INTERDISCIPLINARNI PROJEKT - PAP

UČNI NAČRT PREDMETA/COURSE SYLLABUS

Predmet:	Interdisciplinarni projekt - PAP
Course title:	Interdisciplinary Project - PAP
Članica nosilka/UL Member:	UL FS

Študijski programi in stopnja	Študijska smer	Letnik	Semestri	Izbirnost
Strojništvo - projektno aplikativni program, prva stopnja, visokošolski strokovni	Energetsko strojništvo (smer)	3. letnik	1. semester	izbirni
Strojništvo - projektno aplikativni program, prva stopnja, visokošolski strokovni	Industrijsko inženirstvo (smer)	3. letnik	1. semester	izbirni
Strojništvo - projektno aplikativni program, prva stopnja, visokošolski strokovni	Konstruiranje industrijskih sistemov (smer)	3. letnik	1. semester	izbirni
Strojništvo - projektno aplikativni program, prva stopnja, visokošolski strokovni	Konstruiranje strojev in naprav (smer)	3. letnik	1. semester	izbirni
Strojništvo - projektno aplikativni program, prva stopnja, visokošolski strokovni	Mehatronika (smer)	3. letnik	1. semester	izbirni
Strojništvo - projektno aplikativni program, prva stopnja, visokošolski strokovni	Procesno strojništvo (smer)	3. letnik	1. semester	izbirni
Strojništvo - projektno aplikativni program, prva stopnja, visokošolski strokovni	Proizvodne tehnologije (smer)	3. letnik	1. semester	izbirni
Strojništvo - projektno aplikativni program, prva stopnja, visokošolski strokovni	Snovanje in vzdrževanje letal (smer)	3. letnik	1. semester	izbirni

Univerzitetna koda predmeta/University course code:	0588827
Koda učne enote na članici/UL Member course code:	3030-V

Predavanja /Lectures	Seminar /Seminar	Vaje /Tutorials	Klinične vaje /Clinical tutorials	Druge oblike študija /Other forms of study	Samostojno delo /Individual student work	ECTS
15		15			45	3

Nosilec predmeta/Lecturer:	prof. dr. Iztok Golobič, prof. dr. Edvard Govekar, prof. dr. Niko Herakovič, prof. dr. Mitjan Kalin, prof. dr. Andrej Kitanovski, izr. prof. dr. Robert Kunc, prof. dr. Marko Nagode, prof. dr. Rok Petkovšek, prof. dr. Primož Podržaj, prof. dr. Franci Pušavec, prof. dr. Mihael Sekavčnik, prof. dr. Janko Slavič, doc. dr. Lidija Slemenik Perše, prof. dr. Božidar Šarler, prof. dr. Roman Šturm, izr. prof. dr. Nikola Vukašinović
Izvajalci predavanj:	doc. dr. Vid Agrež, izr. prof. dr. Ciril Arkar, doc. dr. Tomaž Berlec, doc. dr. Drago Bračun, izr. prof. dr. Miha Brojan, prof. dr. Gregor Čepon, doc.

	dr. Martin Česnik, prof. dr. Matevž Dular, prof. dr. Iztok Golobič, prof. dr. Edvard Govekar, izr. prof. dr. Peter Gregorčič, izr. prof. dr. Miroslav Halilovič, prof. dr. Niko Herakovič, prof. dr. Marko Hočevar, izr. prof. dr. Boris Jerman, prof. dr. Matija Jezeršek, prof. dr. Mitjan Kalin, prof. dr. Tomaž Katrašnik, doc. dr. Tomaž Kek, prof. dr. Andrej Kitanovski, prof. dr. Jernej Klemenc, doc. dr. Katja Klinar, izr. prof. dr. Damjan Klobčar, doc. dr. Dominik Kozjek, izr. prof. dr. Davorin Kramar, doc. dr. Andraž Kravos, izr. prof. dr. Robert Kunc, izr. prof. dr. Jože Kutin, izr. prof. dr. Franc Majdič, doc. dr. Boštjan Mavrič, prof. dr. Sašo Medved, izr. prof. dr. Nikolaj Mole, izr. prof. dr. Mitja Mori, prof. dr. Marko Nagode, izr. prof. dr. Simon Oman, izr. prof. dr. Tomaž Pepelnjak, izr. prof. dr. Aljoša Peperko, prof. dr. Rok Petkovšek, viš. pred. dr. Igor Petrović, prof. dr. Primož Podržaj, doc. dr. Marko Polajnar, doc. dr. Primož Potočnik, izr. prof. dr. Jurij Prezelj, prof. dr. Franci Pušavec, doc. dr. Darja Rupnik Poklukar, prof. dr. Mihael Sekavčnik, prof. dr. Janko Slavič, doc. dr. Lidija Slemenik Perše, izr. prof. dr. Uroš Stritih, prof. dr. Božidar Šarler, izr. prof. dr. Domen Šeruga, izr. prof. dr. Marko Šimic, prof. dr. Roman Šturm, doc. dr. Jovan Trajkovski, Jaka Tušek, izr. prof. dr. Joško Valentinčič, izr. prof. dr. Rok Vrabič, izr. prof. dr. Nikola Vukašinović, izr. prof. dr. Matevž Zupančič, prof. ddr. Janez Žerovnik
Izvajalci seminarjev:	
Izvajalci vaj:	
Izvajalci kliničnih vaj:	
Izvajalci drugih oblik:	
Izvajalci praktičnega usposabljanja:	

Vrsta predmeta/Course type:	Splošni izbirni predmet/Elective general course

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

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:	**Prerequisites:**
Izpolnjevanje pogojev za vpis v Visokošolski strokovni študijski program I. stopnje Strojništvo - Projektno aplikativni program.	Meeting the enrollment conditions for the MECHANICAL ENGINEERING - Project Oriented Applied Programme.

Vsebina:	**Content (Syllabus outline):**
Študentje bodo v manjših interdisciplinarnih skupinah, ali posamično, reševali ter analizirali aplikativne inženirske probleme v obliki projektno-seminarskega dela. Projekti se bodo nanašali na dele ali celotne sklope znanj iz posamičnih ali več področij predhodnih semestrov. Projekti bodo zahtevali integracijsko znanje in inženirske prostope, ob upoštevanju širših teoretičnih in praktičnih vidikov, tudi iter- in intra-disciplinarnih. Izzivi bodo vključevalli aktualne tematike iz industrije, širše družbe, mednarodnih ali domačih študentskih tekmovanj in drugih akademskih izzivov. Pri tem bo uporabljen tematsko-problemski pristop, kjer se bo združevalo znanja z različnih področij. Zato bodo študenti spodbujeni, da se povezujejo tudi s kolegi drugih fakultet in/ali industrije in družbe, in na ta	The students individually of as a member of a small team analyse and solve applied engineering problems in the form of peoject-seminar work. The projects are be related to partial or comprehensive knowledge areas from the former study semesters. Integrated knowledge and engineering approaches are inherently linked to this projects as well as application of wider theoretical and practical inter- and intra-disciplinary aspects. The content consist of concurrent industrial problems, social issues, domestic and international student's competitions and academic challenges. A contextual hand-on approach is followed when using knowledge integration from different areas of expertise. The students are encouraged to link themselves with the collegues from the other faculties and/or industry or wider society in order to widen

način razširijo praktične izkušnje reševanja interdisciplinarnih nalog. *Vsebinsko bodo aktivnosti razdeljene v sledeče časovno sosledne vsebine:* 1. Kreacija skupin in oblikovanje ustrezne projektne ideje. Formalizacija projektnih ciljev. 2. Teoretične podlage ter iskanje optimalnih rešitev skozi analizo obstoječega stanja in pristopom inoviranja. 3. Razčlenitev projektne ideje v obvladljive podsklope in iskanje morebitnih kritičnih točk. 4. Razdelitev nalog in določitev časovnice. Spremljanje napredka preko predstavitve vmesnih rezultatov in praktičnega dela. 5. Predstavitev in razširjanje rezultatov.	their professional horizon and practical experience by solving inter-disciplinary tasks. *The course content consists of the following*: 1. Team building and formation of a suitable project idea. Formalisation of project objectives. 2. Theoretical content for finding optimal solutions through the state-o-the-art analysis and innovation approach. 3. Segmentation of the project idea into manageable sub-tatsks in identification of risks. 4. Task allocation and definition of time-sheet. Progress control through intermediate-results presentation and practical work. 5. Presentation and dissemination of results.

Temeljna literatura in viri/Readings:

Določena je smiselno v dogovoru z izbranim nosilcem (mentorjem) predmeta za vsakega študenta posebej glede na izbrano problematiko. Literatura je dosegljiva v knjižnici laboratorija, fakultetni knjižnici ali širše. Praviloma študent študira iz člankov, ki so obravnavali podoben primer, kakor ga ima sam definiranega.
It is determined appropriately in agreement with the selected lecturer (mentor) for each student according to the chosen topic. Literature is available at the lab library, faculty library or beyond. As a rule, a student studies from articles dealing with a similar case as he or she has defined.

Cilji in kompetence:	**Objectives and competences:**
Cilji: 1. Omogočiti študentu seznanitev s temeljno in predmetno specifično literature na delu tematike, ki bo obravnavana v diplomski nalogi. 2. Seznanitev z namensko opremo na področju eksperimentiranja in uporabe računalniških orodij. Študent tako spozna osnovno funkcionalnost opreme, ki jo lahko uporabi. 3. Predmet se izvaja v laboratoriju (enem ali več) odvisno od dogovora z mentorjem in nosilci predmeta. Kompetence: S1-PAP: Sposobnost uporabe pridobljenega znanja v praksi. S2-PAP: Sposobnost samostojnega dela v okviru znanj izbrane študijske smeri. S4-PAP: Sposobnost razčlenitve lažjih strokovnih nalog na podnaloge. S5-PAP: Razvijanje sposobnosti kritičnega in samokritičnega mišljenja. S11-PAP: Sposobnost predstavitve strokovnih problemov in njihovih rešitev v svojem okolju in širše.	**Objectives:** 1. To enable the student to get acquainted with the basic and specific literature on the topic that will be discussed in the Bachelor's degree thesis. 2. To familiarize with the specific equipment in the field of experimentation and use of computer tools. Thus the student learns about the basic functionality of the equipment he can use. 3. The course is carried out in the laboratory (one or more), depending on the agreement with the mentor and course lecturers. **Competencies:** S1-PAP: The ability to use the attained knowledge in the practice. S2-PAP: The ability to work autonomously in the framework of knowledge provided by the selected study module. S4-PAP: The ability to break down professional tasks of lesser complexity into subtasks. S5-PAP: Developing the ability of critical and self-critical thinking. S11-PAP: The ability to present professional problems and the solutions thereof in own environment and wider. S13-PAP: The ability to find sources of knowledge, select among the available resources and use the knowledge acquired for one's work. P4-PAP: Knowing the basic measuring instruments and measuring chains used to measure the basic quantities in the field of mechanical engineering. P6-PAP: Mastering independent project work.

S13-PAP: Sposobnost iskanja virov znanja, selekcija najdenih virov in uporaba tako pridobljenega znanja pri svojem delu. P4-PAP: Pozna osnovne merilne instrumente in merilne verige za merjenje osnovnih veličin na področju strojništva. P6-PAP: Obvlada samostojno projektno delo. P9-PAP: Diplomant je sposoben samostojno opravljati razvojno aplikativna, inženirska in strokovna organizacijska dela ter reševati posamezne dobro definirane naloge na področju strojništva.	P9-PAP: The graduates are able to independently perform applied developmental, engineering and professional organisational work, and to solve well-defined individual tasks in the field of mechanical engineering.

Predvideni študijski rezultati:	**Intended learning outcomes:**
Znanja: Z1: Poglobljeno strokovno teoretično in praktično znanje na določenem področju, podprto s širšo teoretično in metodološko osnovo. Spretnosti: S1.1 Izvajanje kompleksnih operativno-strokovnih opravil, ki vključujejo tudi uporabo metodoloških orodij. S1.2 Obvladovanje zahtevnih, kompleksnih delovnih procesov ob samostojni uporabi znanja v novih delovnih situacijah. S1.3 Diagnosticiranje in reševanje problemov v različnih specifičnih delovnih okoljih, povezanih s področjem izobraževanja in usposabljanja. S1.4 Osnova za izvirna dognanja/ stvaritve in kritično refleksijo.	Knowledge: Z1: Thorough professional theoretical and practical knowledge in a selected field of expertise that is supported with a broad theoretical and methodological basis. Skills: S1.1 Executing complex operational-professional tasks that incorporate usage of methodological tools. S1.2 Mastering demanding and complex work processes by independent usage of knowledge in new working situations. S1.3 Problem diagnostics and solving in different and specific working environments that are linked to the teaching and training content. S1.4 Basis for unique innovations and critical reflections.

Metode poučevanja in učenja:	**Learning and teaching methods:**
Klasične oblike poučevanja: P1 Avditorna predavanja z reševanjem izbranih - za področje značilnih - teoretičnih in praktično uporabnih primerov. P2 Obravnava snovi po urejeni in vnaprej razloženi sistematiki. P5 Uporaba študijskega gradiva v obliki (knjiga, skripta, e-knjiga, tiskana verzija predstavitve predavanj). **Moderne in prožne oblike poučevanja:** P6 Interaktivna predavanja. P7 Študij literature in razprava (timsko delo, viharjenje možgan, organizacija in/ali udeležba tekmovanj, organizacija in/ali udeležba delavnic). P8 Izdelava in predstavitev aplikativnih seminarskih nalog P14 Virtualni eksperimenti	**Conventional teaching methods:** P1 Auditorial lectures with solving selected field-specific theoretical and applied use cases. P2 Presenting the content according to the explained system. P5 Application of study material (textbook, e-book, printed lecture presentations, etc.). **Contemporary and flexible teaching methods:** P6 Interactive lectures. P7 Literature study and discussion (teamwork, brainstorming, organisation- and/or participation at student's competitions or workshops). P8 Making and presenting applied seminar exercises. P14 Virtual experiments.

Načini ocenjevanja:	**Delež/Weight**	**Assessment:**
Ocena končnega poročila.	50,00 %	Final report.
Ocena končnih predstavitev rezultatov.	50,00 %	Presentation of final results.

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

Reference nosilca/Lecturer's references:

Golobič Iztok:

1. GREGORČIČ, Peter, ZUPANČIČ, Matevž, **GOLOBIČ, Iztok**. Scalable surface microstructuring by a fiber laser for controlled nucleate boiling performance of high- and low-surface-tension fluids. *Scientific reports*. May 2018, vol. 8, f. 1-8, ilustr. ISSN 2045-2322. https://www.nature.com/articles/s41598-018-25843-5.pdf, DOI: 10.1038/s41598-018-25843-5. [COBISS.SI-ID 16034331]
2. RAVNIK, Jure, **GOLOBIČ, Iztok**, SITAR, Anže, AVANZO, M., IRMAN, Špela, KOČEVAR, K., CEGNAR, Mateja, ZADRAVEC, Matej, RAMŠAK, Matjaž, HRIBERŠEK, Matjaž. Lyophilization model of mannitol water solution in a laboratory scale lyophilizer. *Journal of drug delivery science and technology*. [Print ed.]. June 2018, vol. 45, str. 28-38, ilustr. ISSN 1773-2247. DOI: 10.1016/j.jddst.2018.0015. [COBISS.SI-ID 21209622]
3. ZUPANČIČ, Matevž, NOVAK, Dušan, DIACI, Janez, **GOLOBIČ, Iztok**. An evaluation of industrial ultrafiltration systems for surface water using fouling indices as a performance indicator. *Desalination*. [Print ed.]. Jul. 2014, vol. 344, str. 321-328, ilustr. ISSN 0011-9164. DOI: 10.1016/j.desal.2014.04.002. [COBISS.SI-ID 13420827]

Govekar Edvard:

1. **GOVEKAR, Edvard**, JEROMEN, Andrej, KUZNETSOV, Alexander, LEVY, Gideon N., FUJISHIMA, Makoto. Study of an annular laser beam based axially-fed powder cladding process. CIRP annals. 2018, vol. 67, iss. 1, str. 241-244, ilustr. ISSN 0007-8506. https://www.sciencedirect.com/science/article/pii/S0007850618301069, DOI: 10.1016/j.cirp.2018.04.082. [COBISS.SI-ID 16026395]
2. POTOČNIK, Primož, **GOVEKAR, Edvard**. Semi-supervised vibration-based classification and condition monitoring of compressors. Mechanical systems and signal processing. Sep. 2017, vol. 93, str. 51-65, ilustr. ISSN 0888-3270. http://www.sciencedirect.com/science/article/pii/S088832701730047X, DOI: 10.1016/j.ymssp.2017.01.048. [COBISS.SI-ID 15296539]
3. KUZNETSOV, Alexander, JEROMEN, Andrej, **GOVEKAR, Edvard**. Droplet detachment regimes in annular laser beam droplet generation from a metal wire. CIRP annals. 2014, vol. 63, iss. 1, str. 225-228, ilustr. ISSN 0007-8506. DOI: 10.1016/j.cirp.2014.0051. [COBISS.SI-ID 13402651]

Herakovič Niko:

1. **HERAKOVIČ, Niko**, ŠIMIC, Marko, TRDIČ, Francelj, SKVARČ, Jure. A machine-vision system for automated quality control of welded rings. *Machine vision and applications*. [Print ed.]. 2011, vol. 22, no. 6, str. 967-98 ISSN 0932-8092. DOI: 10.1007/s00138-010-0293-9. [COBISS.SI-ID 11512091]
2. DEBEVEC, Mihael, ŠIMIC, Marko, **HERAKOVIČ, Niko**. Virtual factory as an advanced approach for production process optimization. *International journal of simulation modelling*. Mar. 2014, vol. 13, no. 1, str. 66-78, ilustr. ISSN 1726-4529. DOI: 10.2507/IJSIMM13(1)6.260. [COBISS.SI-ID 13367835]
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Kalin Mitjan:

1. **KALIN, Mitjan**, KUPEC, Alja. The dominant effect of temperature on the fatigue behaviour of polymer gears. *Wear*, ISSN 0043-1648. [Print ed.], Apr. 2017, vol. 376/377, part B, str. 1339-1346, ilustr. https://www.sciencedirect.com/science/article/pii/S0043164817302788?via%3Dihub, doi: 10.1016/j.wear.2017.02.003. [COBISS.SI-ID 15897115]
2. BARTOLOMÉ, Luis, OBLAK, Eva, **KALIN, Mitjan**. Mechanical behaviour and constitutive models of ZDDP tribofilms on DLC coatings using nano-indentation data and finite element modelling. *Tribology international*, ISSN 0301-679X, Mar. 2016, vol. 95, str. 19-26, ilustr. https://www.sciencedirect.com/science/article/pii/S0301679X15004958?via%3Dihub, doi: 10.1016/j.triboint.2015.10.036. [COBISS.SI-ID 14342939]

3. **KALIN, Mitjan**, OBLAK, Eva, AKBARI, Somayeh. Evolution of the nano-scale mechanical properties of tribofilms formed from low- and high-SAPS oils and ZDDP on DLC coatings and steel. *Tribology international*, ISSN 0301-679X, Apr. 2016, vol. 96, str. 43-56, ilustr., doi: 10.1016/j.triboint.2015.12.013. [COBISS.SI-ID 14398491]

Kitanovski Andrej:

1. KLINAR, Katja, MUÑOZ ROJO, Miguel, KUTNJAK, Zdravko, **KITANOVSKI, Andrej**. Toward a solid-state thermal diode for room-temperature magnetocaloric energy conversion. *Journal of applied physics*. 2020, vol. 127, no. 23, str. 234101-1-234101-10. ISSN 0021-8979. Repozitorij Univerze v Ljubljani – RUL, DOI: 10.1063/5.0006120. [COBISS.SI-ID 19703299].
2. TOMC, Urban, NOSAN, Simon, VIDRIH, Boris, BOGIĆ, Simon, NAVICKAITE, Kristina, VOZEL, Katja, BOBIČ, Miha, **KITANOVSKI, Andrej**. Small demonstrator of a thermoelectric heat-pump booster for an ultra-low-temperature district-heating substation. *Applied energy*. May 2024, vol. 361, [article no.] 122899, str. 1-14, ilustr. ISSN 1872-9118. https://www.sciencedirect.com/science/article/pii/S0306261924002824, Repozitorij Univerze v Ljubljani – RUL, DOI: 10.1016/j.apenergy.2024.122899. [COBISS.SI ID 186961923].
3. PETELIN, Nada, PEČAR, Borut, VRTAČNIK, Danilo, PERNE, Jakob, TOMC, Urban, **KITANOVSKI, Andrej**. Oscillating gadolinium thermal switch. V: *Proceedings : 10th IIR Conference on Caloric Cooling and Applications of Caloric Materials, Baotou, China August 21-24, 2024*. 10th IIR Conference on Caloric Cooling and Applications of Caloric Materials, Baotou, China August 21-24, 2024. Beijing: Chinese Association of Refrigeration; Paris: International Institute of Refrigeration, 2024. Str. 167-173, ilustr. Science et technique du froid. ISBN 978-2-36215-063-0. ISSN 0151-1637. [COBISS.SI-ID 210523907].

Kunc Robert:

1. BASAN, Robert, FRANULOVIĆ, Marina, PREBIL, Ivan, **KUNC, Robert**. Study on Ramberg-Osgood and Chaboche models for 42CrMo4 steel and some approximations. Journal of constructional steel research. [Print ed.]. sep. 2017, vol. 136, str. 65-74, ilustr. ISSN 0143-974X. http://www.sciencedirect.com/science/article/pii/S0143974X17302341, DOI: 10.1016/j.jcsr.2017.05.010. [COBISS.SI-ID 15531035]
2. BIČEK, Matej, **KUNC, Robert**, ZUPAN, Samo. Mechanical impact on in-wheel motor's performance. Journal of mechanics. [Print ed.]. Oct. 2017, vol. 33, iss. 5, str. 607-618, ilustr. ISSN 1727-7191. https://www.cambridge.org/core/journals/journal-of-mechanics/article/div-classtitlemechanical-impact-on-in-wheel-motorandaposs-performancediv/A4D5DB17B7102D3897C02AAAC07A32A7, DOI: 10.1017/jmech.2016.95. [COBISS.SI-ID 15295259]
3. ŽEROVNIK, Andrej, PEPEL, Vili, PREBIL, Ivan, **KUNC, Robert**. The yield-point phenomenon and cyclic plasticity of the uniaxially loaded specimens. Materials & design. Feb. 2016, vol. 92, str. 971-977, ilustr. ISSN 0264-1275. DOI: 10.1016/j.matdes.2015.12.111. [COBISS.SI-ID 14442011]

Nagode Marko:

1. ŠOLINC, Urša, KLEMENC, Jernej, **NAGODE, Marko**, ŠERUGA, Domen. A direct approach to modelling the complex response of magnesium AZ31 alloy sheets to variable strain amplitude loading using Prandtl-Ishlinskii operators. *International journal of fatigue*. Oct. 2019, vol. 127, str. 291-304, ilustr. ISSN 0142-1123. https://www.sciencedirect.com/science/article/pii/S0142112319302397, https://repozitorij.uni-lj.si/IzpisGradiva.php?id=108298&lang=slv, DOI: 10.1016/j.ijfatigue.2019.06.009. [COBISS.SI-ID 16674075]
2. ŠERUGA, Domen, **NAGODE, Marko**. A new approach to finite element modelling of cyclic thermomechanical stress-strain responses. *International journal of mechanical sciences*. Dec. 2019, vol. 164, str. 1-14, ilustr. ISSN 0020-7403. https://www.sciencedirect.com/science/article/pii/S0020740319306964?via%3Dihub, DOI: 10.1016/j.ijmecsci.2019.105139. [COBISS.SI-ID 16795675]
3. **NAGODE, Marko**, ŠERUGA, Domen. Fatigue life prediction using multiaxial energy calculations with the mean stress effect to predict failure of linear and nonlinear elastic solids. *Results in physics*. 2016, vol. 6, f. 352-364, ilustr. ISSN 2211-3797. http://www.sciencedirect.com/science/article/pii/S2211379716300407, DOI: 10.1016/j.rinp.2016.06.007. [COBISS.SI-ID 14715163]

Petkovšek Rok:

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