



Univerza v Mariboru

Fakulteta za naravoslovje
in matematiko

UČNI NAČRT PREDMETA / COURSE SYLLABUS

Predmet:	Sodobne merske tehnike in precizne meritve
Course title:	Modern measurement techniques and precise measurements

Študijski program in stopnja Study programme and level	Študijska smer Study field	Letnik Academic year	Semester Semester
Tehnika – področje izobraževanja, 3. stopnja		1/2	1/3/4
Education in Engineering, 3rd Cycle		1/2	1/3/4

Vrsta predmeta / Course type

Univerzitetna koda predmeta / University course code:

Predavanja Lectures	Seminar Seminar	Vaje Tutorial	Klinične vaje work	Druge oblike študija	Samost. delo Individ. work	ECTS
15	10				155	6

Nosilec predmeta / Lecturer:

Jeziki / Languages:	Predavanja / Lectures:	Slovenski/slovene
	Vaje / Tutorial:	Slovenski/slovene

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

Ni posebnih pogojev

Prerequisites:

No special prerequisites.

Vsebina:

Content (Syllabus outline):

Predavanja:

Predmet obravnava sodobne metode in tehnike merjenja ter njihovo uporabo v različnih inženirskih in znanstvenih disciplinah. Poudarek je na preciznih meritvah, kalibraciji in analizi merilnih podatkov in rezultatov.

Vaje:

Študentje bodo sami opravili raznovrstne meritve količin, uredili rezultate ter jih obdelali. Poudarek bo na preciznih meritvah ter neinvazivnih metodah merjenja.

Vsebina predmeta:**Uvod v merjenje:**

- Osnovni pojmi in definicije
- Vrste meritev in merskih instrumentov
- Napake in negotovosti pri merjenju

Sodobne merske tehnike:

- Optične meritve
- Elektronske meritve
- Akustične meritve
- Termične meritve

Precizne meritve:

- Kalibracija in standardizacija
- Metode za zmanjšanje napak
- Analiza in obdelava merilnih podatkov

Praktične aplikacije:

- Merjenje v industriji
- Merjenje v znanstvenih raziskavah
- Primeri iz prakse

Lectures:

The course deals with modern methods and techniques of measurement and their application in various engineering and scientific disciplines. The emphasis is on precise measurements, calibration and analysis of measurement data and results.

Exercises:

Students will perform various measurements of quantities themselves, arrange the results and process them. The emphasis will be on precise measurements and non-invasive measurement methods.

Course content:**Introduction to measurement:**

- Basic concepts and definitions
- Types of measurements and measuring instruments
- Errors and uncertainties in measurement

Modern measurement techniques:

- Optical measurements
- Electronic measurements
- Acoustic measurements
- Thermal measurements

Precision measurements:

- Calibration and standardization
- Methods for reducing errors
- Analysis and processing of measurement data

Practical applications:

- Measurement in industry
- Measurement in scientific research
- Examples from practice

Temeljni literatura in viri / Readings:

- Kamnik, R., & Kovačič, B. (2009). Praktična geodezija v gradbeništvu (str. VIII, 219). Fakulteta za gradbeništvo.
- Dobovišek A. (2021). Osnovna merjenja : Uvod v merske napake in kvantitativno analizo fizikalnih meritev (str. 79). Fakulteta za naravoslovje in matematiko.
- Hribernik A. (2017). Tehniške meritve: zbrano gradivo. Fakulteta za strojništvo.

Dodatni viri / additional readings:

- Rabinovich, S. G. (2005). Measurement errors and uncertainties: theory and practice (3rd ed., str. XII, 308). AIP Press; Springer Science+Business Media. □ Springer handbook of materials measurement methods (str. XXVI, 1208). (2006). Springer.

Cilji in kompetence:

- Razumevanje osnovnih principov merjenja in merilnih sistemov.
- Pridobitev znanja o sodobnih merskih tehnikah in instrumentih.
- Razvoj veščin za izvajanje preciznih meritev in analizo podatkov.
- Uporaba merilnih tehnik v praktičnih aplikacijah.

Objectives and competences:

- Understanding the basic principles of measurement and measurement systems.
- Gaining knowledge of modern measurement techniques and instruments.
- Developing skills to perform precise measurements and analyze data.
- Using measurement techniques in practical applications.

Predvideni študijski rezultati:

Znanje in razumevanje:

Po zaključku tega predmeta bo študent sposoben:

- samostojno izvesti precizne meritve različnih količin
- kritično analizirati in interpretirati merske rezultate ;
- pokazati sposobnost samostojne izvedbe zahtevnih meritev,
- izkazati razumevanje uporabe merske opreme;
- uporabiti napredne merske instrumente in metode v praksi

Intended learning outcomes:

Knowledge and understanding:

Upon completion of this course, the student will be able to:

- independently perform precise measurements of various quantities
- critically analyze and interpret measurement results ;
- demonstrate the ability to independently perform complex measurements,
- demonstrate an understanding of the use of measurement equipment;
- use advanced measurement instruments and methods in practice

Metode poučevanja in učenja:

Learning and teaching methods:

<ul style="list-style-type: none"> • Predavanja • Laboratorijske vaje • Seminarji in delavnice • Samostojno delo študentov 	<ul style="list-style-type: none"> • Lectures • Laboratory exercises • Seminars and workshops • Independent student work
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Delež (v %) /

Načini ocenjevanja:

Weight (in %) **Assessment:**

<p>Način (pisni izpit, ustno izpraševanje, naloge, projekt)</p> <ul style="list-style-type: none"> • pisni izpit; • seminarska naloga 	<p>50% 50%</p>	<p>Type (examination, oral, coursework, project):</p> <ul style="list-style-type: none"> • written exam; • seminar paper
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Reference nosilca / Lecturer's references:

Kovačič, B., Toplak, S., Paar, R., & Lubej, S. (2022). Application and comparison of non-contact vibration monitoring methods for concrete railway sleepers. *Applied sciences*, 24(12), 1–19. <https://www.mdpi.com/2076-3417/12/24/12875>

Kovačič, B., Muršec, L., & Lubej, S. (2022). Synchronisation of contactless vibration monitoring methods. *International journal of simulation modelling*, 21(1), 113–123. doi:10.2507/IJSIMM21-1-594

Peroš, J., Paar, R., Divić, V., & Kovačič, B. (2022). Fusion of laser scans and image data—RGB+D for structural health monitoring of engineering structures. *Applied sciences*, 12(12), 1–23. <https://www.mdpi.com/2076-3417/12/22/11763>