

UČNI NAČRT PREDMETA / COURSE SYLLABUS

Predmet:	Merilni instrumenti in načrtovanje eksperimentov
Course title:	Measuring Instruments and Experimental Design

Študijski program in stopnja Study programme and level	Študijska smer Study field	Letnik Academic year	Semester Semester
Tehnologije in sistemi v strojništvu – druga stopnja	Tehnologije in sistemi v strojništvu	prvi	drugi
Technologies and systems in mechanical engineering – second cycle	Technologies and systems in mechanical engineering	first	second

Vrsta predmeta / Course type obvezni/obligatory

Univerzitetna koda predmeta / University course code: TSS 1 UN 7

Predavanja Lectures	Seminar Seminar	Vaje Tutorial	Laboratorijske vaje Laboratory work	Druge oblike študija Other forms of study	Samost. delo Individ. work	ECTS
45			30		135	7

Nosilec predmeta / Lecturer: doc. dr. Bogdan Blagojevič

Jeziki / Languages:	Predavanja / Lectures:	slovenski/ slovenian
	Vaje / Tutorial:	slovenski/ slovenian

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

Pogoj za vključitev v delo je vpis v 1. letnik študija.

Prerequisites:

The condition for inclusion in the work is enrollment in the 1st year of study.

Vsebina:

- Pomen in teorija merilne tehnike pri vrednotenju eksperimentalnih rezultatov v znanstvene namene.
- Specialna teme iz merilne tehnike s poudarkom na zajemanju in obdelavi izmerkov npr. v mehaniki tekočin in izdelava lastnih merilnih instrumentov.
- Osnove načrtovanja eksperimentov.
- Enostavni primerjalni eksperimenti.
- Faktorsko načrtovanje: 2^k, 3^k.
- Dvo in tri nivojski eksperiment.
- Regresijski modeli in načrtovanje eksperimentov.
- Multiregresijski modeli oin načrtovanje eksperimentov.
- Eksperimenti z naključnim faktorjem.

Content (Syllabus outline):

- The importance and theory of measurement techniques in the evaluation of experimental results for scientific purposes.
- Special topics in measurement technology with an emphasis on the capture and processing of measurements e.g. in fluid mechanics and manufacture of own measuring instruments.
- Basics of experimental design.
- Simple comparative experiments.
- Factorial designs: 2k, 3k.
- Two and three level experiment.
- Regression models and design of experiments.
- Multi-regression models and experimental design.
- Random factor experiments.

- Merilna negotovost in prilagajanje aproksimacijskih krivulj.
- Statistični testi pri načrtovanju eksperimentov in obdelavi izmerkov.
- Dimenzijska analiza, načrtovanje eksperimentov in obdelava rezultatov.
- Vzorčni pogrešek in analiza variance.
- Uporaba računalniških programov pri načrtovanju in obdelavi izmerkov.

- Measurement uncertainty and fitting with approximation curves.
- Statistical tests in the design of experiments and processing of measurements.
- Dimensional analysis, experimental design and processing of results.
- Sampling error and analysis of variance.
- Use of computer programs in the design and processing of measurement data.

Temeljni literatura in viri / Readings:

- MONTGOMERY, D.C. *Design and analysis of experiments*, 9th edition. Hoboken, NJ: John Wiley & Sons, Inc., 2017.
- DIECK, R. H. *Measurement uncertainty: Methods and application*, 5th edition. ISA, 2017.
- FIGLIOLA, R.S. in D.E. BEASLEY. *Theory and Design for Mechanical Measurements*, 7th edition. John Wiley & Sons, Inc., 2019.
- ZLOKARNIK, M. *Scale-Up in Chemical Engineering*, 2nd edition. Wiley-VCH Verlag GmbH & GmbH & Co. KGaA, 2006.
- SPIEGEL, M. R., J. SCHILLER in R. ALU SRINIVASAN. *Probability and Statistics*, 4th edition. Schaum's outline Series, McGrawHill, 2013.

Cilji in kompetence:

Učna enota prispeva k razvoju naslednjih splošnih in predmetnospecifičnih kompetenc:

- sposobnost samostojnega in ustvarjalnega raziskovalno-razvojnega dela na področju strojništva,
- sposobnost samostojnega spremljanja in kritične presoje najnovejših dosežkov s področja strojništva in širše,
- sposobnost aktivnega pisnega in ustnega sporazumevanja na visoki strokovni kot tudi na poljudni ravni, odvisno od ciljnega občinstva,
- sposobnost timskega dela s strokovnjaki z različnih področij,
- sposobnost učinkovite uporabe informacijsko-komunikacijske tehnologije,
- sposobnost prevzeti odgovornost za lasten poklicni in osebnostni razvoj,
- sposobnost delovanja v sozvočju s poklicno, okoljsko, socialno in etično odgovornostjo,
- poznavanje pomena priprave eksperimentov in merilno tehničnih metod v znanosti in znanstveno raziskovalnem delu.
- delo v timih in priprava na industrijske poskuse.

Objectives and competences:

The learning unit contributes to the development of the following general and subject-specific competences:

- ability of independent and creative research and development work in the field of mechanical engineering,
- ability to independently perceive and critically assess the latest achievements in the field of mechanical engineering and beyond,
- ability to actively communicate in writing and orally at a high professional as well as at a popular level, depending on the target audience,
- ability to work in teams with experts from different fields,
- ability to effectively use information and communication technology,
- ability to take responsibility for one's own professional and personal development,
- ability to work according to professional, environmental, social and ethical responsibility
- understanding of importance of preparing experiments and measuring and technical methods in science and scientific research.
- working in teams and preparing for industrial experiment.

Predvideni študijski rezultati:*Študent/študentka:*

- pozna pomen znanstveno-raziskovalnega dela, pozna metodologijo znanstveno raziskovalnega dela;
- razvije zavedanje pomena timskega dela pri raziskovanju,
- pozna raziskovalne tehnike pri raziskovanju izbranega raziskovalnega problema,
- razvije lastne raziskovalne pristope k reševanju najzahtevnejših inženirskih problemov,
- zna uporabiti znanje v izvedbi raziskovanja,
- razvije raziskovalne sposobnosti,
- razvije zmožnost prilagajanja novim razmeram,
- razvije zmožnost odločanja.

Intended learning outcomes:*Students:*

- know importance of known research work, know methodology of scientific research work;
- develop awareness of the importance of teamwork in research;
- know of research techniques in researching a selected research problem,
- develop skills for of own research approaches to solving the most demanding engineering problems,
- are able to use knowledge in conducting research,
- develop research skills,
- are able to adapt to new conditions,
- are able for decision making.

Metode poučevanja in učenja:

- *predavanja* z aktivno udeležbo študentov (razlaga, diskusija, vprašanja, primeri, reševanje problemov),
- *avditorne vaje*: reševanje problemov, študije primerov, kritično presojanje, diskusija, refleksija izkušenj, vrednotenje, projektno delo, timsko delo,
- *laboratorijske vaje*: praktično reševanje več tipičnih problemov v laboratoriju (na računalniku),
- *seminar*: priprava, predstavitev in uspešen zagovor projektne/raziskovalne naloge, (reševanje problemov, študije primera, kritično presojanje, diskusija, refleksija izkušenj, vrednotenje, projektno delo, timsko delo.

Learning and teaching methods:

- *lectures* with active student participation (explanation, discussion, questions, examples, problem solving),
- *tutorial*: problem solving, case studies, methods of critical thinking, discussion, reflection of experience, evaluation, project work, team work,
- *laboratory work*: practical solving of several typical problems in laboratory (on a computer),
- *seminar tutorial*: presentation and defence of project/research work (problem solving, studies, critical thinking, discussion, reflection of experience, evaluation, project work, team work).

Načini ocenjevanja:

Delež (v %) /

Weight (in %)

Assessment:

Načini:	Delež (v %) / Weight (in %)	Assessment: Types:
<ul style="list-style-type: none"> • laboratorijsko delo (individualno in timsko delo) • izpit 	50 %	<ul style="list-style-type: none"> • laboratory work (individual and team work) • examination
	50 %	