UČNI NAČRT PREDMETA/COURSE SYLLABUS

Predmet:	Raziskave v strojništvu
Course title:	RESEARCH IN MECHANICAL ENGINEERING
Članica nosilka/UL Member:	UL FS

Študijski programi in stopnja	**Študijska smer**	**Letnik**	**Semestri**
Strojništvo - Razvojno raziskovalni program, druga stopnja, magistrski	Mehatronika in laserska tehnika (smer)	2. letnik	2. semester
Strojništvo - Razvojno raziskovalni program, druga stopnja, magistrski	Proizvodno strojništvo (smer)	2. letnik	2. semester
Strojništvo - Razvojno raziskovalni program, druga stopnja, magistrski	Energetsko strojništvo (smer)	2. letnik	2. semester
Strojništvo - Razvojno raziskovalni program, druga stopnja, magistrski	Konstruiranje (smer)	2. letnik	2. semester
Strojništvo - Razvojno raziskovalni program, druga stopnja, magistrski	Mehanika (smer)	2. letnik	2. semester
Strojništvo - Razvojno raziskovalni program, druga stopnja, magistrski	Procesno strojništvo (smer)	2. letnik	2. semester

Univerzitetna koda predmeta/University course code:	0566826
Koda učne enote na članici/UL Member course code:	6011-M

Predavanja	**Seminar**	**Vaje**	**Klinične vaje**	**Druge oblike študija**	**Samostojno delo**	**ECTS**
90		90			195	15

Nosilec predmeta/Lecturer:	Andrej Bombač, Andrej Kitanovski, Andrej Senegačnik, Boris Jerman, Božidar Šarler, Damjan Klobčar, Davorin Kramar, Drago Bračun, Edvard Govekar, Franc Majdič, Franci Pušavec, Iztok Golobič, Janez Diaci, Janez Kušar, Janez Žerovnik, Janko Slavič, Jernej Klemenc, Joško Valentinčič, Jože Kutin, Jurij Prezelj, Lidija Slemenik Perše , Marko Hočevar, Marko Nagode, Matija Jezeršek, Miha Boltežar, Miha Brojan, Mihael Sekavčnik, Miroslav Halilovič, Mitjan Kalin, Niko Herakovič, Nikola Vukašinović, Nikolaj Mole, Primož Podržaj, Robert Kunc, Rok Petkovšek, Rok Vrabič, Roman Šturm, Sašo Medved, Tadej Kosel, Tomaž Katrašnik, Tomaž Pepelnjak, Uroš Stritih
Vrsta predmeta/Course type:	Obvezni splošni predmet /Compulsory general course
Jeziki/Languages:	Predavanja/Lectures: Slovenščina Vaje/Tutorial: Slovenščina

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:	**Prerequisites:**
V sklopu predmeta se student spozna s širšim področjem določenega dela tematike, ki jo bo obdelal v magistrski nalogi. Zato so pogoj za vključitev v delo opravljene študijske obveznosti 1. in 2. semestra MAG študijskega programa.	As part of the course, the student gets introduced to the broader field of a certain part of the topic, which he will deal with in the master's thesis. Therefore, the requirement for the course is completed study obligations of the 1st and 2nd semester of the MAG study program.

Vsebina:	**Content (Syllabus outline):**
Glede na širši vidik obravnavane raziskovalne tematike magistrskega dela študent izbere tri nosilce tega predmeta, pri katerih bo opravljal ta predmet. 1. Predstavitev ciljev predmeta in posameznih raziskovalnih tematik, ki jih bodo študentje opravljali tekom leta. 2. Pregled znanstvene literature dogovoru z izbranimi nosilci predmeta. 3. Interaktivna predstavitev obdelanih temeljnih vsebin z individualno ali skupinsko diskusijo. 4. Opredelitev individualnega parcialnega problema na obravnavanem področju ob vodenju nosilcev predmeta. 5. Priprava načrta iskanja rešitev za opredeljeni parcialni problem ob vodenju nosilcev predmeta. 6. Pregled in študij teoretičnih osnov izbrane tematike. 7. Analitične metode modeliranja sistemov/procesov izbrane tematike*. 8. Numerične metode modeliranja sistemov/procesov izbrane tematike*. * Glede na predvidene naloge so podani poudarki na eksperimentalnih, računalniških ali analitičnih raziskovalnih vsebinah. 9. Interaktivna predstavitev povzetka obdelanih specializiranih vsebin z individualno ali skupinsko diskusijo. 10. Zasnova in razvoj naprave / eksperimentalnega sistema / računskega modela v sklopu izbrane tematike. 11. Razvoj metodologije vrednotenja razvite naprave / eksperimentalnega sistema / računskega modela. 12. Razvoj in izvedba eksperimentalnega dela. 13. Korelacija eksperimentalnih rezultatov s teoretičnimi napovedmi. 14. Interaktivna predstavitev eksperimentalnih, računalniških ali analitičnih orodij ter primerjava z ugotovitvami iz dostopne literature. 15. Pregled izzivov za prihodnost na področju izbrane raziskovalne tematike.	According to the broader aspect of the research topic of the master's thesis, the student chooses three lecturers of this course, with whom he will pursue this course. 1. Presentation of the course objectives and individual research topics that students will undertake throughout the year. 2. Review of the scientific literature in agreement with the chosen lecturers. 3. An interactive presentation of discussed core content through individual or group discussion. 4. Definition of an individual partial problem in the area under consideration guided by lecturers. 5. Preparation of a plan for finding solutions to the defined partial problem guided by lecturers. 6. Review and study of the theoretical basis of the selected topic. 7. Analytical methods for modelling systems / processes of the selected topic *. 8. Numerical methods for modelling systems / processes of the selected topic *. * According to the selected assignment, emphasis are placed on experimental, computer or analytical research. 9. An interactive presentation of a summary of studied specialized content with individual or group discussion. 10. Design and development of the device / experimental system / computational model within the chosen topic. 11. Development of evaluation methodology of developed device / experimental system / computational model. 12. Development and implementation of experimental work. 13. Correlation of experimental results with theoretical predictions. 14. Interactive presentation of experimental, computer or analytical tools and comparison with findings from available literature. 15. An overview of the challenges ahead for the chosen research topic.

Temeljna literatura in viri/Readings:

Določena je smiselno v dogovoru s tremi nosilci 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 three lecturers 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:

Cilji:

1. Omogočiti študentu seznanitev s temeljno in predmetno specifično literaturo na delu tematike, ki bo obravnavana v magistrski nalogi.
2. Seznanitev z namensko opremo na področju eksperimentiranja in uporabe računalniških orodij. Študent tako spozna posebnosti, ki jih lahko uporabi.
3. Predmet se izvaja v laboratoriju (enem ali več) odvisno od dogovora z mentorjem in nosilci predmeta.

Kompetence:

S1-MAG: Sposobnost za opredelitev, razumevanje temeljnih znanstvenih problemov in ustvarjalno reševanje strokovnih izzivov.

S2-MAG: Širitev sposobnosti kritičnega, analitičnega in sintetičnega mišljenja. Razvijanje novega znanja in razumevanja področja. Razvijanje višjih kognitivnih veščin, povezanih z ustvarjanjem novega znanja.

S8-MAG: Sposobnost iskanja virov, kritične presoje informacij, samostojnega nadgrajevanja pridobljenih znanj in poglabljanja znanja na posameznih specializiranih področjih strojništva

S10-MAG: Sposobnost uporabe sodobnih raziskovalnih metod in postopkov. Zmožnost raziskovanja in prenašanja spoznanj v prakso.

P1-MAG: Sposobnost za nadgrajevanje in uporabo temeljnih strojniških znanj ter njihovo razvojno–tehniško implementacijo.

P4-MAG: Sposobnost fizikalnega, matematičnega in numeričnega modeliranja problemov z razvito sposobnostjo kritične analize rezultatov.

P7-MAG: Na osnovi analize in sinteze razvita sposobnost iskanja optimalnejših rešitev.

Objectives and competences:

Objectives:

1. To enable the student to get acquainted with the basic and specific literature on the topic that will be discussed in the master's thesis.
2. To familiarize with the specific equipment in the field of experimentation and use of computer tools. Thus the student learns about the special features that 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-MAG: The ability to define and understand fundamental scientific problems, and to creatively deal with professional challenges.

S2-MAG: Improved capability of critical, analytical and synthetical thinking. Development of new knowledge and comprehension of the professional field. Development of higher cognitive skills, related to the creation of new knowledge

S8-MAG: The ability to find sources, critically evaluate information, independently upgrade the attained knowledge and deepen the knowledge in the individual specialised fields of mechanical engineering.

S10-MAG: The ability to use modern research methods and procedures. Capacity to research and transfer the findings into practice.

P1-MAG: The ability to upgrade and use the fundamental mechanical engineering knowledge, including the developmental-technical implementation thereof.

P4-MAG: The ability for physical, mathematical and numerical modelling of problems, including a developed ability to critically analyse the results.

P7-MAG: The ability to find optimal solutions based on analysis and synthesis.

Predvideni študijski rezultati:

Intended learning outcomes:

Znanja: Z2: Poglobljeno teoretično, metodološko in analitično znanje z elementi raziskovanja, ki je osnova za zelo zahtevno strokovno delo. Spretnosti: S2.1 Obvladovanje zelo zahtevnih, kompleksnih delovnih procesov in metodoloških orodij na specializiranih področjih. S2.2 Načrtovanje in vodenje delovnega procesa na podlagi ustvarjalnega reševanja problemov, povezanih s področjem izobraževanja in usposabljanja. S2.3 Sposobnost izvirnih dognanj/stvaritev in kritične refleksije.	Knowledge: Z2: Thorough theoretical, methodological and analytical knowledge with elements of a research work that form a basis for very demanding professional work Skills: S2.1 Mastering very demanding and complex work processes and methodological tools in specialised professional fields. S2.2 Planning and managing of the working process on the basis of creative solving of problems that are linked to the teaching and training content. S2.3 Ability of 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 (opišite kateri-maks. ena vrstica na eno vrsto gradiva, izbirate med besedami npr. knjiga, skripta, zapiski, e-knjiga, tiskana verzija predstavitve predavanj, e-verzija predstavitve predavanj). **Moderne in prožne oblike poučevanja:** P6 Interaktivna predavanja P7 Študij literature in razprava 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 (description needs to be added, max. one line per material, e.g. textbook, e-book, printed lecture presentations, etc.). **Contemporary and flexible teaching methods:** P6 Interactive lectures. P7 Literature study and discussion. P8 Making and presenting applied seminar exercises. P14 Virtual experiments.

Načini ocenjevanja:	**Delež/Weight**	**Assessment:**
Pisni preskus znanja.	50,00 %	Written examination.
Ocena končnih poročil (po enega za vsakega od treh nosilcev).	50,00 %	Evaluation of final reports (one report per each of three lecturers)

Reference nosilca/Lecturer's references:

Boltežar Miha

1. Tomaž, HOLEČEK, Nikola, ČEPON, Gregor, RIXEN, Daniel J., **BOLTEŽAR, Miha**. Including directly measured

rotations in the virtual point transformation. *Mechanical systems and signal processing*, ISSN 0888-3270, July 2020, vol. 141, str. 1-21, ilustr. https://www.sciencedirect.com/science/article/pii/S0888327019306612, doi: 10.1016/j.ymssp.2019.106440. [COBISS.SI-ID 17033755].

2. OGRINEC, Primož, SLAVIČ, Janko, ČESNIK, Martin, **BOLTEŽAR, Miha**. Vibration fatigue at half-sine impulse excitation in the time and frequency domains. *International journal of fatigue*, ISSN 0142-1123, Jun. 2019, vol. 123, str. 308-317, ilustr. https://www.sciencedirect.com/science/article/pii/S0142112319300568?via%3Dihub, doi: 10.1016/j.ijfatigue.2019.02.031. [COBISS.SI-ID 16539419].
3. GORJUP, Domen, SLAVIČ, Janko, **BOLTEŽAR, Miha**. Frequency domain triangulation for full-field 3D operating-deflection-shape identification. *Mechanical systems and signal processing*, ISSN 0888-3270, Nov. 2019, vol. 133, str. 1-13, ilustr. https://www.sciencedirect.com/science/article/pii/S0888327019305023, doi: 10.1016/j.ymssp.2019.106287. [COBISS.SI-ID 16751899].

Brojan Miha

1. VELDIN, Tomo, BRANK, Boštjan, **BROJAN, Miha**. Computational finite element model for surface wrinkling of shells on soft substrates. *Communications in Nonlinear Science & Numerical Simulation*, ISSN 1007-5704, maj 2019, letn. XX, str. 1-29, ilustr. DOI: 10.1016/j.cnsns.2019.104863. [COBISS.SI-ID 8813409]
2. **BROJAN, Miha**, TERWAGNE, Denis, LAGRANGE, Romain, REIS, Pedro. Wrinkling crystallography on spherical surfaces. *Proceedings of the National Academy of Sciences of the United States of America*, ISSN 0027-8424, Jan. 2015, vol. 112, no. 1, str. 14-19, ilustr., DOI: 10.1073/pnas.1411559112. [COBISS.SI-ID 13852187].
3. TERWAGNE, Denis, **BROJAN, Miha**, REIS, Pedro. Smart morphable surfaces for aerodynamic drag control. Advanced materials, ISSN 0935-9648, Oct. 2014, vol. 26, iss. 38, str. 6608-6611, ilustr., DOI: 10.1002/adma.201401403. [COBISS.SI-ID 13725211]

Diaci Janez

1. PAVLOVČIČ, Urban, **DIACI, Janez**, MOŽINA, Janez, JEZERŠEK, Matija. Wound perimeter, area, and volume measurement based on laser 3D and color acquisition. *BioMedical engineering online*. Apr. 2015, vol. 14, f. 1-15, ilustr. ISSN 1475-925X. DOI: 10.1186/s12938-015-0031-7. [COBISS.SI-ID 13973787]
2. PRIBOŠEK, Jaka, **DIACI, Janez**. Electromagnetic microforging apparatus for low-cost fabrication of molds for microlens arrays. *Journal of micromechanics and microengineering*. [Print ed.]. 2015, vol. 25, nr. 6, str. 1-10, ilustr. ISSN 0960-1317. DOI: 10.1088/0960-1317/25/6/065018. [COBISS.SI-ID 14009115]
3. HORVAT, Darja, LAZAR, Dušan, MOŽINA, Janez, KRIŽAN, Janez, **DIACI, Janez**, TERZIĆ, Mira. Green upconversion in Y2O3 :Yb nanopowder. *Journal of nanophotonics*. Sep. 2015, vol. 9, no. 1, str. 1-12, ilustr. ISSN 1934-2608. http://nanophotonics.spiedigitallibrary.org/article.aspx?articleid=2442453#Experimental, DOI: 10.1117/1.JNP.9.093054. [COBISS.SI-ID 14175259]

Golobič Iztok

1. MOŽE, Matic, ZUPANČIČ, Matevž, HOČEVAR, Matej, **GOLOBIČ, Iztok**, GREGORČIČ, Peter. Surface chemistry and morphology transition induced by critical heat flux incipience on laser-textured copper surfaces. *Applied Surface Science*. [Print ed.]. Oct. 2019, vol. 490, str. 220-230, ilustr. ISSN 0169-4332. https://www.sciencedirect.com/science/article/pii/S0169433219317623?via%3Dihub, DOI: 10.1016/j.apsusc.2019.06.068. [COBISS.SI-ID 16653083]
2. SITAR, Anže, MOŽE, Matic, CRIVELLARI, Michele, SCHILLE, Jörg, **GOLOBIČ, Iztok**. Nucleate pool boiling heat transfer on etched and laser structured silicon surfaces. *International journal of heat and mass transfer*. [Print ed.]. Feb. 2020, vol. 147, str. 1-12, ilustr. ISSN 0017-9310. https://www.sciencedirect.com/science/article/pii/S0017931019344229?dgcid=author, DOI: 10.1016/j.ijheatmasstransfer.2019.118956. [COBISS.SI-ID 16885531]
3. VOGLAR, Jure, GREGORČIČ, Peter, ZUPANČIČ, Matevž, **GOLOBIČ, Iztok**. Boiling performance on surfaces with capillary-length-spaced one- and two-dimensional laser-textured patterns. *International journal of heat and mass transfer*. [Print ed.]. Dec. 2018, vol. 127, part a, str. 1188-1196, ilustr. ISSN 0017-9310. https://www.sciencedirect.com/science/article/pii/S0017931018315357, DOI: 10.1016/j.ijheatmasstransfer.2018.07.056. [COBISS.SI-ID 16149019]

Govekar Edvard

1. KOTAR, Matjaž, FUJISHIMA, Makoto, LEVY, Gideon N., **GOVEKAR, Edvard**. Initial transient phase and stability of

annular laser beam direct wire deposition. *CIRP annals*. 2019, vol. 68, iss. 1, str. 233-236, ilustr. ISSN 0007-8506. https://www.sciencedirect.com/science/article/pii/S0007850619301507?via%3Dihub, DOI: 10.1016/j.cirp.2019.04.118. [COBISS.SI-ID 16601883]

2. JEROMEN, Andrej, **GOVEKAR, Edvard**. Time series analysis based study of a mass-spring-like oscillation and detachment of a metal pendant droplet. *Mechanical systems and signal processing*. Dec. 2016, vol. 80, str. 503-516, ilustr. ISSN 0888-3270. http://www.sciencedirect.com/science/article/pii/S0888327016300772, DOI: 10.1016/j.ymssp.2016.04.038. [COBISS.SI-ID 14623515]
3. POTOČNIK, Primož, SOLDO, Božidar, ŠIMUNOVIĆ, Goran, ŠARIĆ, Tomislav, JEROMEN, Andrej, **GOVEKAR, Edvard**. Comparison of static and adaptive models for short-term residential natural gas forecasting in Croatia. *Applied energy*. Sep. 2014, vol. 129, str. 94-103, ilustr. ISSN 0306-2619. [COBISS.SI-ID 13478939]

Halilovič Miroslav

1. **HALILOVIČ, Miroslav**, STARMAN, Bojan, VRH, Marko, ŠTOK, Boris. A robust explicit integration of elasto-plastic constitutive models, based on simple subincrement size estimation. *Engineering computations*. 2017, vol. 34, iss. 6, str. 1774-1806, ilustr. ISSN 0264-4401. http://www.emeraldinsight.com/doi/pdfplus/10.1108/EC-03-2016-0103, DOI: 10.1108/EC-03-2016-0103. [COBISS.SI-ID 15583259]
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Herakovič Niko

1. **HERAKOVIČ, Niko**, ZUPAN, Hugo, PIPAN, Miha, PROTNER, Jernej, ŠIMIC, Marko. Distributed manufacturing systems with digital agents. *Strojniški vestnik*. Nov./Dec. 2019, vol. 65, no. 11/12, str. 650-657, ilustr. ISSN 0039-2480. https://www.sv-jme.eu/sl/article/distributed-manufacturing-systems-with-digital-agents/, DOI: 10.5545/sv-jme.2019.6331. [COBISS.SI-ID 16942875]
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3. ŠIMIC, Marko, **HERAKOVIČ, Niko**. Reduction of the flow forces in a small hydraulic seat valve as alternative approach to improve the valve characteristics. *Energy conversion and management*. [Print ed.]. 2015, vol. 89, str. 708-718, ilustr. ISSN 0196-8904. https://www.sciencedirect.com/science/article/pii/S0196890414009182?via%3Dihub, DOI: 10.1016/j.enconman.2014.10.037. [COBISS.SI-ID 13766683]

Hočevar Marko

1. NOVAK, Lovrenc, ŠIROK, Brane, **HOČEVAR, Marko**, GATARIĆ, Pero. Influence of load mass and drum speed on fabric motion and performance of a heat pump tumble dryer. Drying technology. [Print ed.]. 2020, str. 1-15, [COBISS.SI-ID 17092379]
2. RAK, Gašper, STEINMAN, Franci, **HOČEVAR, Marko**, DULAR, Matevž, JEZERŠEK, Matija, PAVLOVČIČ, Urban. Laser ranging measurements of turbulent water surfaces. European journal of mechanics.B, Fluids. feb. 2020, letn. xx, št. xx, str. 1-12, [COBISS.SI-ID 9085793]
3. KHLIFA, Ilyass, VABRE, Alexandre, **HOČEVAR, Marko**, FEZZAA, Kamel, FUZIER, Sylvie, ROUSSETTE, Olivier, COUTIER-DELGOSHA, Olivier. Fast X-ray imaging of cavitating flows. Experiments in fluids. Nov. 2017, vol. 58, str. 1-22, [COBISS.SI-ID 15738139]

Jezeršek Matija

1. SENEGAČNIK, Matej, **JEZERŠEK, Matija**, GREGORČIČ, Peter. Propulsion effects after laser ablation in water, confined by different geometries. *Applied physics.A, Materials science & processing*. Feb. 2020, vol. 126, iss. 2, str. 1-12, ilustr. ISSN 0947-8396. https://link.springer.com/article/10.1007%2Fs00339-020-3309-y, DOI:

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Kalin Mitjan

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