

# RAZISKAVE V STROJNIŠTVU

## UČNI NAČRT PREDMETA/COURSE SYLLABUS

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

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

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

<b>Predavanj a /Lectures</b>	<b>Seminar /Seminar</b>	<b>Vaje /Tutorials</b>	<b>Klinične vaje /Clinical tutorials</b>	<b>Druge oblike študija /Other forms of study</b>	<b>Samostoj no delo /Individual student work</b>	<b>ECT S</b>
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, Gregor Čepon, Iztok Golobič, Janez Žerovnik, Janko Slavič, Jernej Klemenc, Joško Valentinčič, Jože Kutin, Jurij Prezelj, Lidija Slemenik Perše, Marko Hočevan, Marko Nagode, Matija Jezeršek, Miha Brojan, Mihael Sekavčnik, Miroslav Halilović, Mitjan Kalin, Niko Heraković, Nikola Vukašinović, Nikolaj Mole, Primož Podržaj, Robert Kunc, Rok Petkovšek, Rok Vrabčič, Roman Šturm, Sašo Medved, Tomaž Berlec, Tomaž Katrašnik, Tomaž Pepelnjak, Uroš Stritih

**Izvajalci predavanj:**

**Izvajalci seminarjev:**

**Izvajalci vaj:**

**Izvajalci kliničnih vaj:**

**Izvajalci drugih oblik:**

**Izvajalci praktičnega  
usposabljanja:**

**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.

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

semestra MAG študijskega programa.	course is completed study obligations of the 1st and 2nd semester of the MAG study program.
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### **Vsebina:**

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.

### **Content (Syllabus outline):**

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

15. Pregled izzivov za prihodnost na področju izbrane raziskovalne tematike.	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.
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### 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

### 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,

<p>pridobljenih znanj in poglobljanja znanja na posameznih specializiranih področjih strojništva</p> <p>S10-MAG: Sposobnost uporabe sodobnih raziskovalnih metod in postopkov. Zmožnost raziskovanja in prenašanja spoznanj v prakso.</p> <p>P1-MAG: Sposobnost za nadgrajevanje in uporabo temeljnih strojniških znanj ter njihovo razvojno-tehniško implementacijo.</p> <p>P4-MAG: Sposobnost fizikalnega, matematičnega in numeričnega modeliranja problemov z razvito sposobnostjo kritične analize rezultatov.</p> <p>P7-MAG: Na osnovi analize in sinteze razvita sposobnost iskanja optimalnejših rešitev.</p>	<p>critically evaluate information, independently upgrade the attained knowledge and deepen the knowledge in the individual specialised fields of mechanical engineering.</p> <p>S10-MAG: The ability to use modern research methods and procedures. Capacity to research and transfer the findings into practice.</p> <p>P1-MAG: The ability to upgrade and use the fundamental mechanical engineering knowledge, including the developmental-technical implementation thereof.</p> <p>P4-MAG: The ability for physical, mathematical and numerical modelling of problems, including a developed ability to critically analyse the results.</p> <p>P7-MAG: The ability to find optimal solutions based on analysis and synthesis.</p>
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<b>Predvideni študijski rezultati:</b>	<b>Intended learning outcomes:</b>
<p>Znanja:</p> <p>Z2: Poglobljeno teoretično, metodološko in analitično znanje z elementi raziskovanja, ki je osnova za zelo zahtevno strokovno delo.</p> <p>Spretnosti:</p> <p>S2.1 Obvladovanje zelo zahtevnih, kompleksnih delovnih procesov in metodoloških orodij na specializiranih področjih.</p> <p>S2.2 Načrtovanje in vodenje delovnega procesa na podlagi ustvarjalnega reševanja problemov, povezanih s področjem izobraževanja in usposabljanja.</p> <p>S2.3 Sposobnost izvirnih dognanj/stvaritev in kritične refleksije.</p>	<p>Knowledge:</p> <p>Z2: Thorough theoretical, methodological and analytical knowledge with elements of a research work that form a basis for very demanding professional work</p> <p>Skills:</p> <p>S2.1 Mastering very demanding and complex work processes and methodological tools in specialised professional fields.</p> <p>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.</p> <p>S2.3 Ability of unique innovations and critical reflections.</p>

<b>Metode poučevanja in učenja:</b>	<b>Learning and teaching methods:</b>
<p><b>Klasične oblike poučevanja:</b></p> <p>P1 Avditorna predavanja z reševanjem izbranih - za področje značilnih -</p>	<p><b>Conventional teaching methods:</b></p> <p>P1 Auditorial lectures with solving selected field-specific theoretical and</p>

<p>teoretičnih in praktično uporabnih primerov.</p> <p>P2 Obravnava snovi po urejeni in vnaprej razloženi sistematiki.</p> <p>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).</p> <p><b>Moderne in prožne oblike poučevanja:</b></p> <p>P6 Interaktivna predavanja</p> <p>P7 Študij literature in razprava</p> <p>P8 Izdelava in predstavitev aplikativnih seminarskih nalog</p> <p>P14 Virtualni eksperimenti</p>	<p>applied use cases.</p> <p>P2 Presenting the content according to the explained system.</p> <p>P5 Application of study material (description needs to be added, max. one line per material, e.g. textbook, e-book, printed lecture presentations, etc.).</p> <p><b>Contemporary and flexible teaching methods:</b></p> <p>P6 Interactive lectures.</p> <p>P7 Literature study and discussion.</p> <p>P8 Making and presenting applied seminar exercises.</p> <p>P14 Virtual experiments.</p>
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<b>Načini ocenjevanja:</b>	<b>Delež/ Weight</b>	<b>Assessment:</b>
Pisni preskus znanja.	50,00 %	Written examination.
Ocena končnih poročil.	50,00 %	Evaluation of final reports.

<b>Ocenjevalna lestvica:</b>	<b>Grading system:</b>
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:**

##### **Tomaž Berlec:**

1. ZUPAN, Hugo, HERAKOVIČ, Niko, ŽEROVNIK, Janez, **BERLEC, Tomaž**. *Layout optimization of a production cell*. International journal of simulation modelling. Dec. 2017, vol. 16, nr. 4, str. 603-616, ilustr. ISSN 1726-4529. [http://www.ijssimm.com/Full\\_Papers/Fulltext2017/text16-4\\_603-616.pdf](http://www.ijssimm.com/Full_Papers/Fulltext2017/text16-4_603-616.pdf). [COBISS.SI-ID [15898139](#)], [JCR, SNIP, WoS do 26. 10. 2022: št. citatov (TC): 12, čistih citatov (CI): 11, čistih citatov na avtorja (CIAu): 2,75, Scopus do 23. 12. 2022: št. citatov (TC): 19, čistih citatov (CI): 18, čistih citatov na avtorja (CIAu): 4,50].
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  4. ŽUŽEK, Tena, RIHAR, Lidija, **BERLEC, Tomaž**, KUŠAR, Janez. *Use of a standard risk model and a risk map for product development project planning and management*. V: ZADNIK STIRN, Lidija (ur.), et al. SOR '19 proceedings. Ljubljana: Slovenian Society Informatika, Section for Operational Research, 2019. Str. 269-274, ilustr. ISBN 978-961-6165-55-6. [COBISS.SI-ID [16810779](#)], [[Scopus](#)].
  5. KOŽELJ, Nejc, **BERLEC, Tomaž**. *Vpliv krajšanja časa menjave orodja na lastno ceno storitve*. V: BERLEC, Tomaž (ur.), BROJAN, Miha (ur.), DROBNIČ, Boštjan (ur.). ŠTeKam : Študentska tehniška konferenca : Fakulteta za strojništvo, Ljubljana, 8. 9. 2022. Ljubljana: Fakulteta za strojništvo, 2022. Str. 71-78, ilustr. ISBN 978-961-6980-90-6. [COBISS.SI-ID [121396483](#)].

#### Andrej Bombač:

1. **BOMBAČ, Andrej**, REK, Zlatko, LEVEC, Janez. Void fraction distribution in a bisectonal bubble column reactor. *AIChE journal*, ISSN 1547-5905. [Online ed.], Apr. 2019, vol. 65, iss. 4, str. 1186-1197, ilustr. <https://onlinelibrary.wiley.com/doi/epdf/10.1002/aic.16534>, doi: [10.1002/aic.16534](https://doi.org/10.1002/aic.16534). [COBISS.SI-ID [16463387](#)]
2. **BOMBAČ, Andrej**, PIRNAR, Jernej. Numerical and experimental analyses of a stirred vessel for a large volumetric flow rate of sparged air. *Chinese journal of chemical engineering*, ISSN 1004-9541, 2019, vol. 27, iss. 10, str. 2304-2312, ilustr. <https://www.sciencedirect.com/science/article/pii/S1004954118314204?via%3Dihub>, doi: [10.1016/j.cjche.2019.03.009](https://doi.org/10.1016/j.cjche.2019.03.009). [COBISS.SI-ID [16556827](#)]
3. PIRNAR, Jernej, ŠIROK, Brane, **BOMBAČ, Andrej**. Effect of airway surface liquid on the forces on the pharyngeal wall : experimental fluid-structure interaction study. *Journal of biomechanics*, ISSN 0021-9290. [Print ed.], Oct. 2017, vol. 63, str. 117-124, ilustr. [https://ac.els-cdn.com/S0021929017304256/1-s2.0-S0021929017304256-main.pdf?\\_tid=5675a9e4-ace7-11e7-bd92-00000aacb362&acdnat=1507549705\\_3545784e854ed245a0807ee62d15b40d](https://ac.els-cdn.com/S0021929017304256/1-s2.0-S0021929017304256-main.pdf?_tid=5675a9e4-ace7-11e7-bd92-00000aacb362&acdnat=1507549705_3545784e854ed245a0807ee62d15b40d), doi: [10.1016/j.jbiomech.2017.08.014](https://doi.org/10.1016/j.jbiomech.2017.08.014). [COBISS.SI-ID [15693339](#)]

#### Drago Bračun:

1. **BRAČUN, Drago**, SELAK, Luka. Optical probing for CNC machining of large parts made from fiber-reinforced polymer composite materials. *International journal of advanced manufacturing technology*, ISSN 0268-3768, 2019, vol. 100, iss. 5/8, str. 1855-1865, ilustr. <https://link.springer.com/content/pdf/10.1007%2Fs00170-018-2789-9.pdf>, doi: [10.1007/s00170-018-2789-9](https://doi.org/10.1007/s00170-018-2789-9). [COBISS.SI-ID [16273435](#)]

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### **Miha Brojan:**

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### **Gregor Čepon:**

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