

Univerza  
v Ljubljani

Fakulteta  
*za gradbeništvo  
in geodezijo*



## Učni načrti

Magistrski študijski program druge stopnje

**STAVBARSTVO (MA)**

## Course Syllabi

2<sup>nd</sup> cycle master study

**BUILDINGS (MA)**

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**UČNI NAČRT PREDMETA / COURSE SYLLABUS**

<b>Predmet:</b>	Diferencialne enačbe in geometrija
<b>Course title:</b>	Differential equations and geometry

Študijski program in stopnja Study programme and level	Študijska smer Study field	Letnik Academic year	Semester Semester
Stavbarstvo – druga stopnja MA		1	1
Buildings – second cycle MA		1	1

**Vrsta predmeta / Course type:** Obvezni strokovni / obligatory professional

**Univerzitetna koda predmeta / University course code:**

Predavanja Lectures	Seminar Seminar	Vaje Tutorial	Klinične vaje work	Druge oblike študija	Samost. delo Individ. work	ECTS
60			30		90	6

**Nosilec predmeta / Lecturer:** izr.prof.dr. Mitja Lakner

<b>Jeziki /</b>	<b>Predavanja / Lectures:</b>	slovenski / Slovene
<b>Languages:</b>	<b>Vaje / Tutorial:</b>	slovenski / Slovene

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

Opravljen izpit iz predmetov Matematika I in Matematika II oz. iz drugih predmetov s primerljivo vsebino.

**Prerequisites:**

Passed exams in Mathematics I and Mathematics II, or other courses with comparable content.

**Vsebina:**

- Navadne diferencialne enačbe: LDE n-tega reda, linearni sistemi, robni problemi, Fourierove vrste, numerično reševanje.
- Parcialne diferencialne enačbe: toplotna in valovna enačba, začetni in robni problemi, Laplaceova transformacija, numerično reševanje.
- Vektorji v prostoru in operacije z njimi.
- Linearne in afine preslikave, matrike.
- Krivulje v ravnini in prostoru: parametrizacija, aproksimacija, Bezierove krivulje, B-zlepki.
- Ploskve: gladka elementarna ploskev, parametrizacija, odsekoma gladka ploskev, premonosne ploskve, rotacijske ploskve, aproksimacija, Bezierove ploskve, dvodimenzionalni kubični B-zlepki.

**Content (Syllabus outline):**

- Ordinary differential equations: LDE of order n, linear systems, boundary value problems, Fourier series, numerical methods.
- Partial differential equations: heat and wave equations, initial and boundary value problems, Laplace transformation, numerical methods.
- Vectors in space and operations with them.
- Linear and affine transformations, matrices.
- Curves in plane and space: parameterisation, approximation, Bezier curves, B-splines.
- Surfaces: elementary smooth surfaces, parameterisation, piecewise smooth surfaces, ruled surfaces, surfaces of revolution, approximations, Bezier surfaces, twodimensional cubic B-splines.

**Temeljni literatura in viri / Readings:**

Braun, M. (1993). *Differential Equations and Their Applications*, Springer-Verlag.  
 Farin, G. 2002. *Curves and surfaces for CAGD*. Morgan – Kaufmann.  
 Kappraff, J. 1991. *Connections – the geometric bridge between art and science*. World scientific.  
 Pinchover, Y., Rubinstein, J., *An Introduction to Partial Differential Equations*, Cambridge University Press, 2005.

**Cilji in kompetence:****Cilji:**

- Omogočiti razumevanje matematičnega aparata, ki ga uporabljajo strokovni predmeti.
- Predstaviti različne oblike diferencialnih enačb in metode za njihovo reševanje.
- Zagotoviti solidno razumevanje osnov geometrije.
- Seznaniti z uporabo računalniških orodij za numerično reševanje diferencialnih enačb in za geometrijsko oblikovanje.
- Vpeljati v samostojno in timsko projektno orientirano delo.

**Pridobljene kompetence:**

- Zmožnost prepoznavanja diferencialne enačbe in izbire ustreznega orodja za iskanje rešitev.
- Sposobnost rešitve nekaterih netrivialnih geometrijskih problemov s kombiniranjem znanja matematike in računalništva.
- Pridobitev ustrezne literature/podpore.

**Objectives and competences:****Objectives:**

- To enable understanding of mathematical tools used by engineering courses.
- To present different forms of differential equations and methods for solving them.
- To ensure solid understanding of basics of geometry.
- To get acquainted with the application of computer software for numerical solving of differential equations and for geometric design.
- 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 in order to solve some nontrivial problems in geometry.
- Skills in acquirement of the appropriate literature.

**Predvideni študijski rezultati:**

- Uporaba diferencialnih enačb pri modeliranju inženirskih problemov.
- Poglobljeno razumevanje geometrije v prostoru.
- Obvladovanje matematičnega aparata do stopnje, ko se lahko suvereno uporablja zmogljiv računalniški program.
- Sposobnost kritične presoje dobljenih računalniških rezultatov.

**Intended learning outcomes:**

- Application of differential equations for modelling of problems in engineering.
- In-depth understanding of the geometry in three dimensions.
- 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:**

Predavanja, seminarske naloge, laboratorijske vaje, domače naloge.

**Learning and teaching methods:**

Lectures, tutorials, consultations, internet.

Delež (v %) /

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

**Reference nosilca / Lecturer's references:**

LIPAR, Peter, LAKNER, Mitja, MAHER, Tomaž, ŽURA, Marijan. Estimation of road centerline curvature from raw GPS data. *The Balt. J. road bridge eng.*, 2011, letn. 6, št. 3, str. 163-168, ilustr., doi: 10.3846/bjrbe.2011.21.

KRAMAR FIJAVŽ, Marjeta, LAKNER, Mitja, ŠKAPIN-RUGELJ, Marjeta. An equal-area method for scalar conservation laws. *The Anziam journal*, 2012, vol. 53, iss. 2, str. 156-170. <http://dx.doi.org/10.1017/1446181112000065>.

LAKNER, Mitja, PETEK, Peter, ŠKAPIN-RUGELJ, Marjeta. *Diskretni dinamični sistemi*, (Podiplomski seminar iz matematike, 28). Ljubljana: DMFA - založništvo, 2015. 157 str., ilustr. ISBN 978-961-212-263-8. [COBISS.SI-ID [279069952](#)].

UČNI NAČRT PREDMETA / COURSE SYLLABUS	
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<b>Predmet:</b>	Dnevna svetloba
<b>Course title:</b>	Daylight

Študijski program in stopnja Study programme and level	Študijska smer Study field	Letnik Academic year	Semester Semester
Stavbarstvo – druga stopnja MA		1	1
Buildings – second cycle MA		1	1

**Vrsta predmeta / Course type:** Obvezni strokovni / obligatory professional

**Univerzitetna koda predmeta / University course code:**

Predavanja Lectures	Seminar Seminar	Vaje Tutorial	Klinične vaje work	Druge oblike študija	Samost. delo Individ. work	ECTS
30			60		90	6

**Nosilec predmeta / Lecturer:** doc. dr. Mitja Košir

<b>Jeziki /</b>	<b>Predavanja / Lectures:</b>	slovenski / Slovene
<b>Languages:</b>	<b>Vaje / Tutorial:</b>	slovenski / Slovene

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

**Prerequisites:**

**Vsebina:**

**Predavanja:**  
 Prostorske konstituante za bioklimatsko oblikovanje stavb (geografske in podnebne razmere lokacije). Človek (upoštevanje psiho-fizioloških potreb človeka pri oblikovanju bivalnega in delovnega okolja). Stavba (notranji prostor in ovoj). Konfiguracija vplivnih faktorjev (dnevna svetloba, osončenje). Metode za izračun in preverjanje osončenja in dnevnega osvetljevanja. Komponente: stekla, zasteklitve, sečila, nadzorni sistemi. Elementi odprtín: horizontalni in vertikalni sistemi. Strategije oblikovanja bivalnega in delovnega okolja s pomočjo dnevne in sončne svetlobe.

**Vaje:**  
 Uporaba znanja na konkretnem primeru v stavbi, oblikovanje koncepta, faktorska analiza, optimizacija sistema (sinteza), simulacije odziva stavbe in prostora s pomočjo programske opreme.

**Content (Syllabus outline):**

**Lectures:**  
 Bioclimatic building design within defined space constituents (location, geography, climatic conditions), human (psycho-physiological human needs and the design of living and working environment), building (indoor environment, building envelope systems). Configuration of influential factors (daylight, insolation). Methods for the calculation and verification of insolation and daylight illuminance. Components: glass, glazing, shading devices, control systems. Elements of transparent constructional complexes: horizontal and vertical systems. Strategies for the design of living and working environment on the basis of insolation and daylight illuminance.

**Tutorial:**  
 Application of theoretical knowledge in a particular building case, concept design, factor analysis, system optimization (synthesis), simulation of the whole building and individual space with appropriate computer software.

**Temeljni literatura in viri / Readings:**

McMullan, R. 2007. Environmental science in building. New York, Palgrave Macmillan.  
 Littlefair, P.J. 1995. Site layout planning for daylight and sunlight, A guide to good practice. Construction Research Communications Ltd.  
 Crisinel, M. ed. 2007. Glass & interactive building envelopes, COST C13. IOS Press.  
 e-učilnica Katedre za stavbe in konstrukcijske elemente na spletu: <http://kske.fgg.uni-lj.si> .

**Cilji in kompetence:****Cilji:**

- Izboljšanje kakovosti grajenega okolja.
- Zmanjševanje negativnih vplivov na zunanje okolje.
- 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).
- Razume značilnosti in delovanje sistemov transparentnih delov stavbnega ovoja in njihovih realizacij.
- Pozna izhodišča kontrolnih sistemov in njihovo vlogo pri optimizaciji delovanja odprtih.
- Sposoben je zasnovati in optimizirati sistem svetlobnih odprtih 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 za področje dnevnega osvetljevanja in osončenja stavb.

**Objectives and competences:****Objectives:**

- The main objectives of the course are to improve the quality of the built environment.
- To minimize negative impacts on the environment.
- 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 the framework of real building case; linking daylight design to other fields of building physics).
- Understanding the main characteristics and functioning of transparent constructional complexes and their implementation.
- Getting familiar with the basics of control systems and their role in the optimization of transparent constructional complexes functioning.
- Ability to design and optimize a proposed system of transparent constructional complexes.
- Ability to use calculation methods and computer software for daylight illuminance and building insolation analyses.
- Critical evaluation and interpretation of results.
- Getting familiar with current legislation from the field of daylight illuminance and insolation of buildings.

**Predvideni študijski rezultati:**

- Razumevanje delovanja transparentnih delov stavbnega ovoja, zasnova in analiza vplivov direktnega osončenja in zajema dnevne svetlobe v stavbi, sposobnost ocene odziva stavbe na osončenje in dnevno svetlobo.
- Uporaba računskih metod in programske opreme za analizo obravnavanih elementov svetlobnega in (posredno) toplotnega odziva stavbe oziroma prostora.

**Intended learning outcomes:**

- Understanding the functioning of transparent constructional complexes, design and analysis of the effects of insolation and daylight in the buildings, ability to assess the building response to the insolation and daylight.
- 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

- Sposobnost samostojne ocene položaja in vloge obravnavnih elementov v sistemu okolje/človek/stavba.
- 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.

- active spaces.
- Ability to evaluate the status and the role of the analysed elements in the system: environment/human/building, identification of interconnections.
- 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:**

Predavanja, laboratorijske vaje.

**Learning and teaching methods:**

Lectures, laboratory work.

**Načini ocenjevanja:**

Delež (v %) /  
Weight (in %)

**Assessment:**

Pisni izpit	<b>30 %</b>	Written exam
Ocena izdelka vaj	<b>70 %</b>	Tutorial and laboratory work

**Reference nosilca / Lecturer's references:**

ERŽEN, Jure, KOŠIR, Mitja. Dinamične metrike za oceno dnevne osvetljenosti in njihova uporaba pri analizi učilnic v slovenskih osnovnih šolah = Dynamic daylighting metrics and its application for the evaluation of classrooms in Slovenian primary schools. *Gradbeni vestnik*, ISSN 0017-2774, feb. 2016, letn. 65, str. 41-53.

KOŠIR, Mitja, KRAINER, Aleš, DOVJAK, Mateja, KRISTL, Živa. Automatically controlled daylighting for visual and nonvisual effects. *Lighting research & technology*, ISSN 1477-1535. [Print ed.], 2011, letn. 43, št. 4, str. 439-455.

KOŠIR, Mitja, KRAINER, Aleš, KRISTL, Živa. A study of visual and non-visual effects of daylighting in an office. V: MAHDAVI, A. (ur.). *Contributions to building physics*. Vienna: Department of building physics and building ecology, 2013, str. 521-527, ilustr.



### UČNI NAČRT PREDMETA / COURSE SYLLABUS

<b>Predmet:</b>	Projektiranje nosilnih konstrukcij stavb
<b>Course title:</b>	Design of building structures

Študijski program in stopnja Study programme and level	Študijska smer Study field	Letnik Academic year	Semester Semester
Stavbarstvo – druga stopnja MA		1	1
Buildings – second cycle MA		1	1

**Vrsta predmeta / Course type:** Obvezni strokovni / obligatory professional

**Univerzitetna koda predmeta / University course code:**

Predavanja Lectures	Seminar Seminar	Vaje Tutorial	Klinične vaje work	Druge oblike študija	Samost. delo Individ. work	ECTS
80		80	80		240	16

**Nosilec predmeta / Lecturer:** prof. dr. Matjaž Dolšek, doc. dr. Primož Može, izr. prof. dr. Jože Lopatič, doc. dr. Sebastjan Bratina, izr. prof. dr. Janko Logar

<b>Jeziki /</b>	<b>Predavanja / Lectures:</b>	slovenski / Slovene
<b>Languages:</b>	<b>Vaje / Tutorial:</b>	slovenski / Slovene

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

Obveznih pogojev ni, vendar delo brez osnovnega znanja statike in dimenzioniranja elementov iz različnih materialov praktično ni mogoče.

**Prerequisites:**

There are no mandatory prerequisites. However, without the basic knowledge how to calculate internal forces and how to proportion the elements made of different materials, the work (participation in the course) is practically impossible.

**Vsebina:**

Predavanja:  
Predavanja potekajo v več delih: Fischinger: Zasnova konstrukcij in potresno inženirstvo; Bratina: Projektiranje betonskih stavb; Sinur: Projektiranje jeklenih stavb; Lopatič: Projektiranje lesenih stavb; Logar: Geotehnično projektiranje. Pred začetkom izdelave projektnih nalog ter sproti med izdelavo nalog glede na specifične potrebe in želje študentov ter posebnosti vsakoletnega izbora obravnavanih stavb.

Splošna uvodna predavanja obravnavajo: Osnovne principe zasnove konstrukcijskega sistema, najprej na splošno, nato pa z upoštevanjem specifične posameznih materialov (betona, prednapetega betona, jekla, sovprežnih rešitev jeklo/beton, lesa in zidanih izvedb). Pri tem je poudarek na

**Content (Syllabus outline):**

Lectures:  
Lectures are composed of five basic parts/courses: Fischinger: Conceptual Design and Earthquake Engineering; Bratina: Design of Concrete Buildings; Sinur: Design of Steel Buildings; Lopatič: Design of Timber Buildings; Logar: Geotechnical Design. Additional lectures, related to specific assignments/projects will be organized before the beginning of the work on the main project as well as during the work as required by the choice of the buildings, analysed each year ("just-in-time lectures").

General introductory lectures are composed of: Basic principles of conceptual design – first given in general, then specifically for different materials used (reinforced concrete, prestressed concrete,

povezavah med elementi ter delovanju konstrukcije kot celote. Principe izbire sistema temeljev in mehanizme njihovega delovanja. Zagotavljanje duktilnosti in principe načrtovanja nosilnosti potresno odpornih stavb. Predstavitev teoretičnih osnov za uporabljeno programsko opremo.

#### Vaje:

Za stavbo, ki je bila že prej zasnovana in obravnavana iz različnih drugih vidikov se preštudira in ovrednoti več različnih rešitev konstrukcijskih sistemov z možnostjo uporabe različnih materialov ali njihove sinteze ter več možnih načinov temeljenja. Pri tem se upošteva soodvisnost rešitev z drugimi bistvenimi zahtevami iz direktive o gradbenih proizvodih. Študentje/ke argumentirajo svojo izbiro in za izbrano varianto izdelajo podrobnejši projekt nosilne konstrukcije. Pri posameznih temah se najprej izdelata nekaj preprostih domačih nalog, ki podajo oziroma utrdijo znanja iz konstruiranja.

steel, composite materials, timber, and masonry). The connections between the elements and the integrity of the structure are emphasized; The principles of choosing adequate foundation system and the mechanisms of their behaviour; Ductility and capacity design for earthquake-resistant structures; Theoretical background for the introduced computer programs.

#### Tutorial:

For building, which was previously addressed within the scope of other courses from other (non-structural) points of view, the students will study and evaluate: different structural systems; made from different materials or their combinations; different foundation systems. They will consider the interrelationship of different requirements given in the EU Construction Products Directive. The students should finally provide argumentation for their final choice and make the design project for the chosen system. Some simple additional assignments will be made to enhance the knowledge related to specific topics related to the main project.

#### Temeljna literatura in viri / Readings:

Beg, D. 1999. Projektiranje jeklenih konstrukcij po evropskem predstandardu ENV 1993-1-1. 2. UL, FGG.  
O'Brien, E.J. 1995. Reinforced and Prestressed Concrete Design. Longman, 1995.  
Thelanderson, S., Larsen, H.J. (urednika). 2003. Timber Engineering. John Wiley & Sons Inc.  
Salgado, R. 2008. The Engineering of Foundations. Boston, McGraw-Hill.  
EASY (Earthquake Engineering Slide Information System), IKPIR FGG, CD ali [www.ikpir.fgg.uni-lj.si/EASY](http://www.ikpir.fgg.uni-lj.si/EASY).

#### Cilji in kompetence:

##### Cilji:

- Razložiti in naučiti standardne postopke za zagotavljanje mehanske odpornosti in stabilnosti konstrukcij stavb iz različnih materialov (betona, jekla, lesa, zidov).
- Razložiti in naučiti standardne postopke za zagotavljanje mehanske odpornosti in stabilnosti temeljev.
- Upoštevajoč redne in izredne (potres, požar) vplive.

##### 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

#### Objectives and competences:

##### Objectives:

- To present, explain and teach the procedures providing mechanical resistance and stability of building structures made of different materials (concrete, steel, timber, masonry) under standard and exceptional (earthquake, fire) loads.

##### 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

osnovnih principov zagotavljanja potresne odpornosti konstrukcij stavb.

- Sposobnost uporabe računskih metod in programske opreme za projektiranje bolj zahtevnih nosilnih konstrukcij stavb in njihovih temeljev.
- Poznavanje sodobnih IT podprtih orodij v projektiranju.

of more complex structural systems of buildings.

- The ability to use the IT supported tools in design.

#### **Predvideni študijski rezultati:**

- 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 bolj zahtevnih nosilnih konstrukcij stavb in njihovih temeljev.
- Sposobnost identifikacije in kvantifikacije kritičnih obtežb.
- Kompetentna uporaba evropskih standardov za projektiranje konstrukcij Eurokod.
- Spoznanje, da je za uspešen projekt stavbe potrebno uravnoteženo izpolniti vseh šest bistvenih zahtev iz Direktive za gradbene proizvode in da h temu pripomore primerna izbira ter kombinacija gradbenih materialov.
- Identifikacija in reševanje problemov, kritična analiza, argumentirana izbira med več možnostmi, sinteza, delo v skupini.

#### **Intended learning outcomes:**

- 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 rather complex 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.
- The students become aware that the successful design project of a building structure depends on the balanced consideration of all 6 basic requirements in the EU Construction Products Directive and on the balanced use of the advantages of different materials.
- 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:**

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.

#### **Learning and teaching methods:**

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

**Reference nosilca / Lecturer's references:**

LAZAR SINKOVIČ, 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, [v tisku] 2015, letn. X, št. XX, str. 1-20.

KOSIČ, Mirko, FAJFAR, Peter, DOLŠEK, Matjaž. Approximate seismic risk assessment of building structures with explicit consideration of uncertainties. *Earthquake engineering & structural dynamics*, ISSN 0098-8847. [Print ed.], avg. 2014, letn. 43, št. 10, str. 1483-1502.

ČERMELJ, Blaž, MOŽE, Primož, SINUR, Franc. On the prediction of low-cycle fatigue in steel welded beam-to-column joints. *Journal of Constructional Steel Research*, ISSN 0143-974X. [Print ed.], feb. 2016, letn. 117, str. 49-63.

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.

SINUR, Franc, MOŽE, Primož, REJEC, Klemen, LUŽAR, Gašper, BEG, Darko. Imperfection sensitivity of thin plates loaded in shear. *Revue roumaine des sciences techniques, Série de mécanique appliquée, Applied mechanics*, ISSN 0035-4074, jan- avg. 2014, št. 1-2, letn. 59, str. 121-139.

PLANINC, Igor, SCHNABL, Simon, SAJE, Miran, LOPATIČ, Jože, ČAS, Bojan. Numerical and experimental analysis of timber composite beams with interlayer slip. *Engineering structures*, ISSN 0141-0296. [Print ed.], 2008, letn. 30, št. 11, str. 2959-2969.

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.

ČAS, Bojan, LOPATIČ, Jože, SAJE, Miran, SCHNABL, Simon, PLANINC, Igor. Experimental and numerical analysis of composite wood beams : paper 199. V: TOPPING, Barry H. V. (ur.). *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, 26 str.

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.

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

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

VOGT, Norbert B., SCHUPPENER, Bernd, WEISSENBACH, Anton, LOGAR, Janko. Projektni pristopi v Evrokodu 7-1 za geotehnično projektiranje v Nemčiji = Design approaches of EC 7-1 for geotechnical verifications used in Germany. *Gradbeni vestnik*, ISSN 0017-2774, oktober 2006, letn. 55, str. 254-261.

**UČNI NAČRT PREDMETA / COURSE SYLLABUS**

<b>Predmet:</b>	Konstrukcijska gradbena fizika
<b>Course title:</b>	Structural building physics

Študijski program in stopnja Study programme and level	Študijska smer Study field	Letnik Academic year	Semester Semester
Stavbarstvo – druga stopnja MA		1	2
Buildings – second cycle MA		1	2

**Vrsta predmeta / Course type:** Obvezni strokovni / obligatory professional

**Univerzitetna koda predmeta / University course code:**

Predavanja Lectures	Seminar Seminar	Vaje Tutorial	Klinične vaje work	Druge oblike študija	Samost. delo Individ. work	ECTS
60		60	60		180	12

**Nosilec predmeta / Lecturer:** izr. prof. dr. Zvonko Jagličić

<b>Jeziki /</b>	<b>Predavanja / Lectures:</b>	slovenski / Slovene
<b>Languages:</b>	<b>Vaje / Tutorial:</b>	slovenski / Slovene

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

**Prerequisites:**

**Vsebina:**

**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 (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.

**Content (Syllabus outline):**

**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 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.

**Temeljni 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., Jagličič, Z. 2014. Osnove gradbene fizike. UL, FGG.

**Cilji in kompetence:****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.

**Pridobljene kompetence:**

- Sposobnost fizikalno-matematične formulacije praktičnih problemov na teh področjih.
- Pravilna izbira matematičnega orodja.

**Objectives and competences:****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.

**Gained competences:**

- Ability to formulate engineering problems using appropriate physical and mathematical methods in order to obtain quantitative results.

**Predvideni študijski rezultati:**

- 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 primerne matematičnega orodja za analizo praktičnih problemov.

**Intended learning outcomes:**

- 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.

**Metode poučevanja in učenja:**

Predavanja, računski zgledi na vajah in uporaba prosto dostopnih računalniških programov za izračun prenosa toplote in vlage skozi konstrukcijske sklope.

**Learning and teaching methods:**

Lectures and problem solving classes  
Application of a freely available computer programs designed for solving heat and moisture transport problems.

**Načini ocenjevanja:**

Delež (v %) /

Weight (in %)

**Assessment:**

Pisni izpit	<b>30 %</b>	Written exam
Ustni zagovor domačih nalog	<b>70 %</b>	Oral defence of home assignments

**Reference nosilca / Lecturer's references:**

COTIČ, Patricia, JAGLIČIĆ, Zvonko, NIEDERLEITHINGER, Ernst, EFFNER, Ute, KRUSCHWITZ, Sabine, TRELA, Christiane, BOSILJKOV, Vlatko. Effect of moisture on the reliability of void detection in brickwork masonry using radar, ultrasonic and complex resistivity tomography. Mat. struct., 2013, letn. 46, št. 10, str. 1723-1735

COTIČ, Patricia, JAGLIČIĆ, Zvonko, BOSILJKOV, Vlatko. Validation of non-destructive characterization of the structure and seismic damage propagation of plaster and texture in multi- leaf stone masonry walls of cultural-artistic value. Journal of cultural heritage, 2013, 12 str.

JAGLIČIĆ, Zvonko, PAJIĆ, Damir, TRONTELJ, Zvonko, DOLINŠEK, Janez, JAGODIČ, Marko. Magnetic memory effect in multiferroic. Appl. phys. lett., 2013, vol. 102, no. 24, str. 242410-1-242410-4



### UČNI NAČRT PREDMETA / COURSE SYLLABUS

<b>Predmet:</b>	Informacijsko modeliranje stavb
<b>Course title:</b>	Building information modelling

Študijski program in stopnja Study programme and level	Študijska smer Study field	Letnik Academic year	Semester Semester
Stavbarstvo – druga stopnja MA		1	2
Buildings – second cycle MA		1	2

**Vrsta predmeta / Course type:** Obvezni strokovni / obligatory professional

**Univerzitetna koda predmeta / University course code:**

Predavanja Lectures	Seminar Seminar	Vaje Tutorial	Klinične vaje work	Druge oblike študija	Samost. delo Individ. work	ECTS
30			30		60	4

**Nosilec predmeta / Lecturer:** doc. dr. Tomo Cerovšek

**Jeziki / Languages:** **Predavanja / Lectures:** slovenski / Slovene  
**Vaje / Tutorial:** slovenski / Slovene

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

**Prerequisites:**

**Vsebina:**

**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 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,

**Content (Syllabus outline):**

**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 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.

študije na osnovi informacijskih modelov stavb (za preverbo količin, analizo materialov, energetska analizo).

### Temeljna literatura in viri / Readings:

Eastman, C.M. 2008. BIM Handbook, A Guide 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:

#### 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 and competences:

#### 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:

- 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,

### Intended learning outcomes:

- 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-

– analize za trajnostno projektiranje na osnovi BIM,  
– integriran projekt BIM z vsemi bistvenimi elementi in izmenjavami modelnih vsebin.

bearing and non-load-bearing elements.

#### Metode poučevanja in učenja:

Predavanja sledijo problemsko naravnemu delu na konkretnem projektu. Vsebine so delno posredovane v obliki multimedijskih gradiv.

#### Learning and teaching methods:

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 (v %) / Weight (in %)	Assessment:
Sprotno delo: oddaja nalog	<b>50 %</b>	Course work and home-works
Pisni teoretični izpit	<b>30 %</b>	Written theoretical exam
Projekt	<b>20 %</b>	BIM Project

#### 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.

UČNI NAČRT PREDMETA / COURSE SYLLABUS	
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<b>Predmet:</b>	Požar
<b>Course title:</b>	Fire

Študijski program in stopnja Study programme and level	Študijska smer Study field	Letnik Academic year	Semester Semester
Stavbarstvo – druga stopnja MA		1	2
Buildings – second cycle MA		1	2

**Vrsta predmeta / Course type:** Obvezni strokovni / obligatory professional

**Univerzitetna koda predmeta / University course code:**

Predavanja Lectures	Seminar Seminar	Vaje Tutorial	Klinične vaje work	Druge oblike študija	Samost. delo Individ. work	ECTS
30			60		90	6

**Nosilec predmeta / Lecturer:** doc. dr. Tomaž Hozjan

<b>Jeziki /</b>	<b>Predavanja / Lectures:</b>	slovenski / Slovene
<b>Languages:</b>	<b>Vaje / Tutorial:</b>	slovenski / Slovene

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

**Prerequisites:**

**Vsebina:**

**Predavanja:**  
Splošno o požarnem inženirstvu. Pregled osnovnih pojmov. Evropski standardi in predpisi. Požarna obtežba. Modeli standardnih in realnih požarov. Ukrepi aktivne požarne zaščite. Evakuacijske poti, sistemi za javljanje in gašenje. Ukrepi 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 požarnega elaborata za enostaven objekt.

**Content (Syllabus outline):**

**Lectures:**  
Introduction to fire engineering. Overview of basic concepts. European standards and regulations. Fire load. Models of standard and real fires. Measures of active fire protection. Evacuation routes, fire detection and fire fighting. Measures of passive fire protection. Influence of high temperatures on material behavior. Determination of temperature field in a structure. Computing determination of the fire resistance of timber, reinforced concrete and steel structures.

**Tutorial:**

Solving of basic tasks, visit of the fire laboratory, design of fire study for a simple building.

**Temeljni literatura in viri / Readings:**

Buchanan, A. H. 2005. Structural design for fire safety. John Wiley & sons Ltd.  
 Wald F. et al. 2004. Vpočet 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:

#### 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 socioloških, naselitenih, 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 primerne modela požarne obtežbe. Sposobnost uporabe poenostavljenih računskih metod za oceno požarne odpornosti enostavnih nosilnih konstrukcij.
- Sposobnost izdelave požarnega elaborata za preproste objekte.

### Objectives and competences:

#### 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 fire resistance of simple load-bearing structures.
- Ability to design fire study for simple objects.

### Predvideni študijski rezultati:

- 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

### Intended learning outcomes:

- 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

požarnega inženirstva. Kritično ovrednotenje računskih modelov in poenostavitve 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.

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:

Predavanja, laboratorijske vaje.

#### Learning and teaching methods:

Lectures, laboratory exercises.

#### Načini ocenjevanja:

Delež (v %) /  
Weight (in %)

#### Assessment:

Samostojno izdelana naloga	<b>50 %</b>	Seminar work
Ustni izpit	<b>50 %</b>	Oral exam

#### Reference nosilca / Lecturer's references:

KOLŠEK, Jerneja, PLANINC, Igor, SAJE, Miran, HOZJAN, Tomaž. The fire analysis of a steel- concrete side-plated beam. Finite elements in analysis and design, ISSN 0168-874X. [Print ed.], okt. 2013, letn. 74, str. 93-110, ilustr., doi: 10.1016/j.finel.2013.06.001.

HOZJAN, Tomaž, SAJE, Miran, SRPČIČ, Stane, PLANINC, Igor. Fire analysis of steel-concrete composite beam with interlayer slip. Computers & Structures, ISSN 0045-7949. [Print ed.], 2011, letn. 89, št. 1-2, str. 189-200, doi:10.1016/j.compstruc.2010.09.004.

HOZJAN, Tomaž, PLANINC, Igor, SAJE, Miran, SRPČIČ, Stane. Buckling of an axially restrained steel column under fire loading. International journal of structural stability and dynamics, ISSN 0219-4554, 2011, letn. 11, št. 3, str. 451-472, doi:10.1142/SO219455411004245

UČNI NAČRT PREDMETA / COURSE SYLLABUS	
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<b>Predmet:</b>	Praktično usposabljanje
<b>Course title:</b>	Practical training

Študijski program in stopnja Study programme and level	Študijska smer Study field	Letnik Academic year	Semester Semester
Stavbarstvo – druga stopnja MA		1	2
Buildings – second cycle MA		1	2

**Vrsta predmeta / Course type:** Obvezni strokovni / obligatory professional

**Univerzitetna koda predmeta / University course code:**

Predavanja Lectures	Seminar Seminar	Vaje Tutorial	Klinične vaje work	Druge oblike študija	Samost. delo Individ. work	ECTS
6				80	34	4

**Nosilec predmeta / Lecturer:** doc. dr. Andreja Istenič Starčič

<b>Jeziki /</b>	<b>Predavanja / Lectures:</b>	slovenski / Slovene
<b>Languages:</b>	<b>Vaje / Tutorial:</b>	slovenski / Slovene

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

**Prerequisites:**

**Vsebina:**

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 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.

**Content (Syllabus outline):**

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 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.

**Temeljni 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:**

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.
- Sposobnost za povezovanje teorije in dela v praksi.

**Objectives and competences:**

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 engineering practice. Ability to integrate theory and practical work.

**Predvideni študijski rezultati:**

- 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

**Intended learning outcomes:**

- 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.



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 razumevanju 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.

– 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:

Terensko delo, mentorstvo, demonstracije, konzultacije, pisanje in vodenje dnevnika in portfolia prakse.

#### Learning and teaching methods:

Field work, mentoring, demonstrations, consultations, writing and keep a diary and portfolio of practices.

Načini ocenjevanja:	Delež (v %) / Weight (in %)	Assessment:
Dnevnik prakse	<b>40 %</b>	Diary of practical work,
Portfolio	<b>30 %</b>	Portfolio
Ustni zagovor	<b>30 %</b>	Oral presentation
Predmet se ocenjuje z »opravi« / »ni opravi«		The course is assessed with "passed" / "not done"

#### 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. Competence 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.

**UČNI NAČRT PREDMETA / COURSE SYLLABUS**

<b>Predmet:</b>	Napredni materiali
<b>Course title:</b>	Advanced materials

Študijski program in stopnja Study programme and level	Študijska smer Study field	Letnik Academic year	Semester Semester
Stavbarstvo – druga stopnja MA		2	3
Buildings – second cycle MA		2	3

**Vrsta predmeta / Course type:** Obvezni strokovni / obligatory professional

**Univerzitetna koda predmeta / University course code:**

Predavanja Lectures	Seminar Seminar	Vaje Tutorial	Klinične vaje work	Druge oblike študija	Samost. delo Individ. work	ECTS
30			60		90	6

**Nosilec predmeta / Lecturer:** doc. dr. Roman Kunič

**Jeziki / Languages:** **Predavanja / Lectures:** slovenski / Slovene  
**Vaje / Tutorial:** slovenski / Slovene

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

**Prerequisites:**

**Vsebina:**

Predavanja:  
 Korelacija med kemijsko strukturo in lastnostmi. Polimerni materiali s povišano temperaturno obstojnostjo in obstojnostjo na UV sevanje. Zaščita polimernih materialov pred pregrevanje: termotropne in termokromne prevleke, premazi z nizko termično emisivnostjo. Premazi s spremenljivo absorpcijo, "hladne" barve, radiacijsko hlajenje. Premazi in nanokompozitne prevleke z večfunkcionalnimi lastnostmi (antisoiling, self-cleaning), "Trde" nanokompozitne prevleke. Uporaba pri sanaciji stavb in za varovanje kulturne dediščine. Optično prepustni polimerni materiali (PTFE, Mylar). Zaščita kovin proti koroziji z nanokompoziti (korozijski procesi, meritve propadanja, spektroskopija, itd). Hranilniki toplote (PCM). Pregled testnih metod za ugotavljanje obstojnosti materialov (pospešeni testi staranja). Ozelenjene strehe. Ogljični odtis, potencial globalnega segrevanja. Temeljenje na toplotni izolaciji. Patologija v gradbeništvu. Fotovoltaika,

**Content (Syllabus outline):**

Lectures:  
 The correlation between chemical structure and properties. Polymer materials with a high thermal stability and resistance to UV radiation. Protection against overheating of polymeric materials: thermotropic and thermochromic coatings, coatings with low thermal emissivity. Coatings with changeable absorption, "cold" colors, radiant cooling. Coatings and nanocomposite coatings with multifunctional properties (antisoiling, self-cleaning), "Hard" nanocomposite coatings. Use the rehabilitation of buildings and for the protection of cultural heritage. Optical permeable polymeric materials (PTFE, Mylar). Protection against corrosion of metal nanocomposites (corrosion processes of decay measurements, spectroscopy, etc.). The storage tanks (PCM). Overview of test methods for determining the stability of the materials (accelerated aging tests). Green roofs. Carbon footprint, global warming potential (GWP). Foundations on thermal insulations. Construction

fototermika. Prezračevalni kolektorji.

Vaje:

Pregled eksperimentalnih postopkov za opredeljevanje lastnosti materialov. Spoznavanje procesov priprave nanokompozitnih prevlek in priprava premazov.

pathology. Photovoltaic, Photothermics. Ventilated panels

Tutorial:

Review of experimental procedures defining properties of materials. Understanding the process of preparation of nanocomposite coatings and coating preparation.

### Temeljna literatura in viri / Readings:

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., Jagličič, Z. 2014. Osnove gradbene fizike. UL, FGG.

e-učilnica Katedre za stavbe in konstrukcijske elemente na spletu: <http://kske.fgg.uni-lj.si>.

Raziskovalni laboratoriji in infrastrukturna centra. Dostopno na:

<http://www.ki.si/raziskovalne-enote/I02-laboratorij-zaspektroskopijo-materialov/>.

### Cilji in kompetence:

Cilji:

- Nadgraditi osnovno znanje o naprednih materialih uporabnih za doseganje toplotno-optičnih učinkov v stavbah.
- Podati pregled njihovih fizikalno-kemijskih lastnosti v povezavi z strukturo materialov.
- Nadgraditi znanje o njihovi uporabi z namenom načrtovanja večfunkcionalnih rešitev.
- Podati pregled možnih rešitev v modernih stavbah.

Pridobljene kompetence:

- Sposobnost koncipiranja toplotno-optičnih rešitev za gradbeništvo na osnovi naprednih materialov.
- Sposobnost razpoznavanja prednosti naprednih materialov na osnovi njihovih fizikalno-kemijskih lastnosti.

### Objectives and competences:

Objectives:

- Upgrade basic knowledge of advanced materials which are useful for achieve thermal-optical effects in buildings.
- To give an overview of physical-chemical properties in relation to the structure of materials.
- Upgrade knowledge about their use in order to design multifunctional solution.
- To give an overview of possible solutions in modern buildings.

Gained competences:

- Ability of conception of thermo-optical solutions for construction on the basis of advanced materials.
- Ability understanding of the benefits of advanced materials based on their physical -chemical properties.

### Predvideni študijski rezultati:

- Razumevanje delovanja transparentnih delov stavbnega ovoja, zasnova in analiza vplivov direktnega osončenja in zajema dnevne svetlobe v stavbi, sposobnost ocene odziva stavbe na osončenje in dnevno svetlobo.
- Uporaba računskih metod in programske opreme za analizo obravnavanih elementov svetlobnega in (posredno) toplotnega odziva stavbe oziroma prostora.
- Sposobnost samostojne ocene položaja in vloge obravnavanih elementov v sistemu

### Intended learning outcomes:

- Understanding the functioning of transparent constructional complexes, design and analysis of the effects of insolation and daylight in the buildings, ability to assess the building response to the insolation and daylight.
- Application of calculation methods and computer software simulations for analyse of evaluated daylight and (indirectly) also thermal response of the buildings and surroundings.
- Ability to independently evaluate the status and the role of the analysed elements in the system:

<p>okolje/človek/stavba in identifikacija medsebojnih povezav.</p> <p>– Spretnosti uporabe domače in tuje literature in drugih virov, zbiranja in interpretiranja podatkov, identifikacija.</p> <p>– Reševanje problemov, kritična analiza, sinteza, delo v skupini.</p>	<p>environment/human/building, and identification of mutual interconnections.</p> <p>– Skills for review of relevant literature sources and other references (national, international), collecting and interpreting the data, problem identification.</p> <p>– Problem solving, critical analysis, synthesis, group work.</p>
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**Metode poučevanja in učenja:**

Predavanja, laboratorijske vaje.

**Learning and teaching methods:**

Lectures, laboratory exercises.

<b>Načini ocenjevanja:</b>	Delež (v %) / Weight (in %)	<b>Assessment:</b>
Seminarske in laboratorijske vaje	<b>70 %</b>	Tutorial and laboratory work
Ustni izpit	<b>30 %</b>	Oral exam

**Reference nosilca / Lecturer's references:**

KUNIČ, Roman, TAVZES, Črtomir, KUTNAR, Andreja. Ogljični odtis toplotnoizolacijskih materialov v toplotnem ovoju stavb = Carbon footprint of thermal insulation materials in building envelopes. Gradbeni vestnik, ISSN 0017-2774, sep. 2012, letn. 61, str. 206-214, ilustr.

DOVJAK, Mateja, KUNIČ, Roman. Reševanje problemov urbanega toplotnega otoka in velike rabe energije z ozelenjenimi konstrukcijskimi sklopi stavb = Green building elements and the urban heat-island effect. AR, ISSN 1580-5573. [Tiskana izd.], 2011, [Št.] 2, str. 39-46, ilustr.

KUNIČ, Roman, KUTNAR, Andreja. Accelerated ageing and global warming potential of vip thermal insulation. V: BRUNNER, Samuel (ur.), WAKILI, Karim Ghazi (ur.). 11th International Vacuum Insulation Symposium : [proceedings, Dübendorf, September 19-20, 2013]. Dübendorf: Empa, 2013, str. 15-16.

UČNI NAČRT PREDMETA / COURSE SYLLABUS	
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<b>Predmet:</b>	Učinkovita raba energije
<b>Course title:</b>	Efficient energy use

Študijski program in stopnja Study programme and level	Študijska smer Study field	Letnik Academic year	Semester Semester
Stavbarstvo – druga stopnja MA		2	3
Buildings – second cycle MA		2	3

**Vrsta predmeta / Course type:** Obvezni strokovni / obligatory professional

**Univerzitetna koda predmeta / University course code:**

Predavanja Lectures	Seminar Seminar	Vaje Tutorial	Klinične vaje work	Druge oblike študija	Samost. delo Individ. work	ECTS
45			90		135	9

**Nosilec predmeta / Lecturer:** doc. dr. Mitja Košir

<b>Jeziki /</b>	<b>Predavanja / Lectures:</b>	slovenski / Slovene
<b>Languages:</b>	<b>Vaje / Tutorial:</b>	slovenski / Slovene

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

**Prerequisites:**

**Vsebina:**

**Predavanja:**  
Metodologije za izračunavanje integrirane energijske učinkovitosti stavb: postopki, dimenzioniranje toplotne izolacije: stavba, konstrukcijski sklopi. Uporaba minimalnih zahtev glede energijske učinkovitosti novih in prenovljenih stavb. Energetska certifikacija stavb. Toplotni mostovi. Zaščita stavb pred pregrevanjem. Strategije in ukrepi za energetska učinkovitost: stavba in konstrukcijski sklopi. Načini uporabe sončne energije v stavbah. Direktiva o energetska učinkovitosti stavb. Pravilnik o učinkoviti rabi energije v stavbah.

**Vaje:**

Računske metode za stacionarno in dinamično toplotno analizo konstrukcijskih sklopov in stavb. Individualne primerjalne analize toplotnega odziva na izbranih stavbah, z uporabo izbrane programske opreme.

**Content (Syllabus outline):**

**Lectures:**  
Methodology for the calculation of integrated energy performance of buildings: methods, sizing of thermal insulation on the level of building and individual constructional complexes. Requirements regarding minimum energy performance for new and renovated buildings. Energy certification of buildings. Thermal bridges. Overheating protection of buildings. Strategies and measures for energy efficiency: building and constructional complexes. Solar energy utilization in buildings. Directive on the energy performance of buildings. Regulations on energy efficiency in buildings.

**Tutorial:**

Computational methods for stationary and dynamic thermal analysis of structural components and buildings. Analysis of thermal response of an individually selected building, using appropriate software.

**Temeljni literatura in viri / Readings:**

Szokolay, S. V. 2004. Introduction to architectural science: the basis of sustainable design. Oxford, Architectural Press.  
 Schittich, C. (urednik.). 2003. Solar Architecture: Strategies, Visions, Concepts. Birkhauser.  
 TSG-1-004, Tehnična smernica za graditev TSG-1-004 Učinkovita raba energije.  
 EN 13970 Thermal performance of buildings - Calculation of energy use for space heating and cooling".  
 e-učilnica Katedre za stavbe in konstrukcijske elemente na spletu: <http://kske.fgg.uni-lj.si>

**Cilji in kompetence:****Cilji:**

- Regulacija porabe toplotne energije za ogrevanje.
- Regulacija porabe toplotne energije za hlajenje.
- Upoštevanje vplivov oblike stavbe, orientacije in geometrije na porabo energije.
- Vpliv strukture zunanega ovoja na varčno rabo energije.
- Izkoriščanjem obnovljivih virov energije v grajenem okolju.

**Pridobljene kompetence:**

- Obvladanje projektiranja in dimenzioniranja toplotne zaščite in zaščite pred pregrevanjem.
- Sposobnost uporabe predpisov in standardov s tega področja.
- Sposobnost uporabe ustrezne programske opreme za optimizacijo na ravni stavbe in njenega ovoja.

**Objectives and competences:****Objectives:**

- The objective of the course is to regulate heating energy consumption.
- The objective of the course is to regulate cooling energy consumption.
- The influence of building shape, orientation, geometry and envelope structure on the energy consumption is studied.
- Final objective is to enable efficient energy use and utilization of renewable energy sources in the built environment.

**Gained competences:**

- Students will master the design process with regard to thermal protection and protection of overheating of buildings.
- They will be able to use relevant rules and standards.
- They will be able to use as appropriate software tools for the optimization of energy performance of the entire building as well as its components.

**Predvideni študijski rezultati:**

- 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 v stavbi, ki vplivajo na porabo toplotne energije.
- 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

**Intended learning outcomes:**

- Ability to identify influential factors that shape the thermal response of the building and its constructional complexes using modern 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 in the building, which affect the use of heating energy.
- 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:**

Predavanja, laboratorijske vaje. Projektni pristop.

**Learning and teaching methods:**

Lectures, laboratory exercises. Project oriented approach.

<b>Načini ocenjevanja:</b>	<b>Delež (v %) / Weight (in %)</b>	<b>Assessment:</b>
Ocena izdelka vaj	<b>70 %</b>	Project executed during tutorial and lab work
Pisni izpit	<b>30 %</b>	Written exam

**Reference nosilca / Lecturer's references:**

KOŠIR, Mitja, CAPELUTO, Isaac Guedi, KRAINER, Aleš, KRISTL, Živa. Solar potential in existing urban layouts : critical overview of the existing building stock in Slovenian context. Energy policy, ISSN 0301-4215. [Print ed.], jun. 2014, letn. 69, št. X, str. 443-456.

KOŠIR, Mitja, KRAINER, Aleš, DOVJAK, Mateja, PERDAN, Rudi, KRISTL, Živa. Alternative to the Conventional Heating and Cooling Systems in Public Buildings. Strojniški vestnik, ISSN 0039-2480, 2010, letn. 56, št. 9, str. 575-283, ilustr.

KOŠIR, Mitja, KRISTL, Živa, KRAINER, Aleš. Active control system based on the application of pasive solar architecture measures. V: ISES Solar World Congress 2011 : Rapid Transition to a Renewable Energy World : Proceedings, Avgust 28 - September 2, 2011, Kassel, Germanij. Kassel: International Solar Energy Society, 2011, str. 1-10.

UČNI NAČRT PREDMETA / COURSE SYLLABUS	
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<b>Predmet:</b>	Bivalno okolje
<b>Course title:</b>	Living environment

Študijski program in stopnja Study programme and level	Študijska smer Study field	Letnik Academic year	Semester Semester
Stavbarstvo – druga stopnja MA		2	3
Buildings – second cycle MA		2	3

**Vrsta predmeta / Course type:** Obvezni strokovni / obligatory professional

**Univerzitetna koda predmeta / University course code:**

Predavanja Lectures	Seminar Seminar	Vaje Tutorial	Klinične vaje work	Druge oblike študija	Samost. delo Individ. work	ECTS
45			90		135	9

**Nosilec predmeta / Lecturer:** doc. dr. Mateja Dovjak

<b>Jeziki /</b>	<b>Predavanja / Lectures:</b>	slovenski / Slovene
<b>Languages:</b>	<b>Vaje / Tutorial:</b>	slovenski / Slovene

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

**Prerequisites:**

**Vsebina:**

**Predavanja:**  
Fizični prostor, ergonomija, fiziologija človeka.  
Viri: geomorfologija, značilnosti podnebja, človek. Toplotno okolje: občutena temperatura, metabolizem, faktor obleke, adaptacija.  
Svetlobno okolje: vizualno udobje. Kvaliteta zraka: fiziološki minimum, emisije. Vlaga v stavbi, hrup, geneza bivalnega okolja, razvoj tehnologij, koncept bioklimatske orientacije. Zdrava stavba (SBS), primeri dobre prakse, aktualni primeri.

**Vaje:**

Uporaba znanja na konkretnem primeru v stavbi, oblikovanje koncepta, factorska analiza, optimizacija sistema (sinteza). Simulacije odziva stavbe in prostora s pomočjo programske opreme.

**Content (Syllabus outline):**

**Lectures:**  
Physical active space, ergonomics, human physiology. Sources: geomorphology, climate type characteristics, human wellbeing. Thermal environment: thermal comfort, operative temperature, metabolic rate, effective clothing insulation, process of adaptation. Visual environment: visual comfort. Air quality: physiological minimum, pollutant emissions. Dampness related problems, noise issues, genesis of bioclimatic environment, technology development, concept of bioclimatic orientation. Healthy building (SBS), examples of best practice.

**Tutorial:**

Application of knowledge on a case of a specific building, concept design, factor analysis, system optimization (synthesis). Simulation of building response /active space response with computer software.



**Temeljni literatura in viri / Readings:**

McMullan, R. 2007. Environmental science in building. New York, Palgrave Macmillan.  
 Liddament, M.V. 1996. A guide to energy efficient ventilation, AIC-TN vent guide.  
 Regulation (EU) No 305/2011 of the European Parliament and of the Council of 9 March 2011 laying down harmonised conditions for the marketing of construction products and repealing Council Directive (89/106/EEC).  
 e-učilnica Katedre za stavbe in konstrukcijske elemente na spletu: <http://kske.fgg.uni-lj.si>

**Cilji in kompetence:**

**Cilji:**

- Izboljšanje kakovosti grajenega okolja.
- Zmanjševanje negativnih vplivov na zunanje okolje.
- Učinkovita izraba virov.
- Zagotavljanje zdravega notranjega okolja za prebivalce.

**Pridobljene kompetence:**

- Pozna faktorje, ki vplivajo na bivalno in delovno okolje.
- Razume procese delovanja posameznih vplivnih faktorjev 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).

**Objectives and competences:**

**Objectives:**

- The main objectives of the course are to improve the quality of the built environment
- Minimization of negative impacts on the environment.
- Efficient use of natural resources.
- Providing healthy indoor environment for building occupants.

**Gained competences:**

- Student is familiar with influencing factors inside living and working environment.
- He understands the interactive impacts of defined influencing factors.
- He is able to use calculation methods and computer software for the design of healthy and comfort indoor environment.
- He masters the transfer between analysed systems: “outdoor environment- building envelope-indoor environment-human wellbeing” (in the framework of conceptualization of specific building case; link to other parameters of building physics).

**Predvideni študijski rezultati:**

- Razumevanje delovanja posameznih vplivnih faktorjev notranjega okolja na počutje in zdravje uporabnikov, sposobnost ocene odziva stavbe in uporabnikov na uporabljene ukrepe.
- Uporaba računskih metod in programske opreme za analizo obravnavanih elementov kvalitete notranjega okolja.
- Sposobnost samostojne ocene položaja in vloge obravnavanih elementov v sistemu okolje/človek/stavba.
- identifikacija medsebojnih povezav v sistemu okolje/človek/stavba.
- Spretnosti uporabe domače in tuje literature in drugih virov.
- Zbiranja in interpretiranja podatkov.
- Identifikacija in reševanje problemov, kritična analiza, sinteza, delo v skupini.

**Intended learning outcomes:**

- Understanding the functioning of the influencing factors of the internal environment on user health and comfort, the ability to evaluate the building and user response on the implemented measures.
- Application of calculation methods and computer software to analyse the evaluated elements of the indoor environmental quality.
- Ability to evaluate the status and role of analysed 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, critical analysis, synthesis, team work.

**Metode poučevanja in učenja:**

Predavanja, laboratorijske vaje.

**Learning and teaching methods:**

Lectures, laboratory exercises.

**Načini ocenjevanja:**Delež (v %) /  
Weight (in %)**Assessment:**

Ocena izdelka vaj

**70 %**

Seminar and laboratory work.

Pisni izpit

**30 %**

Written exam

**Reference nosilca / Lecturer's references:**

DOVJAK, Mateja, KUKEC, Andreja, KRISTL, Živa, KOŠIR, Mitja, BILBAN, Marjan, SHUKUYA, Masanori, KRAINER, Aleš. Integral control of health hazards in hospital environment. Indoor + built environment, ISSN 1420- 326X, okt. 2013, letn. 22, št. 5, str. 776-795, ilustr.

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

KOŠIR, Mitja, KRAINER, Aleš, DOVJAK, Mateja, PERDAN, Rudi, KRISTL, Živa. Alternative to the Conventional Heating and Cooling Systems in Public Buildings. Strojniški vestnik, ISSN 0039-2480, 2010, letn. 56, št. 9, str. 575-283, ilustr.

**UČNI NAČRT PREDMETA / COURSE SYLLABUS**

<b>Predmet:</b>	Avtomatsko vodenje sistemov
<b>Course title:</b>	Automatic management of systems

Študijski program in stopnja Study programme and level	Študijska smer Study field	Letnik Academic year	Semester Semester
Stavbarstvo – druga stopnja MA		2	4
Buildings – second cycle MA		2	4

**Vrsta predmeta / Course type:** Obvezni strokovni / obligatory professional

**Univerzitetna koda predmeta / University course code:**

Predavanja Lectures	Seminar Seminar	Vaje Tutorial	Klinične vaje work	Druge oblike študija	Samost. delo Individ. work	ECTS
45			45		90	6

**Nosilec predmeta / Lecturer:** prof. dr. Igor Škrjanc, doc. dr. Vito Logar

**Jeziki / Predavanja / Lectures:** slovenski / Slovene  
**Languages: Vaje / Tutorial:** slovenski / Slovene

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

**Prerequisites:**

**Vsebina:**

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 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 (krmljenje, 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

**Content (Syllabus outline):**

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 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:

simulacijskih paketov: Matlab-Simulink in Dymola- Modelica. Izvedba avtomatskega vodenja na modelnih laboratorijskih napravah. Seminar: vsak študent samostojno izdelava seminarsko nalogo pod mentorstvom učitelja ali asistenta.

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.

### Temeljni 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 : priručnik za laboratorijske vaje, 1. izdaja. UL FE.

### Cilji in kompetence:

#### 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 and competences:

#### 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:

- 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.

### Intended learning outcomes:

- 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

Spoznana računalniška orodja za modeliranje, simulacijo in vodenje bodo gotovo uporabna tudi pri drugih predmetih.

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:**

Predavanja, laboratorijske vaje in seminarska naloga.

**Learning and teaching methods:**

Lectures, laboratory exercises and seminar work.

<b>Načini ocenjevanja:</b>	Delež (v %) / Weight (in %)	<b>Assessment:</b>
Seminarsko in laboratorijsko delo	<b>70 %</b>	Seminar and laboratory work.
Pisni izpit	<b>30 %</b>	Written exam

**Reference nosilca / Lecturer's references:**

EULER-ROLLE, Nikolaus, ŠKRJANC, Igor, HAMETNER, Christoph, JAKUBEK, Stefan. Automated generation of feedforward control using feedback linearization of local model networks. Engineering applications of artificial intelligence, ISSN 0952-1976. [Print ed.], Apr. 2016, vol. 50, str. 320-330.

ŠKRJANC, Igor, ŠUBIC, Barbara. Control of indoor CO<sup>2</sup> concentration based on a process model. Automation in construction, ISSN 0926-5805. [Print ed.], Jun. 2014, vol. 42, str. 122-126.

TOMAŽIČ, Simon, LOGAR, Vito, KRISTL, Živa, KRAINER, Aleš, ŠKRJANC, Igor, KOŠIR, Mitja. Indoor-environment simulator for control design purposes. Building and environment, Dec. 2013, vol. 70, str. 60-72.

DOVŽAN, Dejan, LOGAR, Vito, ŠKRJANC, Igor. Implementation of an evolving fuzzy model (eFuMo) in a monitoring system for a waste-water treatment process. IEEE transactions on fuzzy systems, Oct. 2015, vol. 23, no. 5, str. 1761-1776.

LOGAR, Vito, FATHI, Amirhossein, ŠKRJANC, Igor. A computational model for heat transfer coefficient estimation in electric arc furnace. Steel research international, ISSN 1611-3683, 2015, vol. 86, str. 1-9.

LOGAR, Vito, KRISTL, Živa, ŠKRJANC, Igor. Using a fuzzy black-box model to estimate the indoor illuminance in buildings. Energy and buildings, Feb. 2014, vol. 70, str. 343-351.

### UČNI NAČRT PREDMETA / COURSE SYLLABUS

<b>Predmet:</b>	Vrednotenje trajnosti stavb
<b>Course title:</b>	Building sustainability assessment

Študijski program in stopnja Study programme and level	Študijska smer Study field	Letnik Academic year	Semester Semester
Stavbarstvo – druga stopnja MA		2	4
Buildings – second cycle MA		2	4

**Vrsta predmeta / Course type:** Obvezni strokovni / obligatory professional

**Univerzitetna koda predmeta / University course code:**

Predavanja Lectures	Seminar Seminar	Vaje Tutorial	Klinične vaje work	Druge oblike študija	Samost. delo Individ. work	ECTS
30			30		60	4

**Nosilec predmeta / Lecturer:** doc. dr. Roman Kunič

<b>Jeziki /</b>	<b>Predavanja / Lectures:</b>	slovenski / Slovene
<b>Languages:</b>	<b>Vaje / Tutorial:</b>	slovenski / Slovene

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

**Prerequisites:**

**Vsebina:**

Cilj predmeta je seznaniti študente s principi okoljskega in trajnostnega inženirskega načrtovanja, oblikovanja in sistemskega pristopa k reševanju problemov in obvladovanju iterativnih postopkov razvoja od abstraktne zamisli do konkretne rešitve konstrukcijskih sklopov, kot tudi stavb kot celote, in obratno. Pri predmetu študent spozna postopke vrednotenja trajnostne gradnje, okoljskega vrednotenja stavbe kot celote, pravilne izbire gradiv in posledično sestavljanje konstrukcijskih sklopov in naprav, spozna dejavnike tveganja, napačne izbire gradiv ali neustrezne kombinacije materialov v poljubnem konstrukcijskem sklopu ali stavbi. Pri tem pa upošteva vse parametre celovitega načrtovanja in zahteve za inženirsko načrtovanje stavb. V sklopu laboratorijskih vaj študenti opravljajo izračune z ustrezno računalniško opremo.

PREDAVANJA:

**Content (Syllabus outline):**

The aim of the course is to acquaint students with principles of environmental and sustainable engineering planning, design and systematic approach to problem solving and management of iterative development processes from abstract ideas to concrete solutions of structural components, as well as the buildings as a whole, and vice versa.

The students learn about the processes of evaluating sustainable construction, environmental evaluation of the building as a whole, the correct selection of materials and the resulting assembly of structural assemblies and devices, learn about risk factors, the wrong choice of materials or inappropriate combinations of materials in any structural elements. Taking into account all the parameters of a comprehensive design and engineering requirements for the design of buildings. As a part of laboratory exercises students perform calculations using appropriate computer software.

- Argumenti ekonomičnosti
- Argumenti vpliva na okolje
- Študija možnosti in izvršljivosti
- EKO minimalizem
- Vsebovana energija
- CO2 ekvivalent
- Trajnostnost
- Kakovost
- Življenjska doba
- Trajnost materialov
- Določevanje življenjske dobe, določevanje trajnosti
- Lokacija stavbe in transporti do mesta vgradnje
- Izbira okoljsko primernih gradiv in koncipiranje razvoja ustreznih konstrukcijskih sklopov in celotnih stavb,
- Pregled testnih metod za ugotavljanje obstojnosti materialov (pospešeni testi staranja)
- Ogljični odtis, potencial globalnega segrevanja

**LECTURES:**

- Arguments economy
- Arguments impact on the environment
- Study possibilities and enforceability
- ECO minimalism
- The energy content
- CO2 equivalent
- Sustainability
- Quality
- Life span
- Durability of materials
- Determination of service life determination of sustainability
- Location of the building and transportation to the installation location
- Choosing environmentally preferable materials, and devising the development of advanced structural components,
- Review of test methods for determining the durability of materials (accelerated aging tests)
- Carbon footprint, global warming potential

**Temeljni literatura in viri / Readings:**

Santamouris, M., Environmental Design of Urban Buildings, An Integrated Approach, Earthscain, 2006  
 Pacheco F., Eco Efficient Construction and Building Materials, Life Cycle Assesment (LCA, Eco Labelling and Case Studies, Woodhead Publishing, 2014  
 Smith G.B., S. Granqvist, Green Nanotechnology, Solutions for Sustainability and Press, 2010  
 Leffers, M.R., Sustainable Construciton and Design – Pearson Education Prentice Hall, 2010  
 Mequignon M., H. Ait Haddou, Lifetime Environmental Impact of Buildings, Springer, 2014

## Elektronski viri:

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

Spletna stran UL FGG / Internet site UL FGG: <http://www3.fgg.uni-lj.si/>

**Cilji in kompetence:**

## CILJI:

- Nadgraditi osnovno znanje o izbiri materialov, konstrukcijskih sklopov, kot tudi stavb kot celote v pogledu trajnostne gradnje, zmanjševanju vpliva na okolje in analizi v celotnem življenjskem ciklusu stavb in drugih objektov,
- Nadgraditi znanje z metodami, teoretičnimi in praktičnimi rešitvami, z namenom okoljsko samovzdržnega načrtovanja, s čim manjšim vplivom na okolje.
- Podati pregled naprednih metod in načinov ugotavljanja in dokazovanja vplivov na okolje, tako v procesu proizvodnje (pridobivanja surovin, predelave, proizvodnje, same vgradnje gradiv in gradnje objektov, vključno z vsemi transporti), uporabe (potrebne energije za

**Objectives and competences:**

## OBJECTIVES:

- to upgrade the basic knowledge about choice of materials, structural assemblies, as well as the buildings as a whole in the context of sustainable construction, reducing the impact on the environment and analysis throughout the life cycle of buildings and other structures,
- to upgrade the knowledge of methods, theoretical and practical solutions in order to sustainable environmental planning, with minimum impact on the environment.
- To give an overview of advanced methods and ways of identifying and proving the impact on the environment, both in the production process (extraction, processing, production, installation of materials and construction of buildings as a

vzdrževanje stavbe, obnove, sanacije in druga popravila) in konca uporabe (odstranjevanje in dekompozicija objektov, možnost ponovne uporabe, recikliranja in deponiranja).

**PRIDOBLENE KOMPETENCE:**

- Sposobnost izbire gradiv v procesu načrtovanja objektov s ciljem čim manjšega vpliva na okolje, ob istovrstnem upoštevanju vplivov v celotnem življenjskem ciklusu stavb in drugih objektov,
- Nadgraditi vsa do sedaj pridobljena znanja s področja stavbarstva z znanji okoljsko vzdržne gradnje in uporabe objektov v celotni življenjski dobi,
- Sposobnost razpoznavanja prednosti okoljske gradnje in uporabe objektov.

whole, including all transports) and use (energy required for building maintenance, renovation, rehabilitation and other repairs) and end use (remove and decomposition of objects and its parts, re-use, recycling).

**ACQUIRED COMPETENCES:**

- Ability to choose materials in the design process of buildings with a view to minimize the impact on the environment, taking into account all impacts throughout the lifecycle of buildings and other structures,
- Upgrade all acquired knowledge in the field of architecture with the skills of environmentally sustainable construction and use of buildings throughout its lifetime,
- Ability to recognize environmental benefits of the construction and use of buildings.

**Predvideni študijski rezultati:**

- Sposobnost koncipiranja rešitev v pogledu varovanja okolja in zniževanja vplivov na okolje.
- Študent s svojim znanjem in izkušnjami postane konkurenčen na trgu strokovnega, raziskovalno - razvojnega in znanstvenega področja, s poudarkom na grajenem okolju.

**Intended learning outcomes:**

- Ability to create a solution in view of protecting the environment and reducing environmental impacts on the environment.
- Students got knowledge and experience to become competitive in the professional market, research - development and scientific fields, with a focus on the built environment.

**Metode poučevanja in učenja:**

Predavanja, seminarske naloge, laboratorijske vaje, domače naloge.

**Learning and teaching methods:**

Lectures, tutorials, consultations, homework.

**Načini ocenjevanja:**

Seminarske naloge in sprotno delo  
Izpit (teoretičen del)

Delež (v %) /  
Weight (in %)

**70 %**

**30 %**

**Assessment:**

Exercises and homework

Exam (theoretical part)

**Reference nosilca / Lecturer's references:**

KUNIČ, Roman, MIHELČIČ, Mohor, OREL, Boris, SLEMENIK PERŠE, Lidija, BIZJAK, Aleš, KOVAČ, Janez, BRUNOLD, Stefan. Life expectancy prediction and application properties of novel polyurethane based thickness sensitive and thickness insensitive spectrally selective paintcoatings for solar absorbers. Solar energy materials and solar cells, ISSN 0927-0248. [Print ed.], 2011, letn. 95, št.11, str. 2965-2975.  
KUNIČ, Roman, KOŽELJ, Matjaž, OREL, Boris, SURCA, Angelja Kjara, VILČNIK, Aljaž, SLEMENIK PERŠE, Lidija, MERLINI, Dušan, BRUNOLD, Stefan. Adhesion and thermal stability of thickness insensitive spectrally selective (TISS) polyurethane-based paint coatings on copper substrates. Solar energy materials and solar cells, ISSN 0927-0248. [Print ed.], 2009, vol. 93, no. 5, str. 630-640.



KUNIČ, Roman. Forest-based bioproducts used for construction and its impact on the environmental performance of a building in the whole life cycle. V: KUTNAR, Andreja (ur.), MUTHU, Subramanian Senthilkannan (ur.). Environmental impacts of traditional and innovative forest-based bioproducts, (Environmental footprints and eco-design products and processes, ISSN 2345-7651). Singapore: Springer, 2016, str. 173-204.

### UČNI NAČRT PREDMETA / COURSE SYLLABUS

<b>Predmet:</b>	Pametna hiša
<b>Course title:</b>	Smart house

Študijski program in stopnja Study programme and level	Študijska smer Study field	Letnik Academic year	Semester Semester
Stavbarstvo – druga stopnja MA		2	4
Buildings – second cycle MA		2	4

**Vrsta predmeta / Course type:** Obvezni strokovni / obligatory professional

**Univerzitetna koda predmeta / University course code:**

Predavanja Lectures	Seminar Seminar	Vaje Tutorial	Klinične vaje work	Druge oblike študija	Samost. delo Individ. work	ECTS
30			30		60	4

**Nosilec predmeta / Lecturer:** doc. dr. Mitja Košir

<b>Jeziki /</b>	<b>Predavanja / Lectures:</b>	slovenski / Slovene
<b>Languages:</b>	<b>Vaje / Tutorial:</b>	slovenski / Slovene

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

**Prerequisites:**

**Vsebina:**

**Predavanja:**  
Geneza odnosa koncept – tehnologija. Interaktivnost vplivov na lokaciji. Sheme sistema pametne hiše: okolja, sistemi vedenja, stopnje vodenja, implementacija. Vloga individualnosti: zdravje, udobje, učinkovitost pri načrtovanju. Interaktivnost in povezanost prostora in časa s povezavo tega načela z informacijsko tehnologijo. Vpliv kulture in tehnologije, fiziologije in energije ter nove informacijske tehnologije na učinkovitost. Topologija komunikacij. Pametni proizvodi, podsistemi in avtomatizirano bivalno okolje. Vpliv dinamične odprtine in fasadni sistemi. Regulacija dnevne/umetne svetlobe. Pregled in kritična predstavitev aktualnih primerov.

**Laboratorijske vaje:**

Načrtovanje zasnove stavb na osnovi izhodišč dinamičnega odziva na zunanje spremembe. Individualne simulacije in primerjalne analize

**Content (Syllabus outline):**

**Lectures:**  
Relation between concept and technology. Interactivity of various influence factors on the building location. Schemes of smart house systems: environment, systems of user behaviour, regulation, implementation. Role of individuality in the process of design: health, comfort, efficiency. Space and time interactivity in the built environment and its integration with information technology. Impact of culture and technology, physiology, energy use issues and new information technology on the system performance. Topology of communications. Smart products, subsystems and automated living environment. Influence of dynamically regulated façade envelope. Daylight/artificial light control. Review and critical presentation of real life examples.

**Laboratory work:**

Strategies for the design of buildings on the basis

izbranih primerov stavb iz vaj.

of dynamic response to outdoor conditions.  
Individual simulations and comparative analysis of the selected practical examples.

### Temeljni literatura in viri / Readings:

Krainer, A. 1993. Toward smart buildings, (Building science and environment-conscious design, Module 1: Design principles, 7). London: European Commission.

Addington, M., Schodek, D. 2005. Smart Materials and Technologies. Elsevier, Architectural Press. (izbrana poglavja)

IEA (International Energy Agency). 1999. Solar Energy Houses, Strategies, Technologies, Examples, James&James.

Lee, E., Selkowitz, S., Bazjanac, V., Inkarojrit, V., Kohler, C. 2002. High-performance commercial building facades. Lawrence Berkley National Laboratory.

e-učilnica Katedre za stavbe in konstrukcijske elemente na spletu: <http://kske.fgg.uni-lj.si>.

### Cilji in kompetence:

Cilji:

- Izboljšanje kakovosti bivalnega in delovnega okolja z razumno uporabo novih tehnologij in minimalno porabo energije za delovanje sistema.
- Optimalna komunikacija z drugimi strokami in enakopravno sodelovanje s svojimi kompetencami z njimi.
- Vodenja sistemov načrtovanja in gradnje, kjer se bo v praksi pojavil skupaj z arhitektom.

Pridobljene kompetence:

- Obvladanje osnovnih principov inženirskega načrtovanja.
- Obvladanje postopka systemske in faktorske analize.
- Sposobnost uporabe različnih orodij za analizo in načrtovanje stavb.
- Sposobnost uporabe literature in kritične presoje produktov razvoja stroke.
- Sposobnost upoštevati tekočo zakonodajo in standarde.

### Objectives and competences:

Objectives:

- The main objectives of the course are to improve the quality of the living and working environment with the rational use of new technologies and minimal use of energy for system operation.
- Optimal communication with other experts with equal participation in their own field of competences.
- Being able to design the framework of control systems of buildings.
- Working in coordination with architect.

Gained competences:

- Mastering the basic principles of engineering design, mastering the processes of system analysis and factor analysis.
- Ability to use calculation methods and computer software in the process of building design.
- Ability to use relevant literature with critical evaluation of available products.
- Getting familiar with current legislation from relevant filed.

### Predvideni študijski rezultati:

- Sposobnost identifikacije vplivnih faktorjev, ki oblikujejo dinamično in sonaravno bivalno okolje z razumno uporabo razpoložljivih tehnologij. Razumevanje povezav med njimi in stopnje njihovih pomembnosti.
- Učinkovita koordinacija različnih strokovnih področij, ki se pojavljajo pri načrtovanju in gradnji stavb in aktivno sodelovanju na delu, ki ga pokrivajo gradbeniške intervencije.

### Intended learning outcomes:

- Ability to identify the influencing factors for the design of dynamic and sustainable living environment with rational use of new technologies. Understanding the interconnections among them and the level of individual importance.
- Efficient coordination of various fields influencing the design of buildings and construction, active participation in implementation of interventions.

- 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 evaluate the status and the role of elements in the “environment/human/building” system, identification of interconnections between them.
- Skills for review of relevant literature sources and other references (national, international).
- Collecting and interpreting the data.
- Identification and solving of problems, critical analysis, synthesis, group work.

**Metode poučevanja in učenja:**

Predavanja in laboratorijske vaje. Projektni pristop.

**Learning and teaching methods:**

Lectures and laboratory exercises. Project oriented approach.

**Načini ocenjevanja:**

Laboratorijsko delo (projektno delo)  
Pisni izpit

Delež (v %) /  
Weight (in %)

**70 %**

**30 %**

**Assessment:**

Laboratory work (project work).  
Written exam

**Reference nosilca / Lecturer's references:**

TOMAŽIČ, Simon, LOGAR, Vito, KRISTL, Živa, KRAINER, Aleš, ŠKRJANC, Igor, KOŠIR, Mitja. Indoor-environment simulator for control design purposes. Building and environment, ISSN 0360-1323. [Print ed.], Dec. 2013, vol. 70, str. 60-72, ilustr.

KOŠIR, Mitja, KRAINER, Aleš, KRISTL, Živa. Integral control sistem of indoor environment in continuously occupied spaces. Automation in construction, ISSN 0926-5805. [Print ed.], 2012, letn. 21, št. 1, str. 199-209, ilustr.

KOŠIR, Mitja. Analiza regulacijskih sistemov bivalnega okolja v stavbah = Analysis of control systems for building performance. Gradbeni vestnik.

UČNI NAČRT PREDMETA / COURSE SYLLABUS	
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<b>Predmet:</b>	Magistrski seminar
<b>Course title:</b>	Master seminar

Študijski program in stopnja Study programme and level	Študijska smer Study field	Letnik Academic year	Semester Semester
Stavbarstvo – druga stopnja MA		2	4
Buildings – second cycle MA		2	4

**Vrsta predmeta / Course type:** Obvezni strokovni / obligatory professional

**Univerzitetna koda predmeta / University course code:**

Predavanja Lectures	Seminar Seminar	Vaje Tutorial	Klinične vaje work	Druge oblike študija	Samost. delo Individ. work	ECTS
	30			60	90	6

**Nosilec predmeta / Lecturer:** doc. dr. Mateja Dovjak in učitelji na študijskem programu / and teachers at the study programme

<b>Jeziki /</b>	<b>Predavanja / Lectures:</b>	slovenski / Slovene
<b>Languages:</b>	<b>Vaje / Tutorial:</b>	slovenski / Slovene

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

**Prerequisites:**

**Vsebina:**

Študenti pri Magistrskem seminarju v uvodnem delu poslušajo serijo predavanj s področja znanstveno raziskovalnega in strokovnega dela (hipoteza, eksperimentalno delo, modeliranje, ponovljivost eksperimentov ...), zbiranja podatkov in literature ter raziskovalne etike in intelektualne lastnine. Predstavljeni so pristopi k oblikovanju teme magistrske naloge, iskanja literature ter priprave in oblikovanja znanstveno-tehničnega teksta.

Skozi redna individualna srečanja z mentorji in somentorji ter vodjo seminarja študenti izoblikujejo temo magistrske naloge (druge oblike študija v obsegu 60 h). V času trajanja seminarja pripravijo dispozicijo naloge, ki jo javno predstavijo in zagovarjajo ob koncu semestra.

**Content (Syllabus outline):**

Students at the Masters seminar attend a series of lectures on the subject of scientific research and professional work presentation (hypothesis, experimental work, modelling, repeatability of experiments,...), data and literature search and preparation as well as research ethics and intellectual property. The basic approaches for writing and conceptualization of master's thesis topic, search for literature and the preparation and design of scientific and technical texts are presented.

Through regular individual meetings with supervisors, co-supervisors and the leader of the seminar, students develop their own master thesis topic (other forms of study in the extent of 60 h). During the seminar they prepare master thesis disposition, which is publicly presented and defended at the end of the semester.

**Temeljni literatura in viri / Readings:**

Evans, D., Gruba, P. 2002. How to Write a Better Thesis, Second edition. Melbourne University Press.  
 Young, M. 2002. The technical writer's handbook – Writing with style and clarity. University Science Books.  
 Montgomery, D. C., Runger, G. C. 2007. Applied Statistics and Probability for Engineers. John Wiley & Sons.  
 Koler-Povh T., Turk G. 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](http://www3.fgg.uni-lj.si/fileadmin/user_upload/UL_FGG_-_Pr_10_Navodila_za_oblikovanje_visokosolskih_del_na_UL_FGG_2011_07.pdf)  
 Članki v strokovnih in znanstveno raziskovalnih revijah ter znanstvene monografije, ki jih študentje potrebujejo pri pisanju svojega magistrskega dela.

**Cilji in kompetence:****Cilji**

- Predstavitev lastnega dela.
- Priprava izhodišč za samostojno izdelavo obsežnejšega strokovnega dela.
- Definiranje ciljev in načina doseganja le-teh.
- Kritična opredelitev do dela drugih.

**Pridobljene kompetence**

- Sposobnost samostojnega raziskovalnega in načrtovalskega dela.
- Sposobnost izdelave in predstavitve dispozicije magistrskega dela.
- Pridobitev ustrezne literature/podpore.

**Objectives and competences:****Objectives:**

- Presentation of executed work.
- Preparation of starting points for the execution of individual professional work.
- Definition of goals and method for their execution.
- Critical assessments of other students work.

**Gained competences:**

- Ability for independent research and design.
- Ability to make and present a master thesis disposition.
- Acquirement of the appropriate literature.

**Predvideni študijski rezultati:**

- Sposobnost predstavitve disertacije lastnega magistrskega dela in razumevanje dela drugih študentov.
- Priprava učinkovite in razumljive predstavitve strokovnih vsebin.
- Metodologija učinkovite komunikacije (pisna in ustna).
- Oblikovanje fokusa raziskovalnega in strokovnega dela.
- Zasnova strukture magistrskega dela (hipoteza, metode, pregled literature).
- Iskanje relevantne literature.

**Intended learning outcomes:**

- Ability to present and defend the disposition of master thesis and the ability to understand work of other students.
- Preparation of an effective and comprehensive presentation of professional content.
- The methodology of effective communication (written and oral).
- Creation of research focus in the framework of the professional work.
- Conception of the master thesis structure (hypothesis, methods, literature review).
- Finding relevant literature.

**Metode poučevanja in učenja:**

Predavanja vodje seminarja ali drugih pedagogov, raziskovalno delo, individualni sestanki z mentorjem, somentorjem in vodjo seminarja, predstavitve dispozicije magistrskega dela s strani študentov.

**Learning and teaching methods:**

Lectures by the seminar organizer or by other lecturers, individual meetings with supervisors, co-supervisors and the leader of the seminar, student's presentation of master thesis disposition.

<b>Načini ocenjevanja:</b>	Delež (v %) / Weight (in %)	<b>Assessment:</b>
Aktivna udeležba na seminarju	<b>40 %</b>	Active participation in seminar work
Priprava in javna predstavitev teme in zasnove magistrskega dela (dispozicija)	<b>60 %</b>	Preparation and public presentation of the master thesis concept (disposition)

**Reference nosilca / Lecturer's references:**

DOVJAK, Mateja, KUKEC, Andreja. Prevention and control of sick building syndrome (SBS). Part 2, Design of a preventive and control strategy to lower the occurrence of SBS. Sanitarno inženirstvo, dec. 2014, no. 1, vol. 8, str. 41- 55.

DOVJAK, Mateja, KUKEC, Andreja, KRISTL, Živa, KOŠIR, Mitja, BILBAN, Marjan, SHUKUYA, Masanori, KRAINER, Aleš. Integral control of health hazards in hospital environment. Indoor + built environment, okt. 2013, letn. 22, št. 5, str. 776-795.

KACJAN ŽGAJNAR, Katarina, GALIČIČ, An, ZORAN, Urška, PAJEK, Luka, DOVJAK, Mateja. Analysis of sanitary-technical and hygienic conditions of Slovenian kindergartens and proposed measures. Sanitarno inženirstvo, dec. 2013, no. 1, vol. 7, str. 4-20.

UČNI NAČRT PREDMETA / COURSE SYLLABUS	
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<b>Predmet:</b>	Magistrsko delo
<b>Course title:</b>	Master thesis

Študijski program in stopnja Study programme and level	Študijska smer Study field	Letnik Academic year	Semester Semester
Stavbarstvo – druga stopnja MA		2	4
Buildings – second cycle MA		2	4

**Vrsta predmeta / Course type:** Obvezni strokovni / obligatory professional

**Univerzitetna koda predmeta / University course code:**

Predavanja Lectures	Seminar Seminar	Vaje Tutorial	Klinične vaje work	Druge oblike študija	Samost. delo Individ. work	ECTS
				150	150	10

**Nosilec predmeta / Lecturer:** učitelj na študijskem programu / teacher at the study programme

<b>Jeziki /</b>	<b>Predavanja / Lectures:</b>	slovenski / Slovene
<b>Languages:</b>	<b>Vaje / Tutorial:</b>	slovenski / Slovene

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

Opravljen Magisterski seminar, odobrena tema in mentor s strani Študijskega odbora Oddelka za gradbeništvo skladno s Pravilnikom o študiju na I. in II. stopnji.

**Prerequisites:**

Passed Master seminar, 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:**

Magistrsko delo se izdelava pod mentorstvom izbranega učitelja. Izhodišče za izdelavo magistrskega dela je opravljen Magisterski seminar v kontekstu katerega se pripravi dispozicija magistrske naloge. Delo se javno predstavi ob zaključku študija. Vsebovati mora:

- Uvod
- 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

**Content (Syllabus outline):**

Master thesis shall be made under the supervision of a selected teacher. Disposition of master thesis executed in the Master seminar course is the basis for the preparation of master thesis. The work is presented in public at the end of the study. It must include:

- 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



raziskovalnega dela.

work.

### Temeljni 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](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:

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 and competences:

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:

- Pridobi znanja na vseh fazah, ki so del samostojnega reševanja konkretnih problemov in nalog na področju stavbarstva, sodelovanja in tudi skupinskega 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.

### Intended learning outcomes:

- 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.
- They understand the interdisciplinary of this area.
- They learn how to use the theoretical knowledge in engineering practice.
- Use of theoretical knowledge in practice.

- Raba teoretičnih znanj v praksi.
- Povezovanje ter inovativna dejavnost pri delu.
- Načrtovanje, izvedba in kritično vrednotenje pri reševanju.
- Reševanje problemov ter prezentacija izsledkov strokovnih nalog in raziskav.
- Sodelovanje, vključevanje strokovnjakov in skupno reševanje problemov.

- Connection and innovative activity at work.
- Planning, execution and critical evaluation in problem solving and presentation of results of technical tasks and research.
- Including, participation, involvement of experts and joint problem solving.

**Metode poučevanja in učenja:**

Samostojno delo, konzultacije.

**Learning and teaching methods:**

Independent work, consultations.

**Načini ocenjevanja:**

Delež (v %) /

Weight (in %)

**Assessment:**

Magistrska naloga	<b>50 %</b>	Master thesis
Javna predstavitev in zagovor	<b>50 %</b>	Public presentation and defence

**Reference nosilca / Lecturer's references:**

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UČNI NAČRT PREDMETA / COURSE SYLLABUS	
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<b>Predmet:</b>	Tehnologija instalacij
<b>Course title:</b>	Technology of installations

Študijski program in stopnja Study programme and level	Študijska smer Study field	Letnik Academic year	Semester Semester
Stavbarstvo – druga stopnja MA		1, 2	2, 3
Buildings – second cycle MA		1, 2	2, 3

**Vrsta predmeta / Course type:** Izbirni strokovni / elective professional

**Univerzitetna koda predmeta / University course code:**

Predavanja Lectures	Seminar Seminar	Vaje Tutorial	Klinične vaje work	Druge oblike študija	Samost. delo Individ. work	ECTS
30		30	30		90	6

**Nosilec predmeta / Lecturer:** prof. dr. Vincenc Butala

<b>Jeziki /</b>	<b>Predavanja / Lectures:</b>	slovenski / Slovene
<b>Languages:</b>	<b>Vaje / Tutorial:</b>	slovenski / Slovene

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

**Prerequisites:**

**Vsebina:**

**Predavanja:**  
Uvod v vsebine, namen predmeta in program, kompetence. Notranje okolje v stavbah. Modeliranje notranjega okolja. Koncepti učinkovitih ter inovativnih sistemov za bivanje in delo uporabnika prostora, ter drugih namembnosti prostorov. Odziv uporabnika prostora na občutene parametre notranjega okolja – študija funkcij in modelov. Napredne tehnologije in sistemi za OPK in pripravo tople vode. Osnove regulacije in krmiljenja OPK sistemov za doseganje zahtevanih (želenih) parametrov v notranjih prostorih stavb. Osnove meritev in monitoring OPK sistemov. Reševanje problemov in osnovna načela projektiranja ter ocenjevanje kakovosti OPK sistemov.

**Vaje:**

Teoretične vaje (uporaba različnih modelov za analizo notranjega okolja, računanje posameznih parametrov notranjega okolja). Laboratorijske

**Content (Syllabus outline):**

**Lectures:**  
Introduction to topics, aims of the course and program, competences. Indoor environment in buildings. Indoor environment modelling. Concepts of efficient and innovative systems for occupant's living and working environment, and for other purposes of spaces. Occupant's response to the perceptible indoor environment parameters – studies of functions and models. Advanced technologies and systems for HVAC and hot water preparation. Fundamentals of regulation and feedback control of HVAC systems to achieve the required (desired) parameters in indoor spaces of buildings. Fundamentals of measurements and HVAC monitoring. Problem solving, planning fundamentals, and quality assessment of the HVAC systems.

**Tutorial:**

Theoretical exercises (use of different models for the analysis of indoor environment, calculating

vaje (spoznavanje z merilno opremo, meritev neposrednega notranjega okolja, demonstracijske vaje na laboratorijskem modelu klimatske naprave) Seminarski izdelek: Študent bo izbral vsebino, v smeri katere želi poglobiti svoje znanje. V sodelovanju z učiteljem bo izdelal seminar.

different parameters of indoor thermal environment). Laboratory work (learning about measuring equipment, direct measurement of indoor environment parameters, demonstration exercises on a laboratory model of air-conditioner). Seminar work: Students will choose the work task depending on individual requests to deepen their knowledge. In collaboration with teachers they will create seminar work.

### Temeljni literatura in viri / Readings:

ASHRAE. 2007. ASHRAE Handbook: HVAC Application. Atlanta.  
 Mundt, E. et al. 2004. Ventilation effectiveness, REHVA Guidebook 2. Brussels.  
 Handbuch der Klimatechnik, Verlag C.F. Muller GmbH, Karlsruhe, 1989.  
 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:

#### 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 tehnologije in osnove (sistemov) ogrevanja, prezračevanja in klimatizacije (hlajenja) (OPK) ter sistemov za pripravo tople vode.
- Podati teoretične osnove regulacije OPK sistemov.

#### 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.

### Objectives and competences:

#### 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.
- 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:**

- Sposobnost razumevanja notranjega okolja v korelaciji z uporabnikom prostora in s tem povezanega delovanja OPK sistemov.
- Uporaba pridobljenih znanj pri osnovnih analizah ocenjevanja notranjega okolja in ustreznosti vgrajenih OPK 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 uporabi računalniških programov.

**Intended learning outcomes:**

- 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:**

Predavanja, teoretične in laboratorijske vaje, samostojna izdelava individualnih nalog.

**Learning and teaching methods:**

Lectures, theoretical and laboratory tutorial, individual work.

**Načini ocenjevanja:**

Delež (v %) /  
Weight (in %)

**Assessment:**

Seminar	<b>20 %</b>	Work
Laboratorijske vaje	<b>30 %</b>	Laboratory tutorial
Pisni izpit	<b>50 %</b>	Written exam

**Reference nosilca / Lecturer's references:**

MAZEJ, Mitja, BUTALA, Vincenc. Investigation in the characteristics of the personal ventilation using computational fluid dynamics. Indoor + built environment, ISSN 1420-326X, 2012, vol. 21, no. 6, str. 749-771, ilustr.

PREK, Matjaž, BUTALA, Vincenc. An enhanced thermal comfort model based on the exergy analysis approach. International journal of exergy, ISSN 1742-8297. [Print ed.], 2012, vol. 10, iss. 2, str. 190-208.

PREK, Matjaž, BUTALA, Vincenc. Principles of exergy analysis of human heat and mass exchange with the indoor environment. International journal of heat and mass transfer, ISSN 0017-9310. [Print ed.], Dec. 2010, vol. 53, iss. 25/26, str. 5806-5814.

### UČNI NAČRT PREDMETA / COURSE SYLLABUS

<b>Predmet:</b>	Informacijske in komunikacijske tehnologije v grajenem okolju
<b>Course title:</b>	Information and communication technologies in built environment

Študijski program in stopnja Study programme and level	Študijska smer Study field	Letnik Academic year	Semester Semester
Stavbarstvo – druga stopnja MA		1, 2	2, 3
Buildings – second cycle MA		1, 2	2, 3

**Vrsta predmeta / Course type:** Izbirni strokovni / elective professional

**Univerzitetna koda predmeta / University course code:**

Predavanja Lectures	Seminar Seminar	Vaje Tutorial	Klinične vaje work	Druge oblike študija	Samost. delo Individ. work	ECTS
45		45			90	6

**Nosilec predmeta / Lecturer:** prof. dr. Žiga Turk

<b>Jeziki /</b>	<b>Predavanja / Lectures:</b>	slovenski / Slovene
<b>Languages:</b>	<b>Vaje / Tutorial:</b>	slovenski / Slovene

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

**Prerequisites:**

**Vsebina:**

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 športnih dogodkih ... Zakaj ne bi v bodočnosti projektirali stavb? Druga so vedno bolj 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

**Content (Syllabus outline):**

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 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.

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.

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.

### Temeljni 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:

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.
- Postaviti okvir za gradbeno informatiko, ki ga v toku študija dopolnjujejo bolj specialni predmeti.
- Razumeti vlogo poklica »specialista-gradbenega-informatika« za gradbeno industrijo in karijerne 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.

### Objectives and competences:

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 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:**

- 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.

**Intended learning outcomes:**

- 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:**

Predavanja, obogatena z multimedijскими vsebinami in demonstracijami. Projektne organizirane vaje, kjer se delo usmerja v enovit projektni rezultat. Samostojno delo doma s korekturami v šoli.

**Learning and teaching methods:**

Lectures enriched with multimedia and demos. Project oriented exercises focused into a unified project result. Work at home with consultations.

<b>Načini ocenjevanja:</b>	Delež (v %) / Weight (in %)	<b>Assessment:</b>
Teoretično znanje na izpitu	<b>40 %</b>	Theoretical exam
Sodelovanje na vajah in predavanjih	<b>20 %</b>	Activity and collaboration
Projekt in izdelek	<b>40 %</b>	Project work quality

**Reference nosilca / Lecturer's references:**

MEŽA, Sebastjan, TURK, Žiga, DOLENC, Matevž. Component based engineering of a mobile BIMbased augmented reality system. Automation in construction, ISSN 09265805. [Print ed.], jun. 2014, letn. 42, št. X, str. 112, 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 00172774, okt. 2011, letn. 60, št. 10, str. 279284, ilustr.



KLINC, Robert, TURK, Žiga, DOLENC, Matevž. Engineering collaboration 2.0 : requirements and expectations. Journal of information technology in construction, ISSN 18744753, 2009, letn. 14, pos. št., str. 473488, ilustr. Dostopno na: <http://www.itcon.org/2009/31>.

**UČNI NAČRT PREDMETA / COURSE SYLLABUS**

<b>Predmet:</b>	Športna vzgoja
<b>Course title:</b>	Physical education

Študijski program in stopnja Study programme and level	Študijska smer Study field	Letnik Academic year	Semester Semester
Stavbarstvo – druga stopnja MA		1, 2	2, 3
Buildings – second cycle MA		1, 2	2, 3

**Vrsta predmeta / Course type:** Izbirni splošni / elective general

**Univerzitetna koda predmeta / University course code:**

Predavanja Lectures	Seminar Seminar	Vaje Tutorial	Klinične vaje work	Druge oblike študija	Samost. delo Individ. work	ECTS
5		40			45	3

**Nosilec predmeta / Lecturer:** prof. dr. Branko Škof

**Jeziki / Predavanja / Lectures:** slovenski / Slovene  
**Languages: Vaje / Tutorial:** slovenski / Slovene

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

Zdravstveni status, ki dovoljuje ustrezen telesni napor.

**Prerequisites:**

Health status, which allows appropriate physical exercise.

**Vsebina:**

**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 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

**Content (Syllabus outline):**

**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 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.

treniranja.

Poleg izbrane športne panoge bo študent moral opraviti 5 vodenih enodnevnih ali večdnevnih športnih aktivnosti v naravi, ter preizkus motoričnih in funkcionalnih sposobnosti.

Students have to do: five guided multi-day sports activities in nature and aerobic endurance test.

### Temeljni 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 al., 2007. Šport po meri otroka in mladostnika. Ljubljana, Fakulteta za šport UL, Inštitut za šport, 445 str.

Berčič, H. et al. 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:

#### 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

- 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.

### Objectives and competences:

#### 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,
- 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:

- razumevanje temeljnih pojmov in teorij delovanja človekovega gibalnega, srčno žilnega in dihalnega sistema ter njihovih najpogostejših patologij
- oblikovanje razumskega in čustvenega odnosa

### Intended learning outcomes:

- 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

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.

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:

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.

#### Learning and teaching methods:

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 (v %) / Weight (in %)	Assessment:
Teoretični izpit	20 %	Theoretical exam
Praktični izpit	80 %	Practical exam

#### Reference nosilca / Lecturer's references:

AUERSPERGER, Irena, ŠKOF, Branko, LESKOŠEK, Bojan, KNAP, Bojan, JERIN, Aleš, LAINŠČAK, Mitja. Exercise-induced 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 characteristics [!] 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.