOVJAK, Mateja, SHUKUYA, Masanori, KRAINER, Aleš. Connective thinking on building envelope - Human body exergy analysis. International journal of heat and mass transfer. [Print ed.]. Nov. 2015, vol. 90, str. 1015-1025, ilustr. ISSN 0017-9310. DOI: 10.1016/j.ijheatmasstransfer.2015.07.021. [COBISS.SI-ID 7607393]
DOVJAK, Mateja, MARKELJ, Jernej, KUNIČ, Roman. Embodied global warming potential of different thermal insulation materials for industrial products. Journal of Engineering and Applied Sciences [Elektronski vir]. - ISSN 1819-6608. - Letn. 13, št. 6, str. 2242-2249. [COBISS.SI-ID 839945]
ZAVRL, Eva, EL MANKIBI, Mohamed, DOVJAK, Mateja, STRITIH, Uroš. Experimental investigation of air-based active-passive system for cooling application in buildings. Sustainable cities and society. [Spletna izd.]. Oct. 2022, vol. 85, str. 1-13, ilustr. ISSN 2210-6715. DOI: 10.1016/j.scs.2022.104031. [COBISS.SI-ID 117204483]

MAGISTRSKO DELO

UČNI NAČRT PREDMETA/COURSE SYLLABUS

Predmet:	Magistrsko delo
Course title:	Master thesis
Članica nosilka/UL Member:	UL FGG

Študijski programi in stopnja	Študijska smer	Letnik	Semestri	Izbirnost
Stavbarstvo, druga stopnja, magistrski	Ni členitve (študijski program)	2. letnik	2. semester	obvezni

Univerzitetna koda predmeta/University course code:	0035050
Koda učne enote na članici/UL Member course code:	1348

Predavanja /Lectures	Seminar /Seminar	Vaje /Tutorials	Klinične vaje /Clinical tutorials	Druge oblike študija /Other forms of study	Samostojno delo /Individual student work	ECTS
0	0	0	0	240	240	16

Nosilec predmeta/Lecturer:	
Vrsta predmeta/Course type:	Obvezni strokovni/Obligatory professional

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

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

Vsebina:	Content (Syllabus outline):
Magistrsko delo se izdela pod mentorstvom izbranega učitelja. Izhodišče za izdelavo magistrskega dela je prijavljena tema magistrske naloge. Delo se javno predstavi ob zaključku študija. Vsebovati mora: • Uvod	Master thesis shall be made under the supervision of a selected teacher. The starting point for creating a master's thesis is the declared topic of the master's thesis. The work is presented in public at the end of the study. It must include:

• Delovno hipotezo • Pregled virov • Material in metode • Rezultate • Razpravo • Povzetek Praviloma se v magistrskem delu obravnavajo praktični problemi s področja stavbarstva (predvsem na področju bistvenih zahtev št. 3, 4, 5 in 6) ter podajajo rešitve, do katerih pridejo s pomočjo študija in izsledkov lastnega raziskovalnega dela.	• Introduction • The working hypothesis • Overview of sources • Material and methods • Results • Discussion • Summary The thesis will ordinarily deal with practical problems from the area of buildings (mainly in the area of essential demands No. 3, 4, 5 and 6) that provide further solutions which come out from the study and from the results of students' own work.

Temeljna literatura in viri/Readings:

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

Cilji in kompetence:	**Objectives and competences:**
Cilji: • Uporabiti pridobljena znanja v poglobljenem študiju na temi magistrskega dela. • Pod mentorstvom izdelati koncept dela, v katerem so opredeljeni namen, cilji, metode in viri za izdelavo tega dela. • Razvijanje samostojnega, kritičnega in etičnega načina dela. Pridobljene kompetence: • Sposobnost samostojnega načrtovalskega in raziskovalnega dela. • Sposobnost izdelave celovite in zaključene projektne in/ali raziskovalne naloge. • Z javno predstavitvijo magistrskega dela pridobiti komunikacijske spretnosti in sposobnosti.	Objectives: • To use the knowledge gained by in-depth study on the thesis topic. • Under supervisor's supervision student prepares a concept, where the purposes, goals, methods and references for the thesis are presented. • To develop independent, critical and ethical way of working. Gained competences: • Ability to independent research and design. • Ability to produce report about the executed design and/or research task. • With public presentation student obtains communication skills and abilities.

Predvideni študijski rezultati:	**Intended learning outcomes:**
• Pridobi znanja na vseh fazah, ki so del samostojnega reševanja konkretnih problemov in nalog na področju stavbarstva, sodelovanja in tudi skupinskega	• Students acquire knowledge in all phases, which are part of a real problem and tasks in buildings, as well as cooperation and teamwork within various entities in the area of buildings.

dela v okviru različnih subjektov na področju stavbarstva. • Razume stavbarstvo kot interdisciplinarno panogo, vezano na ostale naravoslovne in tehniške vede in na okolje. • Uporaba doseženega znanja v inženirski praksi.	• They understand the interdisciplinary of this area. • They learn how to use the theoretical knowledge in engineering practice. • Use of theoretical knowledge in practice.

Metode poučevanja in učenja:	**Learning and teaching methods:**
Samostojno delo, konzultacije	Independent work, consultations

Načini ocenjevanja:	**Delež/Weight**	**Assessment:**
Magistrska naloga	50,00 %	Master thesis
Javna predstavitev in zagovor	50,00 %	Public presentation and defence

Ocenjevalna lestvica:	**Grading system:**
5 - 10, pri čemer velja, da je pozitivna ocena od 6 - 10	5 - 10, a student passes the exam if he is graded from 6 to 10

Reference nosilca/Lecturer's references:

TEHNOLOGIJA INSTALACIJ

UČNI NAČRT PREDMETA/COURSE SYLLABUS

Predmet:	Tehnologija instalacij
Course title:	Technology of installations
Članica nosilka/UL Member:	UL FGG

Študijski programi in stopnja	Študijska smer	Letnik	Semestri	Izbirnost
Stavbarstvo, druga stopnja, magistrski (od študijskega leta 2026/2027 dalje)	Ni členitve (študijski program)		1. semester, 2. semester	izbirni

Univerzitetna koda predmeta/University course code:	0038006
Koda učne enote na članici/UL Member course code:	1263

Predavanja /Lectures	Seminar /Seminar	Vaje /Tutorials	Klinične vaje /Clinical tutorials	Druge oblike študija /Other forms of study	Samostojno delo /Individual student work	ECTS
30	0	60	0	0	90	6

Nosilec predmeta/Lecturer:	izr. prof. dr. Uroš Stritih
Vrsta predmeta/Course type:	Izbirni strokovni/Elective professional

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

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

Vsebina:	Content (Syllabus outline):
1. Osnove (termodinamika, prenos toplote, energenti…); 2. Naprave za ogrevanje in hlajenje (kotli, ogrevala, hladilniki, toplotne črpalke,…); 3. Črpalke in cevovodne instalacije v ogrevalnih in hladilnih sistemih; 4. Plinske instalacije;	1. Basics (thermodynamics, heat transfer, energy sources...); 2. Heating and cooling devices (boilers, heaters, refrigerators, heat pumps, etc.); 3. Pumps and pipeline installations in heating and cooling systems; 4. Gas installations;

5. Priprava tople sanitarne vode ter vodovod in kanalizacija; 6. Vlažni zrak in procesi (gretje, hlajenje, ovlaževanje, razvlaževanje, mešanje); 7. Klimatizacija in klimatske naprave (AHU); 8. Ventilatorji in kanalski razvodi za prezračevanje in klimatizacijo; 9. Sistemi za izrabo odpadne toplote (regeneratorji in rekuperatorji); 10. Elektroinstalacije ter fotovoltaika; 11. Sistemi za varovanje pred požari; 12. Regulacija in krmiljenje OHK sistemov ter centralni nadzorni sistemi; 13. Raba energije v stavbah in vpliv instalacij; 14. BIM modeli in stavbne instalacije; 15. Ogled sistema instalacij v praksi.	5. Preparation of hot sanitary water and water supply and sewerage; 6. Moist air and processes (heating, cooling, humidification, dehumidification, mixing); 7. Air conditioning and air conditioning units (AHU); 8. Fans and ducts for ventilation and air conditioning; 9. Systems for the use of waste heat (regenerators and recuperators); 10. Electrical installations and photovoltaics; 11. Fire protection systems; 12. Regulation and control of OHK systems and central control systems; 13. Energy use in buildings and the impact of installations; 14. BIM models and building installations; 15. Viewing the installation system in practice.

Temeljna literatura in viri/Readings:

ASHRAE. 2021. ASHRAE Handbook: HVAC Application. Atlanta.
Mundt, E. et al. 2004. Ventilation effectiveness, REHVA Guidebook 2. Brussels.
Bjarne Olsen et al. 2007 : Low temperature heating and high temperature cooling, REHVA Guidebook 7, Brussels
Jarek Kurnitski et al., 2018: Residential Heat Recovery Ventilation, REHVA Guidebook 25, Brussels
Maija Virta, 2019: HVAC Commissioning Process, REHVA Guidebook 2019, Brussels
Recknagel, Sprenger, Alberts: Heizung + Klimatechnik, 2020, ITM Innotech Medien, Augsburg
Handbuch der Klimatechnik, Verlag C.F. Muller GmbH, Karlsruhe, 2022.
Wargocki, P. et al. 2006. Indoor climate and productivity in offices, REHVA Guidebook 6. Brussels.
Bilateral project. Thermal energy storage. Dostopno na: http://www.fs.uni-lj.si/los.

Cilji in kompetence:	**Objectives and competences:**
Cilji: • Podati osnove razumevanja in poznavanja notranjega okolja stavb (toplotno okolje, kakovost zraka) v korelaciji z uporabnikom prostora in strojnimi instalacijami. • Podati osnove povezave prostorske umeščenosti uporabnika prostora – človeka (npr. delovno okolje) z vrednotenjem notranjega okolja na podlagi osnovnih tehničnih zakonitosti in strojnimi instalacijami. • Podati osnovne tehnologij in osnove (sistemov) ogrevanja, prezračevanja in klimatizacije (hlajenja) (OPK) ter sistemov za pripravo tople vode. • Podati teoretične osnove regulacije OHK sistemov.	Objectives: • The main objective of this course is to make student understand the fundamentals of indoor environment in buildings (thermal environment and air quality) in correlation with the occupants and engineering installations. • To explain the fundamental relations of the occupant's position in a room (e.g. working environment) with indoor environment evaluation considering the fundamental technical requirements and engineering installations. • To explain the basics of technologies and heating, ventilation and air-conditioning systems as well as the fundamentals of hot water systems.

Pridobljene kompetence: • Pridobljena znanja bodo omogočila, da bo študent: • Sposoben oceniti in osnovno načrtovati delovno in bivalno notranje okolje (toplotno okolje, kakovost zraka) s predvidenim tveganjem za ugodje in zdravje uporabnika prostora, • Sposoben osnovnega modeliranja parametrov notranjega okolja, • Sposoben prepoznati različne osnovne ogrevalne, prezračevalne in klimatske sisteme in sisteme za pripravo tople vode.	• To explain the theoretical fundamentals of the HVAC system regulation. Gained competences: • Ability to estimate and prepare basic design of working and living environment (thermal environment, air-quality) with foreseen risk for the occupant's comfort and health risk. • Ability of basic modelling of the indoor environment parameters. • Ability to identify different heating, ventilation and air-conditioning systems and hot water systems.

Predvideni študijski rezultati:	**Intended learning outcomes:**
• Sposobnost razumevanja notranjega okolja v korelaciji z uporabnikom prostora in s tem povezanega delovanja OHK sistemov. • Uporaba pridobljenih znanj pri osnovnih analizah ocenjevanja notranjega okolja in ustreznosti vgrajenih OHK v inženirski praksi. • Pridobljena znanja so izjemno potrebna pri gradbenem inženirstvu. • Sposobnost logičnega razmišljanja in ustrezen inženirski pristop, ki vodi v kakovostno gradbeno aplikacijo. • Uporaba ustrezne literature, zbiranje in interpretacija podatkov, delna kritična analiza. • Sposobnost upoštevanja dinamike procesov pri načrtovanju in uporabe računalniških programov.	• Ability to understanding the indoor environment in correlation with occupants and HVAC system operating. • Application of acquired knowledge at fundamental indoor environment analysis and assessments and suitability of built-in HVAC systems. • Ability to think logically and take appropriate engineering approach which leads to high-quality application. • Using corresponding literature, collecting and interpreting data, critical analysis. • Ability to take into consideration the processes of dynamics at the planning and use of computers programs.

Metode poučevanja in učenja:	**Learning and teaching methods:**
Predavanja, teoretične in laboratorijske vaje, samostojna izdelava individualnih nalog.	Lectures, theoretical and laboratory tutorial, individual work.

Načini ocenjevanja:	**Delež/Weight**	**Assessment:**
Seminar	25,00 %	Seminary work
Vaje	35,00 %	Tutorial
Pisni izpit	50,00 %	Written exam

Ocenjevalna lestvica:	**Grading system:**
5 - 10, pri čemer velja, da je pozitivna ocena od 6 - 10	5 - 10, a student passes the exam if he is graded from 6 to 10

Reference nosilca/Lecturer's references:

Zavrl, Eva ; El Mankibi, Mohamed ; Dovjak, Mateja ; Stritih, Uroš. Experimental investigation of air-based active-passive system for cooling application in buildings [Elektronski vir]. Leto: 2022, Vir: Sustainable cities and society [Elektronski vir]. - ISSN 2210-6715. - Vol. 85, str. 1-13 COBISS.SI-ID 117204483

Koželj, Rok ; Mlakar, Urška ; Zavrl, Eva ; Stritih, Uroš ; Stropnik, Rok. An experimental and numerical analysis of an improved thermal storagetank with encapsulated PCM for use in retrofitted buildings for heating. Leto: 2021, Vir: Energy and buildings. - ISSN 0378-7788. - Vol. 248, str. 1-13 COBISS.SI-ID 69257475

Stropnik, Rok ; Koželj, Rok ; Zavrl, Eva ; Stritih, Uroš. Improved thermal energy storage for nearly zero energy buildings with PCM integration. Leto: 2019, Vir: Solar energy. - ISSN 0038-092X. - Vol. 190, str. 420-426, COBISS.SI-ID 16754715

STRITIH, Uroš, CHARVÁT, Pavel, KOŽELJ, Rok, KLIMEŠ, Lubomír, OSTERMAN, Eneja, OSTRÝ, Milan, BUTALA, Vincenc. PCM thermal energy storage in solar heating of ventilation air: Experimental and numerical investigations. *Sustainable cities and society*, ISSN 2210-6715. [Spletna izd.], 2018, vol. 37, f. 104-115.

STRITIH, Uroš, TYAGI, V. V., STROPNIK, Rok, PAKSOY, Halime, HAGHIGHAT, Fariborz, JOYBARI, Mahmood Mastani. Integration of passive PCM technologies for net-zero energy buildings. *Sustainable cities and society*, ISSN 2210-6715. [Spletna izd.], Aug. 2018, vol. 41, str. 286-295.

INFORMACIJSKE IN KOMUNIKACIJSKE TEHNOLOGIJE V GRAJENEM OKOLJU

UČNI NAČRT PREDMETA/COURSE SYLLABUS

Predmet:	Informacijske in komunikacijske tehnologije v grajenem okolju
Course title:	Information and communication technologies in built environment
Članica nosilka/UL Member:	UL FGG

Študijski programi in stopnja	Študijska smer	Letnik	Semestri	Izbirnost
Stavbarstvo, druga stopnja, magistrski	Ni členitve (študijski program)		1. semester, 2. semester	izbirni

Univerzitetna koda predmeta/University course code:	0035038
Koda učne enote na članici/UL Member course code:	1738

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

Nosilec predmeta/Lecturer:	prof. dr. Žiga Turk
Vrsta predmeta/Course type:	Izbirni strokovni /Elective professional

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

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

Vsebina:	Content (Syllabus outline):
Predavanja: Razvoj digitalne tehnologije je tisti faktor, ki najmočneje spreminja načine in vzorce dela v poklicih, ki oblikujejo grajeno okolje. Spremembe se dogajajo na štirih frontah. Prva je vedno večja računska moč, ki vodi k vedno bolj vernim simulacijam tako naravnih pojavov kot človeške inteligence. Računalniki zmagujejo v šahu, vozijo avtomobile, pišejo poročila o	The advances in digital technology are the factor that is most strongly changing kinds and types of work in occupations working on the built environment. Changes are occurring on four fronts. The first is the increasing computing power, leading to a more faithful simulation of natural phenomena and artificial intelligence. Computers are winning at chess, driving cars, writing reports on sporting events ... Why not

športnih dogodkih ... Zakaj ne bi v bodočnosti projektirali stavb? Druga so vedno bolje strukturirane informacije. Inženirji več ne rišejo črtnih risb, ampak gradijo vsebinsko bogate informacijske "BIM" modele in izdelujejo fotorealistične simulacije. Bo to omejilo ali razširilo ustvarjalnost? Tretja fronta je vedno boljše komuniciranje med ljudmi. Primeri tega so družabna omrežja in internet. Četrta fronta je prodor informacijske tehnologije v neračunalniško okolje skozi senzorje, kamere in podobno. Zaradi vsega tega se bistveno spreminja način projektiranja. Od lokalnega sodelovanja okrog risb prehajamo na globalno sodelovanje okrog digitalnih informacij. Cilj predavanj je posredovati teorije in koncepte, ki bodo osnova za vseživljensko učenje, ki bo potrebno o novih tehnologijah. Cilj vaj je posredovati praktično znanje pri uporabi programov in spletnih storitev za sodelovanje na računalniških platformah – torej za učinkovito komuniciranje, koordinacijo, ustvarjanje, izmenjavo in deljenje informacij. Vaje tečejo projektno v povezavi s katerim od strokovnih predmetov.	design buildings? The second is increasingly structured information. Engineers no longer draw line drawings, but build content-rich information "BIM" model and produce realistic simulations. Will this limit or augment creativity? The Third front is improved communication between people. Examples of this are the social networks and the Internet. The fourth front is the penetration of information technology in physical environment through sensors, cameras and the like. All this significantly changes the way we design. From local participation around drawings we are transitioning to a global collaboration around digital information. The aim of the lectures is to provide theories and concepts that will form the basis for lifelong learning, which will be on new technologies. The aim of the exercises is to provide practical knowledge in the use of programs and online services for collaboration on computing platforms - thus for effective communication, coordination, creation, exchange and dissemination of information. Exercises running the project in conjunction with one of the technical courses.

Temeljna literatura in viri/Readings:

Mitchell, William J., and Malcolm McCullough. Digital design media. John Wiley & Sons, 1995.
Zarli, A. et al. 2004. Building a Better Future, eBook, ICCI Consortium.
Deutsch, R. 2011. BIM and integrated design: Strategies for architectural practice. John Wiley & Sons.
Eastman, C. et al. 2011. BIM handbook: A guide to building information modeling for owners, managers, designers, engineers and contractors. John Wiley & Sons.
Raphael, B., Smith, I.F.C. 2003. Fundamentals of computer-aided engineering. John Wiley & Sons.
Turk Ž, Učno gradivo v spletni učilnici, posodobljeno letno.

Cilji in kompetence:	**Objectives and competences:**
Cilji: • Spoznati pomen računalniške tehnologije kot povezovalnega gradnika v gradbeni industrije in v procesih, ki v tej industriji potekajo. • Spoznati osnovno teoretično in tehnološko ozadje. • Poglobiti razumevanje o neposrednih in strateških vidikih informatizacije v gradbeništvu.	Objectives: • Understand the importance of information technology as an integrating element among the entities of the construction industry and its processes. • Learn about basic theoretical and technological backgrounds. • Deepen the understanding of the direct and strategic aspects of informatization in construction. • Establish a conceptual framework of themes and topics of construction

• Postaviti okvir za gradbeno informatiko, ki ga v toku študija dopolnjujejo bolj specialni predmeti. • Razumeti vlogo poklica »specialista-gradbenega-informatika« za gradbeno industrijo in karierne priložnosti. Pridobljene kompetence: • Sposobnost strateškega in kritičnega razmišljanja o uporabi informacijskih tehnologij v gradbeništvu. • Sposobnost uporabe praktičnih tehnoloških rešitev – lokalnih programov in storitev na internetu.	informatics, which will be expanded by other courses • Understand the importance of professions in which engineers specialize in IT knowledge and see it a career opportunity. Gained competences: • Ability of strategic and critical thinking about the use of information technology in construction. • Ability to use technological solutions, local software and services on the internet.

Predvideni študijski rezultati:	**Intended learning outcomes:**
• Vloga informatike v družbi nasploh in v gradbeništvu posebej. • Pregled nad temami gradbene informatike. • Strateški vidiki informatizacije na področju gradbeništva. • Razumevanje znanstvenih metod dela v gradbeni informatiki. • Raba ključnih orodij za delo in učenje na daljavo. • Uporaba znanstvenih metode pri informatizaciji procesov v gradbeništvu. • Kritična analiza uporabe IKT v gradbeništvu. • Sposobnost uporabiti metode znanstvenega dela v okviru gradbene informatike tudi na druga področja. • Sposobnost strateškega uvajanja informacijskih tehnologij v gospodarstvo. • Sposobnost organiziranja IKT podpore projektom. • Sposobnost postati informacijski manager projekta. • Sposobnost sodelovati v softverskih projektih.	• The role of information technology in society in general and in construction in particular. • Overview of the topics of construction informatics. • Strategic aspects of information in the field of construction. • Understanding of scientific methods in construction informatics. • Use of key tools for distance working and distance learning. • Use of key tools for the three kinds of integration (information-knowledge, process, communication). • Critical analysis of the use of ICT in construction • Ability of systematic analysis of the use of information technologies. • Ability to organize ICT project support. • Ability to become an IT manager (CIO) of a project, BIM manager of a project. • Ability to be involved in software development projects.

Metode poučevanja in učenja:	**Learning and teaching methods:**
Predavanja, obogatena z multimedijskimi vsebinami in demonstracijami. Projektno organizirane vaje, kjer se delo usmerja v enovit projektni rezultat. Samostojno delo doma s korekturami v šoli.	Lectures enriched with multimedia and demos. Project oriented exercises focused into a unified project result. Work at home with consultations

Načini ocenjevanja:	**Delež/Weight**	**Assessment:**
Teoretično znanje na izpitu	40,00 %	Theoretical exam
Sodelovanje na vajah in predavanjih	20,00 %	Activity and collaboration

Projekt in izdelek	40,00 %	Project work quality

Ocenjevalna lestvica:	**Grading system:**

Reference nosilca/Lecturer's references:

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. http://www.sciencedirect.com/science/article/pii/S0926580514000363, doi: http://dx.doi.org/10.1016/j.autcon.2014.02.011.
TODOROVIĆ, Miloš, TURK, Žiga. Upoštevanje trajnostnih kriterijev pri projektiranju z orodjem BIM = Designing using sustainability criteria with BIM tools. Gradbeni vestnik, ISSN 0017¬2774, okt. 2011, letn. 60, št. 10, str. 279¬284, ilustr.
KLINC, Robert, TURK, Žiga, DOLENC, Matevž. Engineering collaboration 2.0 : requirements and expectations. Journal of information technology in construction, ISSN 1874-4753, 2009, letn. 14, pos. št., str. 473-488, ilustr. Dostopno na: http://www.itcon.org/2009/31.

ŠPORTNA VZGOJA

UČNI NAČRT PREDMETA/COURSE SYLLABUS

Predmet:	Športna vzgoja
Course title:	Sports Education
Članica nosilka/UL Member:	UL FGG

Študijski programi in stopnja	Študijska smer	Letnik	Semestri	Izbirnost
Geodezija in geoinformatika, druga stopnja, magistrski	Ni členitve (študijski program)		1. semester, 2. semester	izbirni
Stavbarstvo, druga stopnja, magistrski	Ni členitve (študijski program)		1. semester, 2. semester	izbirni

Univerzitetna koda predmeta/University course code:	0035039
Koda učne enote na članici/UL Member course code:	1256

Predavanja /Lectures	Seminar /Seminar	Vaje /Tutorials	Klinične vaje /Clinical tutorials	Druge oblike študija /Other forms of study	Samostojno delo /Individual student work	ECTS
0	0	0	0	45	45	3

Nosilec predmeta/Lecturer:	prof. dr. Branko Škof
Vrsta predmeta/Course type:	Izbirni splošni /Elective general

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

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:	**Prerequisites:**
Zdravstveni status, ki dovoljuje ustrezen telesni napor.	Health status, which allows appropriate physical exercise.

Vsebina:	**Content (Syllabus outline):**
Predavanja Splošni teoretični del vsebuje predavanja, ki so skupna vsem športnim programom in se izvajajo skupno za vse študente (osnove delovanja človekovega telesa, njegovega gibalnega, srčno žilnega in dihalnega sistema, psihomotorične in	Lectures General theoretical part contains lectures, which are common to all sports programs made collectively for all students (basic function of the human body, movement of the body and cardiovascular system, psychomotor and

funkcionalne sposobnosti, športno-gibalna aktivnost kot preventivna in kurativna dejavnost za ohranjanje in utrjevanje zdravja, osnove zdravega prehranjevanja in regulacije telesne teže ter drugih medicinskih vidikov športa, metode preverjanja in ugotavljanja stanja psihomotoričnih in funkcionalnih sposobnosti). Specialni teoretični del je vezan na izbrano športno panogo (posebnosti športne panoge, njen vpliv na človeka, tehnika, taktika in pravila, osnove telesne in tehnično taktične priprave) in se izvaja skozi praktične vaje; Praktične vaje Študent izbira med ponujenimi športnimi panogami. Za vsako panogo se izvaja program učenja, izpopolnjevanja znanja in osnovnega treniranja. Poleg izbrane športne panoge bo študent moral opraviti 5 vodenih enodnevnih ali večdnevnih športnih aktivnosti v naravi, ter preizkus motoričnih in funkcionalnih sposobnosti.	functional abilities, prevention and curative activity for developing health, basic nutrition and healthy diet, regulation of body weight and other medical aspects of sports, checking methods and assessment of psychomotor and functional abilities). Special theoretical part is linked to the selected sport (specificity of sport, human development through sport, technique, tactics and rules, fundamentals of physical and technical preparation) and is implemented through practical exercises; Practical work Students choose between the offered sport branches. For each sport have a program of learning and skill training. Students have to do: five guided multi-day sports activities in nature and aerobic endurance test.

Temeljna literatura in viri/Readings:

Škof, B. 2012. Does physical activity at a young age really mean a healthier adulthood and old age? Annales kinesiologiae, ISSN 2232-2620, 2012, vol. 3, no. 2, str. 149-166.
Škof, B. 2010. Spravimo se v gibanje - za zdravje in srečo gre: kako do boljše telesne zmogljivosti slovenske mladine? Ljubljana, Fakulteta za šport UL, Inštitut za šport, 253 str.
Škof, B. et at., 2007. Šport po meri otroka in mladostnika. Ljubljana, Fakulteta za šport UL, Inštitut za šport, 445 str.
Berčič, H. et at. 2007. Šport v obdobju zrelosti. Fakulteta za šport UL, Inštitut za šport, 240 str.
Škof, B., Zabukovec V., Boben, D., Cecič Erpič S., 2005. Pedagoško-sociološki vidiki športne vzgoje. Ljubljana, Fakulteta za šport UL, Inštitut za kineziologijo, 237 str.

Cilji in kompetence:	**Objectives and competences:**
Cilji • odpravljanje in preprečevanje posledic pomanjkanja gibanja oz. skrb za izboljšanje psihofizičnih sposobnosti, krepitev zdravja in ustvarjalno izrabo prostega časa. • ozaveščanje o vrednotah športa in preko tega vplivanje na oblikovanje pozitivnih stališč do športa in navajanje na zdrav način življenja • izpopolnjevanje znanja v izbrani športnih panogah • oblikovanje trajnega aktivnega odnosa do športa kot kompenzacijske dejavnosti k študiju in delu Kompetence	Objectives • care for improving psychophysical abilities, health strength and creative use of free time • raising awareness about the values of sports, encouraging a positive attitude to sports and healthy way of lifestyle • perfecting knowledge in selected sports • encouraging positive attitude to sport as a • compensatory activity to study and work Competences • formed positive attitude towards sports activities and permanent concern for the preservation of health and working ability. • rational incorporation of sports into lifestyle,

• oblikovanje trajnega pozitivnega odnosa do športne dejavnosti in trajne skrbi za ohranjanje zdravja in delovnih sposobnosti, • racionalno vgrajevanje športa v način življenja, • sposobnost samostojne skrbi za zdrav način življenja skozi športno-gibalno aktivnost, • pripravljenost in sposobnost samostojnega vključevanja v organizirane ali neorganizirane oblike športnega udejstvovanja v novih študijskih ali delovnih okoljih, • promocija in uveljavljanje fakultete in univerze.	• understand the concern for a healthy lifestyle through sports and physical activity, • readiness and ability of self-depended inclusion in organized or non-organized forms of sports in the new study or work environments, • promotion and recognition of the Faculty and University.

Predvideni študijski rezultati:	**Intended learning outcomes:**
• razumevanje temeljnih pojmov in teorij delovanja človekovega gibalnega, srčno žilnega in dihalnega sistema ter njihovih najpogostejših patologij • oblikovanje razumskega in čustvenega odnosa do telesnega napora, poznavanje teorije aktivnega počitka in metod za regeneracijo telesa, poznavanje zdravega prehranjevanja in regulacije telesne teže. Izpopolnitev znanja izbranih športnih zvrsti • uporaba pridobljenih znanj in vedenj v vsakodnevnem življenju za kompenzacijo negativnih učinkov enostranskih obremenitev v času študija • skozi pridobljena znanja in vedenja zagotovitev večje kvalitete življenja in večje učinkovitosti pri študiju in delu • psihofizična pripravljenost organizma je pogoj za reševanje vsakodnevnih obveznosti in nalog.	• understanding the basic concepts and theories of human locomotion, cardiovascular and respiratory systems and their most frequent pathologies in relation to mental health • creation of rational and emotional attitude toward physical effort, knowledge of the theory of active rest and methods for body regeneration, knowledge of healthy diet and body weight regulation, • improvement of knowledge in selected sport. Use of acquired knowledge and skills in daily life to compensate daily stresses and negative effects of unilateral load during the study, • through the acquired knowledge and behaviour increased quality of life and increased efficiency of study and work are ensured, • good psychophysical preparedness is a condition to solve everyday duties and obligations.

Metode poučevanja in učenja:	**Learning and teaching methods:**
Pouk se izvaja v pokritih športnih objektih in v naravi v obliki predavanj in vaj, skupinskih in individualnih konzultacij kontinuirano preko celega semestra, pa tudi v zgoščenih (kurznih) oblikah, vendar z enakim fondom ur, pri čemer se večji del teorije podaja skozi praktične vaje. Uporablja se naslednje učne oblike: frontalna, individualna, delo v manjših skupinah.	Activities are implemented in indoor sports facilities and the natural environment in the form of lectures and exercises, group and individual consultations through the whole semester as well as in concentrated forms, major part of theory is performed through practical exercises. Learning forms: frontal, individual, small group work.

Načini ocenjevanja:	Delež/Weight	Assessment:
Teoretični izpit	20,00 %	Theoretical exam
Praktični izpit	80,00 %	Practical exam

Ocenjevalna lestvica:	Grading system:

Reference nosilca/Lecturer's references:

AUERSPERGER, Irena, ŠKOF, Branko, LESKOŠEK, Bojan, KNAP, Bojan, JERIN, Aleš, LAINŠČAK, Mitja. Exerciseinduced changes in iron status and hepcidin response in female runners. PloS one, 2013, vol. 8, issue 3, tabele, graf. prikazi, [8 str.]
PLEVNIK, Matej, PIŠOT, Rado, ŠKOF, Branko. The effects of a six-month training programme on running endurance, morphological characheristics [!] and some aerobic ability parameters of adult women with different physical abilities = Vpliv šestmesečnega vadbenega programa na tekaško vzdržljivost, morfološke značilnosti in nekatere kazalce aerobne zmogljivosti odraslih žensk z različno začetno zmogljivostjo. Ann. Kin. (Koper, Tisk. Izd.), 2012, vol. 3, no. 2, str. 181-195.
AUERSPERGER, Irena, KNAP, Bojan, JERIN, Aleš, BLAGUS, Rok, LAINŠČAK, Mitja, SKITEK, Milan, ŠKOF, Branko. The effects of 8 weeks of endurance running on hepcidin concentrations, inflammatory parameters and iron status in female runners. Int. J. sport nutr. Exerc. Metab. (Print), 2012, vol. 22, issue 1, str. 55-63.

AVTOMATSKO VODENJE SISTEMOV

UČNI NAČRT PREDMETA/COURSE SYLLABUS

Predmet:	Avtomatsko vodenje sistemov
Course title:	Automatic management of systems
Članica nosilka/UL Member:	UL FGG

Študijski programi in stopnja	Študijska smer	Letnik	Semestri	Izbirnost
Stavbarstvo, druga stopnja, magistrski (od študijskega leta 2026/2027 dalje)	Ni členitve (študijski program)		1. semester	izbirni

Univerzitetna koda predmeta/University course code:	0578752
Koda učne enote na članici/UL Member course code:	1346

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

Nosilec predmeta/Lecturer:	Igor Škrjanc, Vito Logar
Vrsta predmeta/Course type:	Izbirni strokovni/Elective professional

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

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

Vsebina:	Content (Syllabus outline):
Predavanja: Sistemi: sistemski pristop, osnovni pojmi o sistemih, sistemski pristop pri načrtovanju vodenja. Modeliranje in simulacija: vrste modelov in načini modeliranja, ciklični postopek, vrednotenje in verifikacija, osnovni zapisi (dif. enačbe, prenosne funkcije in bločni	Lectures: Systems: systems approach, basic concepts, systems approach in control design. Modelling and simulation: types of models and modelling methods, cyclic procedures, validation and verification, basic forms (differential equations, transfer functions and block diagrams). Object

diagrami). Objektno orientirano modeliranje, osnove simulacije, metode simulacije. Orodja: Matlab-Simulink, Dymola-Modelica. Modeliranje in simulacija toplotnih in svetlobnih tokov v zgradbi. Avtomatsko vodenje sistemov: inženirski pristop z bločnimi diagrami in tehnološkimi shemami. Osnovni pojmi (krmiljenje, regulacija, sledenje, odpravljanje motenj, učinki povratne zanke na ustaljeno stanje, stabilnost). Osnovne regulacijske strukture: stopenjski, PID, mehki regulator, avtomatsko vodenje toplotnih in svetlobnih tokov v zgradbi. Vaje: Laboratorijske vaje: delo s pomočjo modelersko simulacijskih paketov: Matlab-Simulink in Dymola- Modelica. Izvedba avtomatskega vodenja na modelnih laboratorijskih napravah. Seminar: vsak študent samostojno izdela seminarsko nalogo pod mentorstvom učitelja ali asistenta.	oriented modelling, basics of simulation, methods of simulation. Tools: Matlab- Simulink, Dymola-Modelica. Modelling and simulation of heat and light processes in buildings. Automatic control: engineering approach with block diagrams and process schemes, basic concepts (open-loop and closed-loop control, disturbance reduction, closed-loop effects on steady state, stability). Basic control structures: step control, PID control fuzzy control, automatic control of heat and light in buildings. Tutorial: Laboratory work: work using modelling/simulation software: Matlab-Simulink and Dymola-Modelica. Application of automatic control on different laboratory plants. Tutorial: each student is required to conduct an individual seminar work under teacher's or assistant's supervision.

Temeljna literatura in viri/Readings:

Škrjanc, I. 2012. Avtomatsko vodenje sistemov. UL, FE. (skripta v pripravi)
Zupančič, B. 1996. Zvezni regulacijski sistemi 1. del, 3. Izdaja. UL, FE.
Zupančič, B., Karba, R., Matko, D. 1995. simulacija dinamičnih sistemov, 1.izdaja. UL, FE.
Karba, R. 1999. Modeliranje procesov, 1. Izdaja. UL, FE.
Oblak, R., Škrjanc, I. 2005. Matlab s simulinkom : priročnik za laboratorijske vaje, 1. izdaja. UL FE.

Cilji in kompetence:	**Objectives and competences:**
Cilji: • Prikaz področja avtomatike na zanimiv način preko številnih primerov. • Seznanitev s celovitostjo življenjskega cikla sistemov vodenja. • Poudarek na sistemskem pristopu. Pridobljene kompetence: • Osvojitev osnovnih metod modeliranja in simulacije sistemov. • Osvojitev osnovnih metod avtomatskega vodenja s poudarkom na regulacijskih metodah. • Seznanitev s celovitostjo obravnavanih postopkov s pomočjo primerov iz gradbeništva.	Objectives: • Introduction to the field of automatic control using interesting case examples. • Introduction to control life-cycles. • Emphasis on systems approach. Gained competences: • Mastering basic methods of system modelling and simulation. • Mastering basic principles of automatic control with emphasis on control methods. • Introduction to the integrity of presented procedures using examples from civil engineering.

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

• Osnovna znanja iz modeliranja, simulacij in avtomatskega vodenja pretežno zveznih dinamičnih procesov, kot so procesi ogrevanja in osvetljevanja v zgradbah. • Znanja bodo pridobljena in demonstrirana ob številnih primerih, kar bo poudarilo uporabnostno komponento. • Poglobljeno razmišljanje s pomočjo sistemskega pristopa, ki je vodilo pri obravnavi, omogoča uporabo obravnavanih pristopov na podoben način tudi pri drugačnih problemih. • Sistemski pristop pri reševanju problemov. Modeliranje in simulacija bosta podana na način, ki bo demonstriran pretežno s problemi v gradbeništvu, vendar bo uporabnost dosti širša. • Metode vodenja bodo prav tako širše uporabne. Spoznana računalniška orodja za modeliranje, simulacijo in vodenje bodo gotovo uporabna tudi pri drugih predmetih.	• Basic knowledge in modelling, simulation and automatic control of mainly continuous dynamic processes, such as heating and lighting processes in buildings. • The assessment and demonstration of the knowledge will be based on various case examples, emphasising its usability and applicability. • Concepts of in-depth thinking based on systems approach, allowing the use of the presented concepts in similar manner also on other areas. • Systems approach to problem solving. The methods of modelling and simulation will be presented using different examples from civil engineering, but with broader applicability. • Similarly, the presented methods of systems control are also useful in a wider field of application. Presented software tools for modelling, simulation and control are useful for different lectures as well.

Metode poučevanja in učenja:	**Learning and teaching methods:**
Predavanja, laboratorijske vaje in seminarska naloga.	Lectures, laboratory exercises and seminar work

Načini ocenjevanja:	**Delež/Weight**	**Assessment:**
Seminarsko in laboratorijsko delo	70,00 %	Seminar and laboratory work
Pisni izpit	30,00 %	Written exam

Ocenjevalna lestvica:	**Grading system:**
5 - 10, pri čemer velja, da je pozitivna ocena od 6 - 10	5 - 10, a student passes the exam if he is graded from 6 to 10

Reference nosilca/Lecturer's references:

BLAŽIČ, Aljaž, ŠKRJANC, Igor, LOGAR, Vito. Prediction interval soft sensor for dissolved oxygen content estimation in an electric arc furnace. Applied soft computing. 2024, vol. 167
BLAŽIČ, Aljaž, ŠKRJANC, Igor, LOGAR, Vito. Soft sensor of bath temperature in an electric arc furnace based on a data-driven Takagi-Sugeno fuzzy model. Applied soft computing. 2021, vol. 113
SABOOHI, Yadollah, FATHI, Amirhossein, ŠKRJANC, Igor, LOGAR, Vito. Optimization of the electric arc furnace process. IEEE transactions on industrial electronics. 2019, vol. 66, no. 10
FATHI, Amirhossein, SABOOHI, Yadollah, ŠKRJANC, Igor, LOGAR, Vito. Comprehensive electric arc furnace model for simulation purposes and model-based control. Steel research international. Mar. 2017, vol. 88, no. 3
LOGAR, Vito. Modelling of indoor lighting conditions in building for control design purposes. Simulation notes Europe. Dec. 2016, vol. 26, no. 4

NAPREDNA GRADIVA

UČNI NAČRT PREDMETA/COURSE SYLLABUS

Predmet:	Napredna gradiva
Course title:	Advanced construction and building materials
Članica nosilka/UL Member:	UL FGG

Študijski programi in stopnja	Študijska smer	Letnik	Semestri	Izbirnost
Gradbeništvo, druga stopnja, magistrski	Gradbene konstrukcije (smer)		2. semester	izbirni
Stavbarstvo, druga stopnja, magistrski	Ni členitve (študijski program)		2. semester	izbirni

Univerzitetna koda predmeta/University course code:	0034927
Koda učne enote na članici/UL Member course code:	1562

Predavanja /Lectures	Seminar /Seminar	Vaje /Tutorials	Klinične vaje /Clinical tutorials	Druge oblike študija /Other forms of study	Samostojno delo /Individual student work	ECTS
15	15	30	0	0	60	4

Nosilec predmeta/Lecturer:	prof. dr. Violeta Bokan-Bosiljkov
Vrsta predmeta/Course type:	Izbirni strokovni /Elective professional

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

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

Vsebina:	Content (Syllabus outline):
Predavanja Pregled sodobnega razvoja materialov in tehnologij, ki omogočajo ta razvoj (nanotehnologije n.pr.) ter posebnih lastnosti materialov. Podrobnejši prikaz lastnosti in uporabnosti naprednih materialov po štirih osnovnih skupinah: keramike, kovine, polimeri	Lectures Overview of the development of modern materials and technologies that facilitate this development (e.g. nanotechnology) and specific material properties. Detailed presentation of properties and applicability of advanced materials according to four basic categories:

in kompoziti. Prikaz posebnosti pri uporabi naprednih materialov pri snovanju konstrukcij z vidika projektiranja, izvedbe in vzdrževanja. Osnove za ocenjevanje življenjskega cikla naprednih materialov, v primerjavi z klasičnimi materiali, ter ocene stroškov uporabe in vzdrževanja konstrukcij. Seminar Manjše skupine študentov (do 4 študenti v skupini) izdelajo predlog konstrukcijskega elementa ali sklopa narejenega iz naprednega materiala in analizirajo njegove lastnosti, ter ga primerjajo z enakim elementom oz. sklopom narejenim iz klasičnega materiala. Vaje Spoznavanje strukture naprednih materialov z optičnim mikroskopom. Preskušanje osnovnih mehanskih in tehnoloških lastnosti naprednih materialov, analiza rezultatov preskusov in primerjava z relevantnimi lastnostmi klasičnih materialov. Uporaba eksperimentalno in analitično dobljenih podatkov pri seminarski nalogi.	ceramics, metals, polymers and composites. Presentation of specifics in the use of advanced materials when designing structures in terms of design, execution and maintenance. Basics of life cycle assessment of advanced materials, when compared with conventional materials, and the estimation of cost of serviceability and maintenance of structures. Seminar Small groups of students (up to 4 students per group) prepare a proposal for a structural element or set of elements made of advanced material. They analyse its behaviour and properties, and compare it with the same element or set of elements made of common material. Tutorials Analysis of the structure of advanced materials with optical microscope. Testing of basic mechanical and technological properties of advanced materials. Analysis of test results and comparison with relevant properties of conventional materials. Application of the experimentally and analytically obtained data in the seminar work.

Temeljna literatura in viri/Readings:

Shackelford J.F. 2008. Introduction to Materials Science for Engineers. Prentice Hall, 7th Edition.
Christian U. Grosse. 2007. Advances in Construction Materials 2007. Berlin, Heidelberg, Springer Verlag.
Axel Ritter. 2006. Smart Materials in Architecture, Interior Architecture and Design. A Birkhäuser book.
Bjorn Berge. 2009. Ecology of Building Materials. Taylor&Francis, 2nd Edition.

Cilji in kompetence:	**Objectives and competences:**
- Cilji: spoznati razvoj sodobnih in naprednih materialov ter možnosti snovanja novih tipov konstrukcij in izdelave nekonstrukcijskih elementov s posebnimi lastnostmi in uporabnostjo. - Pridobljene kompetence: sposobnost presoje smiselnosti uporabe naprednih materialov, z vidika možnosti snovanja zahtevnih konstrukcij, in presoje njihove ekonomičnosti povezane tudi z oceno življenjskih stroškov.	- Objectives: onsight in the development of modern and advanced materials and in the possibility of designing new types of structures as well as fabrication of non-structural elements with special properties and application possibilities. - Acquired competences: the ability to select reasonable applications of advanced materials, from the aspect of the design of complex structures, and the assessment of their economy, involving also the cost of living.

Predvideni študijski rezultati:	**Intended learning outcomes:**
- Razumevanje osnovnih lastnosti naprednih materialov in njihova uporaba pri snovanju	- Understanding the basic properties of advanced materials and their use in the design

sodobnih konstrukcij. Presoja primernosti uporabe naprednih ali klasičnih materialov. - Uporaba pri snovanju konstrukcijskih elementov in sklopov iz naprednih materialov, ki se uporabljajo v gradbeništvu (armirane plastike, lamelirano steklo, samozgoščevalni betoni, lesni kompoziti) - Pridobljena znanja omogočajo kritično presojo in odločanje o uporabi različnih vrst materialov v skladu z zahtevami po nosilnosti, trajnosti, uporabnosti in ekonomičnosti. - Nabor specializiranih znanj se lahko poveže v širši sklop s konstrukcijskim seminarjem kot nadgradnja osnovnih znanj pridobljenih pri predavanjih ali kot samostojni seminar.	of modern structures. Appropriate selection of either advanced or conventional materials, for specific application. - Application for design of construction elements or sets of elements made of advanced building and construction materials (reinforced plastic, laminated glass, self-compacting concrete, wood composites). - The acquired knowledge enables critical assessment and decision-making about the use of different types of materials in accordance with the requirements regarding the load-bearing capacity, durability, application and economy. - A set of specialized skills can be linked to a broader set in the framework of the construction seminar as an upgrade of basic knowledge acquired during lectures or as an independent seminar.

Metode poučevanja in učenja:	**Learning and teaching methods:**
Predavanja na osnovi učbenika, ki ga pripravi nosilec predmeta s sodelavci. Seminar kot uvajanje v projektiranje konstrukcij iz naprednih materialov. Manjše skupine študentov (do 4) izdelajo seminarsko nalogo. Laboratorijske vaje v skupini do 15 študentov, kjer se ti seznanijo z osnovnimi lastnostmi naprednih materialov. 30 ur laboratorijskih vaj.	Lectures on the basis of a textbook prepared by the lecturer and co-workers. The seminar as an introduction to the design process of structures made of advanced materials. Small groups of students (up to 4) prepare and defend a seminar work. Laboratory tutorials in a group of 15 students, where they learn about the basic properties of advanced materials. 30 hours of laboratory exercises.

Načini ocenjevanja:	**Delež/Weight**	**Assessment:**
Seminarska naloga	40,00 %	Seminar work and its defend
Kolokvij ali izpit	60,00 %	Colloquium or examination

Ocenjevalna lestvica:	**Grading system:**
5 - 10, pri čemer velja, da je pozitivna ocena od 6 - 10	5 - 10, a student passes the exam if he is graded from 6 to 10

Reference nosilca/Lecturer's references:

BOKAN-BOSILJKOV, Violeta. SCC mixes with poorly graded aggregate and high volume of limestone filler. Cem. concr. res.., 2003, vol. 33, no. 9, str. 1279-1286.

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.

DUH, David, ŽARNIĆ, Roko, BOKAN-BOSILJKOV, Violeta. Strategies for finding the adequate air void threshold value in computer assisted determination of air void characteristics in hardened concrete. Computers and Concrete, ISSN 1598-8198, april 2008, letn. 5, št. 2, str. 101-116.

INŽENIRSKE LESENE KONSTRUKCIJE

UČNI NAČRT PREDMETA/COURSE SYLLABUS

Predmet:	Inženirske lesene konstrukcije
Course title:	Engineering Timber Structures
Članica nosilka/UL Member:	UL FGG

Študijski programi in stopnja	Študijska smer	Letnik	Semestri	Izbirnost
Gradbeništvo, druga stopnja, magistrski	Gradbene konstrukcije (smer)		2. semester	izbirni
Stavbarstvo, druga stopnja, magistrski	Ni členitve (študijski program)		2. semester	izbirni

Univerzitetna koda predmeta/University course code:	0034929
Koda učne enote na članici/UL Member course code:	1553

Predavanja /Lectures	Seminar /Seminar	Vaje /Tutorials	Klinične vaje /Clinical tutorials	Druge oblike študija /Other forms of study	Samostojno delo /Individual student work	ECTS
30	0	30	0	0	60	4

Nosilec predmeta/Lecturer:	doc. dr. Jože Lopatič
Vrsta predmeta/Course type:	Izbirni strokovni/Elective professional

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

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

Vsebina:	Content (Syllabus outline):
Predavanja Tehnologija izdelave gradbenih lesnih proizvodov in posebnosti pri njihovem dimenzioniranju (lameliran lepljeni les, slojeviti furnirni les, plošče z usmerjenim iverjem, lamelirane plošče). Posebnosti dokazovanja varnosti lameliranih lepljenih konstrukcij proti	Lectures Manufacturing technologies of engineered wood products for structural purposes and specifics of their design (glued laminated timber, laminated veneer lumber – LVL, parallel strand lumber – PSL, laminated strand lumber – LSL, oriented strand boards - OSB, cross

porušitvi. Račun pomikov lesenih konstrukcij z upoštevanjem podajnosti veznih sredstev (vpliv zdrsa, reoloških pojavov, stisljivosti elementov pravokotno na vlakna in začetne nepopolnosti). Dimenzioniranje in konstruiranje kompleksnih priključkov, vozlišč in detajlov lesenih konstrukcij. Ploskovni elementi lesenih konstrukcij (stene in stropovi). Zagotavljanje potresne odpornosti lesenih konstrukcij. Požarna odpornost lesenih konstrukcij (računsko določanje požarne odpornosti s poenostavljenimi in naprednimi računskimi metodami, ukrepi za zagotavljanje požarne odpornosti). Lesene stavbe (projektna obtežba, osnovne skupine nosilnih elementov lesenih stavb, zasnova in izbira nosilne konstrukcije stavbe, modeliranje in analiza nosilne konstrukcije, konstruiranje elementov nosilne konstrukcije). Leseni mostovi (zasnova, projektna obtežba, osnovni gradniki nosilne konstrukcije mostu, prevedba dejanske konstrukcije v ustrezen računski model, konstruiranje nosilnih elementov). Vaje - seminarske vaje (računski primeri), - laboratorijske vaje (računalniško podprta izdelava projektne naloge).	laminated timber – CLT). Verification of structural safety of glued laminated timber structures by numerical simulations. Timber walls and floors. Calculation of deflection of timber structures taking into account the flexibility of fasteners (influence of slip), rheology of material, compressibility of elements perpendicular to fibres and initial imperfections of joints. Design of complex joints, nodes and details of timber structures. Assuring earthquake resistance of timber structures. Fire resistance of timber structures (computational definition of fire resistance with simplified and advanced computational methods, measures to assure fire resistance). Timber buildings (design load, basic groups of load- bearing elements of timber buildings, conceptual design and selection of load-bearing structure of a building, modelling and analysis of load-bearing structure, design of elements of load-bearing structure). Timber bridges (design load, basic structural elements of load-bearing structure of a bridge, conceptual design, modelling of actual structure by adequate computational model, design of load-bearing elements). Tutorials: - seminar tutorials (computational examples), - laboratory tutorials (computer-aided elaboration of project work).

Temeljna literatura in viri/Readings:

S. Thelanderson, H.J. Larsen (urednika). 2003. Timber engineering. John Wiley & sons, str. 169-427.
F. Colling. 2004. Holzbau-beispiele. Vieweg, 174 str.
T. Herzog, J.Natterer, R Schweitzer, M. Volz. 2004. Timber Construction Manual. Birkhäuser Architecture.
J. Kolb. 2008. Systems in Timber Engineering. Birkhäuser Architecture.
Z. Žagar. 2003. Drvene konstrukcije II. Pretei d.o.o., str. 164-312.
Ustrezni deli standardov za gradbene konstrukcije Evrokod 0, Evrokod 1, Evrokod 5, Evrokod 8 (SIST EN 1990, SIST EN 1991-1, SIST EN 1991-1-3, SIST EN 1991-1-4, SIST EN 1995-1-1, SIST EN 1998-1).
Študijsko gradivo predavatelja je na spletnem mestu katedre za masivne in lesene konstrukcije Dostopno na: http://www.fgg.uni-lj.si/kmlk/index.htm .

Cilji in kompetence:	**Objectives and competences:**
Cilji - Nadgraditi temeljno poznavanje obnašanja lesenih konstrukcij,	Objectives - To upgrade the basic knowledge of the behaviour of timber structures,

- Podati teoretične podlage za snovanje, računsko modeliranje in načrtovanje kompleksnih lesenih konstrukcij. Pridobljene kompetence - Sposobnost snovanja in projektiranja zahtevnejših inženirskih lesenih konstrukcij poglobitev in razširitev znanja s področja tehnologije lesenih konstrukcij, - Razumevanje obnašanja lesenih konstrukcij vzajemnih, razmerah (požar, potres) - Razumevanje nosilnih mehanizmov inženirskih lesenih konstrukcij, - Kritična presoja ustreznosti izbranega nosilnega mehanizma in računskega modela konstrukcije - Sposobnost uporabe strokovne literature, standardov in računalniških programov v procesu načrtovanja lesenih konstrukcij, - Sposobnost utemeljene izbire med več možnimi nosilnimi sistemi.	- To present the theoretic bases for the conceptual design, computational modelling and design of complex timber structures, Acquired competences - Ability to conceive concept and design demanding engineering timber structures - Deepening and expansion of the knowledge from the area of technology of timber structures, - Understanding the behaviour of timber structures in extreme conditions (fire, earthquake) - Understanding of load-bearing mechanisms of engineering timber structures, - Critical valuation of the adequacy of the selected load- bearing mechanism and computational model of a structure, - Ability to use professional literature, standards and software in the process of design of timber structures, - Ability to make a well-grounded selection from several possible structural systems.

Predvideni študijski rezultati:	**Intended learning outcomes:**
- Poglobitev in razširitev znanja s področja tehnologije lesenih konstrukcij, - Razumevanje obnašanja lesenih konstrukcij vzajemnih razmerah (požar, potres). - Razumevanje nosilnih mehanizmov inženirskih lesenih konstrukcij, - Kritična presoja ustreznosti izbranega nosilnega mehanizma in računskega modela konstrukcije, - Sposobnost uporabe strokovne literature, standardov in računalniških programov v procesu načrtovanja lesenih konstrukcij - Sposobnost utemeljene izbire med več možnimi nosilnimi sistemi.	- Deepening and expansion of the knowledge from the area of technology of timber structures, - Understanding the behaviour of timber structures in extreme conditions (fire, earthquake) - Understanding of load-bearing mechanisms of engineering timber structures, - Critical valuation of the adequacy of the selected load- bearing mechanism and computational model of a structure, - Ability to use professional literature, standards and software in the process of design of timber structures, - Ability to make a well-grounded selection from several possible structural systems.

Metode poučevanja in učenja:	**Learning and teaching methods:**
Predavanja in seminarske vaje v klasični učilnici, laboratorijske vaje v računalniški učilnici. 30 ur laboratorijskih vaj.	Lectures and seminar tutorials in classical classroom, laboratory tutorials in computer classroom. 30 hours of laboratory exercises.

Načini ocenjevanja:	**Delež/Weight**	**Assessment:**
Teoretični del izpita	35,00 %	Theoretical part of exam

Računski del izpita	35,00 %	Computational part of exam
Vaje	30,00 %	Tutorials

Ocenjevalna lestvica:	**Grading system:**
5 - 10, pri čemer velja, da je pozitivna ocena od 6 - 10	5 - 10, a student passes the exam if he is graded from 6 to 10

Reference nosilca/Lecturer's references:

LOPATIČ, J., ČAS, B., Vpliv Vpliv podajnosti stika na obnašanje sestavljenih lesenih nosilcev, Zbornik 21. zborovanja gradbenih konstruktorjev Slovenije, Bled, 14. - 15. oktober 1999. Ljubljana: Slovensko društvo gradbenih konstruktorjev, 1999, str. 175-182, graf. Prikazi.
ČAS, Bojan, LOPATIČ, Jože, SAJE, Miran, SCHNABL, Simon, PLANINC, Igor. Experimental and numerical analysis of composite wood beams : paper 199.Proceedings of the Tenth International Conference on Civil, Structural and Environmental Engineering Computing. Rome, Italy, 30 August-2 September 2005. Stirling [Scotland]: Civil-Comp Press, 2005.
PLANINC, I., SCHNABL, S., SAJE, M., LOPATIČ, J., ČAS, B., Numerical and experimental analysis of timber composite beams with interlayer slip. Eng. Struct.. [Print ed.], 2008, str. 1-11. LOPATIČ, J., SAJE, D., SAJE, F., Creep of timber structures. International journal for engineering modelling, ISSN 1330- 1365, 2005, vol. 18, no. 1/2, str. 1-10.
SAJE, Drago, BANDELJ, Branko, ŠUŠTERŠIČ, Jakob, LOPATIČ, Jože, SAJE, Franc. Shrinkage and creep of steel fiber reinforced normal strength concrete. Journal of testing and evaluation, ISSN 0090-3973, 2013, letn. 41, št.6, str. 959-969, ilustr., doi: 10.1520/JTE20120134. SAJE,
Drago, BANDELJ, Branko, ŠUŠTERŠIČ, Jakob, LOPATIČ, Jože, SAJE, Franc. Autogenous and Drying Shrinkage of Fibre Reinforced High-Performance Concrete. Journal of advanced concrete technology, ISSN 1346-8014, feb. 2012, letn. 10, št. 2, str. 59-73, ilustr., doi: 10.3151/jact.10.59.

ZIDANE KONSTRUKCIJE

UČNI NAČRT PREDMETA/COURSE SYLLABUS

Predmet:	Zidane konstrukcije
Course title:	Masonry Structures
Članica nosilka/UL Member:	UL FGG

Študijski programi in stopnja	Študijska smer	Letnik	Semestri	Izbirnost
Gradbeništvo, druga stopnja, magistrski	Gradbene konstrukcije (smer)		1. semester	izbirni
Stavbarstvo, druga stopnja, magistrski	Ni členitve (študijski program)		2. semester	izbirni

Univerzitetna koda predmeta/University course code:	0170318
Koda učne enote na članici/UL Member course code:	1800

Predavanja /Lectures	Seminar /Seminar	Vaje /Tutorials	Klinične vaje /Clinical tutorials	Druge oblike študija /Other forms of study	Samostojno delo /Individual student work	ECTS
30	0	30	0	0	60	4

Nosilec predmeta/Lecturer:	izr. prof. dr. Matija Gams, prof. dr. Vlatko Bosiljkov
Vrsta predmeta/Course type:	Izbirni strokovni /Elective professional

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

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

Vsebina:	Content (Syllabus outline):
Predavanja *Gradiva* (zidaki in malta, rege, polnilni beton, armaturno jeklo); *Zidovje* – mehanske lastnosti (tlačna, strižna, referenčna natezna in upogibna trdnost, deformacijske lastnosti (elastični, strižni modul, duktilnost), tečenje, raztezek zaradi vlage ali krčenje in raztezek zaradi	Lectures *Masonry material* (units and mortar, joints, grouting, reinforcement); *Masonry* – mechanical properties (compressive, shear, reference tensile and flexural strength, deformation properties (elastic, shear modulus, ductility), creep, moisture expansion, shrinkage,

temperature); *Nearmirano zidovje* (URM) (specifike nosilnih elementov zidovja – zid, steber, pilaster, lok); *Povezano* (C) *in armirano zidovje (RM)*; *Dodatne komponente za zidovje* (vlagozaporne plasti, zidna stremena, sidrni trakovi, obešala in konzole, pripomočki za prednapenjanje, prefabricirane preklade); *Stropne konstrukcije* (prefabricirane, tradicionalne in ločne stropne konstrukcije); *Nekonstrukcijski i sekundarni elementi*; *Modularna zasnova zidane stavbe* (moduli, zasnova, tlorisna oblika in višina zgradbe, razporeditev zidov, okenske in vratne odprtine); *Analiza konstrukcij* (standardi in specifike zidarije pri nas in v tujini, obnašanje konstrukcije v nezgodnih pogojih (drugih kot potres in požar), vplivi drugega reda, analiza elementov konstrukcij (pri navpični, strižni in izvenravninski obremenitvi, zidovi sestavljenih prerezov); *Izračun nosilnosti elementov konstrukcije* (URM (tlak, strig, izvenravninsko, kombinacija osna obtežba in strig), RM (pri upogibu, upogibu in osni obtežbi, strižna obtežba), CM (kombinacija osna obtežba in strig) in zidovje kot polnilo); *Načrtovanje sestave zidov – drugi vplivi* (sestave konstrukcijskih sklopov pogojenih funkcionalnimi zahtevami); *Način in pogoji izvedbe* (detajli, utori, izdelava zidovja, križanja ipd.); *Preverjanje potresne odpornosti zidanih zgradb* (osnovni principi preverjanja, računsko modeliranje obnašanja, specifike računa potresne odpornosti zidanih zgradb); *Projektiranje enostavnega URM objekta; Projektiranje zahtevnega objekta (nelinearna potisna analiza); Specifike preprojektiranja obstoječih tradicionalnih objektov* (karakterizacija obstoječega materiala opečnatega in kamnitega zidovja, določanje teksture in morfologije zidovja, določanje mehanskih lastnosti, izbira ustreznega modela za izračun zidane konstrukcije v odvisnosti od tipa stavbe, lege, geometrije in sestave materiala). Vaje: - laboratorijske in numerične vaje.	temperature expansion); *Unreinforced masonry (URM)* (characteristics of load bearing walls, column, pilaster, arches); *Confined (C) and reinforced masonry (RM); Ancillary components* (damp proof courses, ties, straps, hangers, brackets, prefabricated lintels, prestressing devices); *Floor structures* (prefabricated, traditional and arched structures); *Non-structural and secondary elements*; *Modular building design* (modular design, dimensions, height, wall configuration, openings); *Structural analysis* (code requirements and diversity of masonry material here and abroad, structural behaviour in accidental situations (other than earthquake and fire), second order effect, analysis of structural members (under vertical, shear and out-of-plane loading conditions, walls of composite and flanged sections); *Calculation of ultimate limit state* (URM (compressive, shear, out-of-plane, combined vertical and shear loading), RM (flexure with and without vertical loading, shear loading), CM (combined vertical and shear loading) and masonry infill); *Application of building science for environmental loads* (structural complexes); *Detailing and execution* (details, chases and recesses, bricklaying, wall-floor and wall-roof connections etc.); *Seismic assessment of masonry buildings* (basic principles, numerical modelling, seismic design); *Simplified calculation methods for URM structures; Design of masonry structure (nonlinear pushover analysis); Problems related to redesign of existing traditional buildings* (characterization of existing masonry material, assessment of texture and morphology, determine mechanical parameters for masonry, correct choice of effective numerical strategy for the evaluation of masonry building depending from the type of building, its position, geometry and type of used material). Tutorials: - laboratory and numerical tutorials.

Temeljna literatura in viri/Readings:

R.G. Drysdale, A.A. Hamid, L.R. Baker. 1994. Masonry Structures – Behavior and Design, Prentice Hall

A.W. Hendry, B.P.Sinha, S.R. Davies. 1997. Design of masonry structures – Third edition of Load Bearing Brickwork Design, E&FN Spon. W. Jäger, G. Marzahn. 2009. Mauerwerk, Bemessung nach DIN 1053-100, Ernst & Sohn M. Muravljov, B. Stevanović. 1999. Zidane i drvene konstrukcije zgrada, Gradjevinski fakultet Univerziteta u Beogradu, Srbija. Z. Sorić. 2004. Zidane konstrukcije I. Udžbenici Sveučilišta u Zagrebu, Hrvaška. M. Tomaževič. 1987. Zidane zgradbe na potresnih območjih, UL FAGG, Ljubljana, Slovenija. Deli standardov in nacionalni dodatki za njihovo aplikacijo (SIST EN 1990, SIST EN1996-1-1, SIST EN1996-1-2, SIST EN1996-2, SIST EN1996-3, SIST EN 1998-1, SIST EN 1998-3). Učno gradivo v spletni učilnici UL FGG.

Cilji in kompetence:	**Objectives and competences:**
Cilji: - Razumeti specifike tradicionalne in sodobne zidarije ter ločiti postopke preverjanja nosilnosti v odvisnosti od stopnje zahtevnosti objekta in tipa zidovja. - Osnovno poznavanje obnašanja konstrukcijskih elementov zidanih stavb pri različnih obtežbah. - Razumeti specifike obnašanja (mehaniko loma) zidovja kot kompozita pri večosnih obremenitvah. - Podati teoretične osnove za načrtovanje zidanih konstrukcij pri projektiranju enostavnih in bolj zahtevnih konstrukcij. - Projektiranje ob upoštevanju modularne koordinacije. - Učinkovito modeliranje zidanih konstrukcij v primeru potresne obtežbe v odvisnosti od tipa stavbe. Pridobljene kompetence: - Sposobnost analize in projektiranja enostavnih in bolj zahtevnih zidanih konstrukcij.	Objectives: - To understand problems related to traditional and contemporary masonry and diversification of methods for their assessment. - To obtain basic knowledge on the behaviour of masonry structural elements under different loading conditions. - To understand the behaviour of masonry as composite material under multiaxial loading conditions. - To define the theoretical bases for computational modelling of simplified and demanding masonry structures. - Modular design of masonry buildings. - Efficient modelling strategy for different types of masonry structures in the case of seismic loading. Acquired competences: - Ability to analyse and conceptualize simplified and design demanding masonry structures.

Predvideni študijski rezultati:	**Intended learning outcomes:**
- Ustrezni postopek določanja projektnih mehanskih parametrov za sodobno in tradicionalno zidovje. - Priprava vhodnih parametrov za izračun zidane konstrukcije v odvisnosti od tipa zidovja in konstrukcije. - Sposobnost dimenzioniranja, računskega modeliranja in konstrukcijske izvedbe tradicionalnih in sodobnih zidanih konstrukcij. - Poznavanje in dimenzioniranje izvedbe detajlov. - Sposobnost analize obstoječih tradicionalnih opečnatih in kamnitih zidanih stavb.	- Efficient procedure to determine design values for contemporary and traditional masonry. - Preparation of necessary input data for the assessment of masonry structures depending from the type of masonry and structure. - Ability of designing, computational modelling and construction of contemporary and traditional masonry structures. - Knowledge of special methods for the analysis and design of masonry details. - Ability to analyse existing traditional masonry buildings made from brickwork and stonework.

- Sposobnost načrtovanja novih stavb ob upoštevanju funkcionalnih zahtev za konstrukcijske sklope. - Sposobnost preverjanja potresne odpornosti zidane konstrukcije. - Sposobnost uporabe rezultatov računalniških programov za načrtovanje zidanih konstrukcij.	- Deeper understanding of the behaviour of contemporary masonry structures through application of building science for environmental loads. - Ability to seismic assess masonry structure. - Ability to critically assess the input data and the acquired computational results in the design of masonry structures.

Metode poučevanja in učenja:	**Learning and teaching methods:**
Predavanja in vaje v klasični učilnici, laboratorijske vaje v laboratoriju KPL in računalniški učilnici.	Lectures and tutorials in classical classroom, laboratory tutorials in computer classroom.

Načini ocenjevanja:	**Delež/Weight**	**Assessment:**
Vaje	20,00 %	Tutorials
Teoretični izpit	40,00 %	Theoretical part of exam
Računski izpit	40,00 %	Computational part of exam

Ocenjevalna lestvica:	**Grading system:**
5 - 10, pri čemer velja, da je pozitivna ocena od 6 - 10	5 - 10, a student passes the exam if he is graded from 6 to 10

Reference nosilca/Lecturer's references:

1. **BOSILJKOV, Vlatko**. Computational modelling of laterally loaded masonry walls as a part of support activities for the evaluation of slovenian national parameters for Eurocode 6. V: IBRAHIMBEGOVIĆ, Adnan (ur.), BRANK, Boštjan (ur.), KOŽAR, Ivica (ur.). *3rd International Conference on Multiscale Computational Methods for Solids and Fluids*, September 20-22, 2017, Ljubljana, Slovenia. Ljubljana: Faculty of Civil and Geodetic Engineering. 2017, str. 11-14, ilustr.
2. 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, jan. 2015, letn. 13, št. 1, str. 203-236, doi: 10.1007/s10518-014-9686-x.
3. 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, 2015, letn. 13, št. 1, str. 411-428, doi: 10.1007/s10518-014-9637-6.
4. 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, 2015, letn. 13, 1, str. 129-151, ilustr., doi: 10.1007/s10518-014-9648-3.
5. **BOSILJKOV, Vlatko**, PAGE, Adrian W., SIMUNDIC, Goran, ŽARNIĆ, Roko. Shear Capacity of the Flange-Web Intersections of Brick Masonry Non Rectangular Sections*. Journal of structural engineering*, ISSN 0733-9445. [Print ed.], 2010, letn. 136, št. 5, str. 574-585, doi: 10.1061/(ASCE)ST.1943-541X.0000139.
6. **BOSILJKOV, Vlatko**, PAGE, Adrian W., BOKAN-BOSILJKOV, Violeta, ŽARNIĆ, Roko. 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.

7. TOMAŽEVIČ, Miha, LUTMAN, Marjana, **BOSILJKOV, Vlatko**. Robustness of hollow clay masonry units and seismic behaviour of masonry walls. *Construction & building materials*, ISSN 0950-0618. [Print ed.], 2006, vol. 20, nr. 10, str. 1028-1039.
8. TRILLER, Petra, TOMAŽEVIČ, Miha, **GAMS, Matija**. Seismic strengthening of clay block masonry buildings with composites : an experimental study of a full scale three-storey building model. Bulletin of earthquake engineering, ISSN 1570-761X, Apr. 2019, str. 1-32, ilustr., doi: 10.1007/s10518-019-00609-0.
9. TRILLER, Petra, TOMAŽEVIČ, Miha, **GAMS, Matija**. Seismic behaviour of masonry buildings built of low compressive strength units. Bulletin of earthquake engineering, ISSN 1570-761X, Dec. 2018, vol. 16, iss. 12, str. 6191-6219, ilustr., doi: 10.1007/s10518-018-0418-5.
10. **GAMS, Matija**, TOMAŽEVIČ, Miha, BERSET, Thierry. Seismic strengthening of brick masonry by composite coatings : an experimental study. Bulletin of earthquake engineering, ISSN 1570-761X, Apr. 2017, str. 1-30, ilustr., doi: 10.1007/s10518-017-0136-4.
11. **GAMS, Matija**, ANŽLIN, Andrej, KRAMAR, Miha. Simulation of shake table tests on out-of-plane masonry buildings. Part III, Two-step fem approach. International journal of architectural heritage : conservation, analysis and restoration, ISSN 1558-3058. [Print ed.], Sep. 2016. doi: 10.1080/15583058.2016.1237589.
12. TOMAŽEVIČ, Miha, **GAMS, Matija**, BERSET, Thierry. Strengthening of stone masonry walls with composite reinforced coatings. Bulletin of earthquake engineering, ISSN 1570-761X, Jul. 2015, vol. 13, issue 7, str. 2003-2027, ilustr., doi: 10.1007/s10518-014-9697-7.
13. JÄGER A., **GAMS, Matija**. Practical design of masonry subjected to horizontal loads based on Eurocode 6 shear model. V: MODENA, Claudio (ur.), DA PORTO, Francesca (ur.), VALLUZZI, Maria Rosa (ur.). Brick and Block Masonry : Trends, Innovations and Challenges, Proceedings of the 16th International Brick and Block Masonry Conference (IBMAC 2016), 26-30 June 2016, Padova, Italy. Boca Raton.

VREDNOTENJE NEPREMIČNIN

UČNI NAČRT PREDMETA/COURSE SYLLABUS

Predmet:	Vrednotenje nepremičnin
Course title:	Real Estate Valuation
Članica nosilka/UL Member:	UL FGG

Študijski programi in stopnja	Študijska smer	Letnik	Semestri	Izbirnost
Gradbeništvo, druga stopnja, magistrski	Nizke gradnje (smer)		2. semester	izbirni
Stavbarstvo, druga stopnja, magistrski	Ni členitve (študijski program)		2. semester	izbirni

Univerzitetna koda predmeta/University course code:	0034981
Koda učne enote na članici/UL Member course code:	1555

Predavanja /Lectures	Seminar /Seminar	Vaje /Tutorials	Klinične vaje /Clinical tutorials	Druge oblike študija /Other forms of study	Samostojno delo /Individual student work	ECTS
30	0	30	0	0	60	4

Nosilec predmeta/Lecturer:	doc. dr. Daniel Kozelj
Vrsta predmeta/Course type:	izbirni - strokovni/Elective professional

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

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

Vsebina:	Content (Syllabus outline):
Predavanja: Trg in tržno vrednotenje nepremičnin: predmet ocenjevanja, ocenjevana vrednost in načini ocenjevanja vrednosti nepremičnin; ocenjevanje vrednosti zemljišč, ocenjevanje vrednosti nepremičnin v postopku komasacije, ocenjevanje vrednosti nepremičnin v primerih	Lectures: Real estate market and market real estate valuation: valuation subject, value and real estate valuation approaches: land valuation in specific cases, real estate valuation in the process of consolidation, real estate valuation in cases of easement and other restrictions of

stvarne služnosti in v primerih drugih omejitev lastninske pravice, ocenjevanje vrednosti v specifičnih primerih. Upoštevanje elementov trajnostnega razvoja v postopku ocenjevana vrednosti nepremičnin. Postopek posamičnega vrednotenja nepremičnin in uporaba standardov. Javno dostopni podatki za izdelavo cenitvenega poročila. Pridobivanje podatkov, analiza trga nepremičnin. Samostojna izdelava cenitvenega poročila.	rights. Real estate valuation in specific cases, taking into account elements of sustainable development. Process of individual real estate valuation and application of standards. Public records for real estate valuation reporting. Acquisition of data, analysis of the real estate market. Making a real estate report.

Temeljna literatura in viri/Readings:

Šubic Kovač, M. 2023. Vrednotenje nepremičnin, Študijsko gradivo, UL FGG, Ljubljana, dostopno v spletni učilnici.
Petersen, H. 2005. Marktorientierte Immobilienbewertung, Richard Boorberg Verlag, 85 str.
International valuation standards. International Valuation Standards Committee, IVSC.
Šubic Kovač, M. 1997. Ocenjevanje tržne vrednosti stavbnih zemljišč, Ministrstvo za pravosodje RS, 94 str.
Šubic Kovač, M. 1998. Vrednotenje stavbnih zemljišč. Ljubljana, UL FGG, 179 str.
The Appraisal of Real Estate. 2008. Appraisal Institute (izbrana poglavja).
Slovenska zakonodaja, pravilniki s področja obravnave: Uradni list RS. Dostopno na: http://www.uradni-list.si, www.dz-rs.si, www.pisrs.si/

Cilji in kompetence:	**Objectives and competences:**
Cilji: - Spoznavanje izrazoslovja in procesa vrednotenja nepremičnin ter razumevanje različnih načinov vrednotenja. Kompetence: - Pozna in razume izrazoslovje, proces in načine posamičnega vrednotenja nepremičnin. - Pozna in razume različne metode vrednotenja nepremičnin. - Sposobnost pridobivanja in analiziranja podatkov o trgu nepremičnin. - Sposobnost samostojno izdelati cenitveno poročilo. - Sposobnost prilagajanje novim razmeram pri razvoju stroke.	Objective: - To acquire knowledge regarding terminology and the process of real estate valuation; understanding various real estate valuation methods. Competences: - To know and understand the terminology and the process of real estate valuation - To know and understand various methods of real estate valuation - Ability to acquire and analyse data regarding real estate market - Ability to make an individual real estate report - Ability to adjust to changing conditions in the field of real estate valuation.

Predvideni študijski rezultati:	**Intended learning outcomes:**
- Študent pridobi znanje o načinih vrednotenja nepremičnin in jih zna uporabiti v praksi ter pri razvoju stroke. - Študent na osnovi pridobljenih znanj in spoznanj pri tem predmetu lahko kritično presoja razvoj vrednotenja nepremičnin, zahteve strank pri izdelavi cenitvenega poročila.	- Student acquires knowledge about various methods of real estate valuation and knows how to use them in practice and in the process of development of the field of real estate valuation. - Student has the ability to critically consider developments in the field of real estate

- Študent zna izdelati cenitveno poročilo s pomočjo metode primerljivih poslov.	valuation and customers' requirements when making real estate report. - Student is able to make a real estate report using market approach method.

Metode poučevanja in učenja:	**Learning and teaching methods:**
Predavanja, seminarske vaje z uporabo IKT.	Lectures, seminar tutorials using visual aids.

Načini ocenjevanja:	**Delež/Weight**	**Assessment:**
Projekt (cenitveno poročilo)	100,00 %	Project (real estate report)

Ocenjevalna lestvica:	**Grading system:**
5 - 10, pri čemer velja, da je pozitivna ocena od 6 - 10	5 - 10, a student passes the exam if he is graded from 6 to 10

Reference nosilca/Lecturer's references:

KAFOL STOJANOVIĆ, Ajda, KOZELJ, Daniel, ŠUBIC KOVAČ, Maruška. Assessment of water distribution system capacity as settlement-development decision-making expert basis at the local level = Ocena zmogljivosti vodovodnega sistema kot strokovna podlaga za odločanje o usmerjanju razvoja naselij na lokalni ravni. Geodetski vestnik : glasilo Zveze geodetov Slovenije, ISSN 0351-0271. [Tiskana izd.], 2020, letn. 64, št. 3, str. 389-401, ilustr.

KOZELJ, Daniel, RAK, Gašper, ŠKERJANEC, Mateja, ČENČUR CURK, Barbara, TORKAR, Anja, VALENČIČ, Urška, BRAČIČ-ŽELEZNIK, Branka, SIMONETI, Maja, LUKŠIČ, Andrej, VILHAR, Urša, KOZAMERNIK, Erika, JANŽA, Mitja, VAHTAR, Marta. Camaro-D : sodelovanje deležnikov pri uvajanju naprednih praks gospodarjenja s prostorom z vidika vplivov na vodni režim v povodju Donave : slovensko pilotno območje: Iška in Iški vršaj na Ljubljanskem barju - napajalno območje vodarne Brest. Ljubljana: Fakulteta za gradbeništvo in geodezijo: Naravoslovnotehniška fakulteta: Vodovod kanalizacija snaga, 2019. 51 str., ilustr.

RAK, Gašper, ŠKERJANEC, Mateja, BRAČIČ-ŽELEZNIK, Branka, KOZELJ, Daniel. Vpliv spremembe rabe tal na poplavno nevarnost in oskrbo z vodo = Impact of land use changes on flood risk and water supply. Ujma : revija za vprašanja varstva pred naravnimi in drugimi nesrečami, ISSN 0353-085X, 2019, št. 33, str. 168-178, ilustr.

UNIVERZALNA GRADITEV IN UPORABA OBJEKTOV

UČNI NAČRT PREDMETA/COURSE SYLLABUS

Predmet:	Univerzalna graditev in uporaba objektov
Course title:	Universal design and use of buildings
Članica nosilka/UL Member:	UL FGG

Študijski programi in stopnja	Študijska smer	Letnik	Semestri	Izbirnost
Stavbarstvo, druga stopnja, magistrski	Ni členitve (študijski program)		2. semester	izbirni

Univerzitetna koda predmeta/University course code:	0644335

Predavanja /Lectures	Seminar /Seminar	Vaje /Tutorials	Klinične vaje /Clinical tutorials	Druge oblike študija /Other forms of study	Samostojno delo /Individual student work	ECTS
15	15	30			60	4

Nosilec predmeta/Lecturer:	izr. prof. dr. Mateja Dovjak
Vrsta predmeta/Course type:	Izbirni strokovni /Elective professional

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

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

Vsebina:	Content (Syllabus outline):
Predavanja in seminarji • Pomen univerzalne graditve in uporabe objektov v kontekstu trajnostnega načrtovanja za raznolikost človeštva, družbeno vključenost in enakovrednost. • Pregled mednarodnih in nacionalnih pravnih aktov ter standardov in priporočil na področju dostopnosti in uporabe gradbenih objektov.	Lectures and seminar • The significance of universal design and use of buildings in the context of sustainable planning for human diversity, social inclusion, and equity. • An overview of international and national legal acts, standards, and recommendations in the field of accessibility and use of buildings.

• Mednarodna klasifikacija funkcioniranja, invalidnosti in zdravja (ICF); potrebe in zahteve uporabnikov stavb. • Dostopnost in uporaba javnih površin. • Dostopnost in uporaba nestanovanjskih stavb, inkluzivno oblikovanje in dostopnost do informacij. • Dostopnost in uporaba stanovanjskih stavb. • Definicija in vloga ergonomije za ohranjanje zdravja in dobrega počutja v delovnem in bivalnem okolju. • Sočasna vpeljava ergonomskih načel in antropometrije v načrtovanje delovnega mesta. • Morfologija procesa univerzalne graditve stavb za vsa življenjska obdobja, konvencionalne in napredne rešitve. Laboratorijske vaje Uporaba znanja na konkretnih primerih v grajenem okolju z ovirami, analiza stanja in določitev ukrepov. Spoznavanje potreb in zahtev oseb s trajno ali začasno oviranostjo, oseb z zmanjšano zmožnostjo (terenske vaje). Uporaba pristopa uporabniško usmerjenega načrtovanja za reševanje aktualnih problemov v grajenem okolju. Odločitvena analiza v morfologiji načrtovanja stavb in napredne rešitve.	• International classification of functioning, disability and health (ICF); needs and requirements. • Accessibility and use of public spaces. • Accessibility and use of non-residential buildings, inclusive design, and access to information. • Accessibility and use of residential buildings. • The definition and role of ergonomics in maintaining health and well-being in the work and living environment. • The simultaneous implementation of ergonomic principles and anthropometry in workplace design. • The morphology of the process of universal building construction for all life stages, conventional and advanced solutions. Laboratory tutorial: Application of knowledge to concrete examples in the built environment with obstacles, analysis of the situation, and determination of measures. Understanding the needs and requirements of people with permanent or temporary disabilities, people with reduced capabilities (field exercises). Application of the user-centered design approach to solve current problems in the built environment. Decision analysis in the morphology of building design and advanced solutions.

Temeljna literatura in viri/Readings:

Sanford, J. A. (2012). Universal design as a rehabilitation strategy. Springer Publishing Company. [Dostopno v DiKUL]. (pp.3-110; 267-277)
Železnik, B., Sendi, R., & Kerbler, B. (2020). Stanovanje v starosti: Prilagoditve domačega okolja za kakovostno bivanje. Urbanistični inštitut Republike Slovenije.
Dovjak, M., & Kukec, A. (2019). Creating healthy and sustainable buildings: an assessment of health risk factors. Springer Open, cop. https://doi.org/10.1007/978-3-030-19412-3
(pp. 1-74)
Vovk, M. (2000). Načrtovanje in prilagajanje grajenega okolja v korist funkcionalno oviranim osebam. Ljubljana: Urbanistični inštitut Republike Slovenije.
MOP (2016). Inkluzivno oblikovanje in dostop do informacij v okviru načrtovanja in gradnje objektov v javni rabi. Priročnik, 1. izdaja. Ministrstvo za okolje in prostor.
MOP (2017). Univerzalna stanovanjska graditev. Priročnik, 1. izdaja. Ministrstvo za okolje in prostor.

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

• Poznati in razumeti pomen univerzalne graditve in uporabe objektov ter ergonomije za zdravje in dobro počutje. • Poznati zakonske zahteve in priporočila univerzalne graditve in uporabe objektov v kontekstu trajnostnega načrtovanja. • Razumeti raznolikost uporabnikov in njihove specifične potrebe v celotnem procesu graditve. • Razumeti morfologijo procesa univerzalne graditve stavb za vsa življenjska obdobja ter prepoznati konvencionalne in napredne rešitve. • Sposobnost analiziranja in interpretacije področnih pravnih aktov, standardov in priporočil. • Sposobnost uporabe načel inkluzivnega oblikovanja pri načrtovanju nestanovanjskih in stanovanjskih stavb. • Sposobnost sočasne vpeljave ergonomskih načel in antropometrije v načrtovanje delovnega mesta. • Sposobnost timskega delovanja.	• To know and understand the importance of universal design and use of buildings, as well as ergonomics for health and well-being. • To know the legal requirements and recommendations for universal design and use of buildings in the context of sustainable planning. • To understand the diversity of users and their specific needs throughout the construction process. • To understand the morphology of the universal design process of buildings for all life stages and to recognize conventional and advanced solutions. • The ability to analyze and interpret relevant legal acts, standards, and recommendations. • The ability to apply the principles of inclusive design in the planning of non-residential and residential buildings. • The ability to simultaneously implement ergonomic principles and anthropometry in workplace design. • The ability to work in a team.

Predvideni študijski rezultati:	**Intended learning outcomes:**
Študent • Uporabi zakonske zahteve in priporočila za univerzalno graditev ter načela ergonomije za zdravje in dobro počutje v projektni nalogi. • Uporabi načela inkluzivnega oblikovanja pri načrtovanju nestanovanjskih in stanovanjskih stavb. • Sočasno vpelje ergonomska načela in antropometrijo v načrtovanje delovnega mesta; konvencionalne in napredne rešitve v projektno nalogo. • Argumentira predlog rešitev v multidisciplinarnem timu.	Student • Apply legal requirements and recommendations for universal design and principles of ergonomics for health and well-being in project tasks. • Apply principles of inclusive design in the planning of non-residential and residential buildings. • Simultaneously implement ergonomic principles and anthropometry in workplace design; incorporate conventional and advanced solutions into the project task. • Argue proposed solutions within a multidisciplinary team.

Metode poučevanja in učenja:	**Learning and teaching methods:**
Predavanja, seminar in laboratorijske vaje. Projektni pristop.	Lectures, seminars, and laboratory exercises. Project approach.

Načini ocenjevanja:	**Delež/Weight**	**Assessment:**
Izpit	50,00 %	Exam
Ocena projektne naloge	50,00 %	Project assignment

Ocenjevalna lestvica:	Grading system:
5 - 10, pri čemer velja, da je pozitivna ocena od 6 - 10	5 - 10, a student passes the exam if he is graded from 6 to 10

Reference nosilca/Lecturer's references:

Dovjak, M., & Kukec, A. (2019). Creating healthy and sustainable buildings: an assessment of health risk factors. Springer Open, cop. https://doi.org/10.1007/978-3-030-19412-3 (pp. 1-74)
Recek, P., Kump, T., & Dovjak, M. (2019). Indoor environmental quality in relation to socioeconomic indicators in Slovenian households. *Journal of housing and the built environment*, 34, 4, 1065-1085. https://doi.org/10.1007/s10901-019-09659-x
Dovjak, M., Hvala, U., Plemelj Mohorič, A., & Klinc, R. Oblikovanje stanovanja za vsa življenjska obdobja = Designing an apartment for human life cycle stages. V: Galof, K. (ur.), Švajger, A. (ur.), Ocepek, J. (ur.). Kakovost = priložnost + možnost + izbira : 11. kongres delovnih terapevtov Slovenije : Otočec, 30. in 31. maj 2024. Ljubljana: Zbornica delovnih terapevtov Slovenije, 2024. Str. 27-34, Slovenska revija za delovno terapijo, Letn. 13, supl. 1. ISSN 1580-6561.