Fakulteta za industrijski inženiring
Faculty of Industrial Engineering

UČNI NAČRT PREDMETA / COURSE SYLLABUS	
Predmet:	SENZORJI
Course title:	SENSORS

Študijski program Study programme and level	Študijska smer Study field	Letnik Academic year	Semester Semester
Inženiring vozila		tretji	
Engineering and vehicles		third	

Vrsta predmeta / Course type	Modulni/modulary
Univerzitetna koda predmeta / University course code:	**VS_11037**

Predavanja Lectures	Seminar Seminar	Sem. vaje Tutorial	Lab. vaje Laboratory work	Teren. vaje Field work	Samost. delo Individ. work	ECTS
60	**-**	**15**	**30**	**-**	**105**	**7**

Nosilec predmeta / Lecturer:	doc. dr. Dejan Gradišar

Jeziki / Languages:	**Predavanja / Lectures:**	slovenski/ Slovenian
	Vaje / Tutorial:	slovenski/Slovenian

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:	**Prerequisits:**
• pogoj za delo je vpis v 3. letnik študija;	• enrolled in third study year

Vsebina:	**Content (Syllabus outline):**
• Splošni principi merjenja neelektričnih in električnih veličin. • Signali in razvrstitev signalov • Splošna razvrstitev merilnih členov in njihove električne in mehanske lastnosti • Uporovni senzorji • Kapacitivni senzorji • Induktivni in magnetni senzorji • Piezoelektrični senzorji • Senzorji za zaznavanje razdalj in premika • Senzorji za zaznavanje rotacije • Optični senzorji za zaznavanje okolice • Razpoznavanje objektov, topološki zemljevidi	• General principles for the measurement of non-electrical and electrical quantities. • Signals and classification of signals • General classification of sensors and their electrical and mechanical properties • Resistance sensors • Capacitive sensors • Inductive and magnetic sensors • Piezoelectric sensors • Sensors for measuring distance and movement • Rotary sensors • Optical sensors for detecting the environment • Recognition of objects, topological maps

Velja od: 1. 10. 2019	Sprejel: Senat FINI Novo mesto

Temeljni literatura in viri / Readings:

Obvezna literatura:

- P.P.L. Regtien: Sensors for Mechatronics, Elsevier, 2012.
- A. Belič. Gradniki in tehnologije v sistemih vodenja. Založba FE in FRI, Ljubljana, 2012.
- J. Petrovčič, J. Kocijan. Uporaba gradnikov v sistemih vodenja. Založba FE in FRI, Ljubljana, 2002.
- Jacob Fraden, AIP Handbook of Modern Sensors: 3rd. ed, American Institute of Physics, N.Y., 2003.
- E-gradiva predmeta / E-Course material

Cilji in kompetence:

Objectives and competences:

Cilji

- podati študentu osnovna znanja s področja merjenja neelektričnih in električnih veličin ter njihove uporabe v robotiki in avtomatiki.
- omogočiti študentom uporabo različnih senzorskih tehnologij v robotiki in avtomatiki.

Kompetence

- sposobnost timskega dela, kooperativnost,
- sposobnost interdisciplinarnega povezovanja znanja,
- sposobnost uporabe teoretičnega znanja v praksi,
- sposobnost reševanja konkretnih problemov.

Objectives

- to get basic knowledge in the field of measurement of electric and non-electric signals in robotics and automation
- enable the students to use different sensor technologies in robotics and automation.

Competences

• ability of team work and co-operation,
• the ability to interdisciplinary integration of knowledge,
• the ability to apply theoretical knowledge in practice,
• ability to solve specific problems.

Predvideni študijski rezultati:

Intended learning outcomes:

Študent/študentka:

- Spozna vrste signalov, ki se uporabljajo v robotiki in avtomatiki,
- spozna pomen in vrste senzorjev ter osnovne principe njihovega delovanja in
- spozna principe razpoznavanja prostora in objektov ter gradnjo topoloških zemljevidov.

Student:

• learns the types of signals used in robotics and automatics,
• recognizes the meaning and types of sensors and the basic principles of their operation, and
• learns the principles of space recognition systems and systems for construction of topological maps.

Metode poučevanja in učenja:	Learning and teaching methods:
• *predavanja* • *avditorne in laboratorijske vaje* z aktivno udeležbo študentov (razlaga, diskusija, vprašanja, reševanje nalog) ob pomoči sodobnih pedagoških pripomočkov, • praktičen primer uporabe senzorjev in merilnih naprav Predmet je oblikovan na kombinirani način študija, ki vključuje aktivnosti preko elektronskega (on-line) okolja: te aktivnosti so sestavljene iz samostojnih in skupinskih aktivnosti z uporabo učnega okolja Moodle in drugih elektronskih vsebin. Praviloma vključujejo diskusije v forumih, spletne strani, ogled posnetih predavanj in vaj, preverjanje znanja, odgovori na vprašanja, iskanje po spletu (bazah) itd.	• Lectures • excercises with active participation of students (explanation, discussion, questions, problem solving), with the help of modern teaching aids • practical example of using sensors and measuring devices The course is designed as blended learning that includes online activities: Online activities consist of independent and group activities using the LMS Moodle and other electronic or online content. Activities usually include discussions in forums, websites, viewing of recorded lectures and tutorials, assessments, answering questions, searching the web (databases), etc.

Načini ocenjevanja:	Delež/Weight (%)	Assessment
Pred izpitom mora študent(ka) uspešno opraviti praktične vaje. • Pisni izpit • Ustni izpit Ocenjevalna lestvica je skladna z ECTS in Pravilnikom o preverjanju in ocenjevanju znanja FINI NM.	 70% 30%	Before exam, students must successfully complete excercises. • Written examination • Oral examination Evaluation scale in accordance with ECTS and the Rules on the Evaluation and Assessment of Knowledge FINI NM.

Reference nosilca / Lecturer's references:

Izbrane reference nosilca:

1. GLAVAN, Miha, GRADIŠAR, Dejan, MOSCARIELLO, Salvatore, JURIČIĆ, Đani, VRANČIĆ, Damir. Demand-side improvement of short-term load forecasting using a proactive load management : a supermarket use case. *Energy and buildings*, ISSN 0378-7788. 2019, vol. 186, str. 186-194.
2. GLAVAN, Miha, GRADIŠAR, Dejan, HUMAR, Iztok, VRANČIĆ, Damir. Refrigeration control algorithm for managing supermarket's overall peak power demand. *IEEE transactions on control systems technology*, ISSN 1063-6536. [in press] 2018, 8 str
3. KOCIJAN, Juš, GRADIŠAR, Dejan, STEPANČIČ, Martin, BOŽNAR, Marija, GRAŠIČ, Boštjan, MLAKAR, Primož. Selection of the data time interval for the prediction of maximum ozone concentrations. *Stochastic environmental research and risk assessment*, ISSN 1436-3240, 2018, vol. 32, no. 6, str. 1759-1770.
4. BOŽNAR, Marija, GRAŠIČ, Boštjan, MLAKAR, Primož, GRADIŠAR, Dejan, KOCIJAN, Juš. Nonlinear data assimilation for the regional modeling of maximum ozone values. *Environmental science and pollution research international*, ISSN 0944-1344. 2017, vol. 24, no. 31, str. 24666-24680
5. GLAVAN, Miha, GRADIŠAR, Dejan, INVITTO, Serena, HUMAR, Iztok, JURIČIĆ, Đani, PIANESE, Cesare, VRANČIĆ, Damir. Cost optimisation of supermarket refrigeration system with hybrid model. *Applied thermal engineering*, ISSN 1359-4311. 2016, vol. 103, str. 56-66

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6. KOCIJAN, Juš, GRADIŠAR, Dejan, BOŽNAR, Marija, GRAŠIČ, Boštjan, MLAKAR, Primož. On-line algorithm for ground-level ozone prediction with a mobile station. *Atmospheric environment*, ISSN 1352-2310. 2016, vol. 131, str. 326-333
7. GRADIŠAR, Dejan, GRAŠIČ, Boštjan, BOŽNAR, Marija, MLAKAR, Primož, KOCIJAN, Juš. Improving of local ozone forecasting by integrated models. *Environmental science and pollution research international*, ISSN 0944-1344. 2016, vol. 23, no. 18, str. 18439-18450
8. GRADIŠAR, Dejan, GLAVAN, Miha, STRMČNIK, Stanko, MUŠIČ, Gašper. ProOpter : an advanced platform for production analysis and optimization. *Computers in industry*, ISSN 0166-3615. jun. 2015, vol. 70, str. 102-115
9. GLAVAN, Miha, GRADIŠAR, Dejan, ATANASIJEVIĆ-KUNC, Maja, STRMČNIK, Stanko, MUŠIČ, Gašper. Input variable selection for model-based production control and optimisation. *The international journal of advanced manufacturing technology*, ISSN 0268-3768, 2013, vol. 68, no. 9/12, str. 2743-2759
10. GLAVAN, Miha, GRADIŠAR, Dejan, STRMČNIK, Stanko, MUŠIČ, Gašper. Production modelling for holistic production control. *Simulation modelling practice and theory*, ISSN 1569-190X, jan. 2013, vol. 30, str. 1-20
11. ZORZUT, Sebastjan, GRADIŠAR, Dejan, JOVAN, Vladimir, MUŠIČ, Gašper. Use of a procedural model in the design of production control for a polymerization plant. *The international journal of advanced manufacturing technology*, ISSN 0268-3768, 2009, vol. 44, no. 11/12, str. 1051-1062.
12. ZORZUT, Sebastjan, JOVAN, Vladimir, GRADIŠAR, Dejan, MUŠIČ, Gašper. Closed-loop control of a polymerisation plant using production performance indicators (PIs). *International journal of computer integrated manufacturing*, ISSN 0951-192X. 2009, vol. 22, no. 12, str. 1128-1143.
13. GRADIŠAR, Dejan, MUŠIČ, Gašper. Production-process modelling based on production-management data : a Petri-net approach. *International journal of computer integrated manufacturing*, ISSN 0951-192X. 2007, vol. 20, no. 8, str. 794-810.
14. GRADIŠAR, Dejan, MUŠIČ, Gašper. Automated Petri-net modelling based on production management data. *Mathematical and computer modelling of dynamical systems*, ISSN 1387-3954, 2007, vol. 13, no. 3, str. 267-290.
15. GRADIŠAR, Dejan, MUŠIČ, Gašper. Automated Petri-net modelling for batch production scheduling. V: PAWLEWSKI, Pawel (ur.). *Petri nets - manufacturing and computer science*. Rijeka: InTech. cop. 2012, str. 3-26.