

UČNI NAČRT PREDMETA / COURSE SYLLABUS

Predmet:	Meritve in merilne naprave
Course title:	Measurements and measurement equipment's

Študijski program Study programme and level	Študijska smer Study field	Letnik Academic year	Semester Semester
Inženiring in vozila		tretji	5
Engineering and vehicles		third	5

Vrsta predmeta / Course type modulni / modularly

Univerzitetna koda predmeta / University course code: VS_11027

Predavanja Lectures	Seminar Seminar	Sem. vaje Tutorial	Lab. vaje Laboratory work	Teren. vaje Field work	Samost. delo Individ. work	ECTS
45		15	30		90	6

Nosilec predmeta / Lecturer: Doc. dr./ Asst. Prof. Dr. Damir Vrančič

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

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

Prerequisites:

– vpis v 3. letnik študija	– Inscription in third year of study
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Vsebina:

Content (Syllabus outline):

<p>– <u>Predavanja</u></p> <p>Mednarodne organizacije za meroslovje in mednarodni sistem merskih enot. Osnovni pojmi merilne tehnike ter splošne lastnosti merilnih naprav in merilnih verig. Merski sistemi, ugotavljanje pogreškov pri merjenju in merilna negotovost. Merilni principi in metode. Uporaba merilne opreme. Merjenje elektriških veličin. Merjenje električnih tokov in napetosti. Merjenje ohmskih upornosti in impedanc. Merjenje električne moči in energije. Merjenje z osciloskopom. Senzorji. Porovni, induktivni in kapacitivni senzorji. Piezoelektrični, optični in inkrementalni senzorji. Načini merjenja in pravi izbor merilnega instrumentarija za merjenje sil, momentov, tlakov, pomikov, zasukov, hitrosti in pospeškov. Sestava merilnih verig in obdelava merilnih rezultatov z uporabo A/D in D/A pretvornikov, filtrov in različnih virov kot sestavnih delov</p>	<p>– <u>Lectures</u></p> <p>International organizations of metrology and International System of Units. Basic concepts of measurement techniques and general properties of measuring instruments and measuring chains. Measurement systems, estimation of measurement errors and measurement uncertainty. Measuring principles and methods. The application of the measuring equipment. Measurement of electrical quantities. Measurement of the electric current and voltage. Measurement of ohmic resistances and impedances. Measurement of the electric power and energy. Measurements using oscilloscope. Sensors. Resistance, inductive and capacitive sensors. Piezoelectric sensors, optical and incremental sensors. Measurements of forces, torques, pressures, displacements and rotation angles, velocities and accelerations. Measuring chains and processing of measuring data by using of A/D and D/A converters, filters</p>
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<p>merilnih verig. Avtomatizirano merjenje s pomočjo računalniške opreme. Virtualni instrumenti.</p> <ul style="list-style-type: none"> - <u>Seminarske in laboratorijske vaje:</u> Poglobitev teoretičnih znanj na seminarskih vajah z reševanjem praktičnih primerov stroke. Pridobitev praktičnih izkušenj na laboratorijskih vajah iz meritev elektriških in neelektriških veličin. 	<p>and different sources. Automated measuring with computer equipment. Virtual instruments.</p> <ul style="list-style-type: none"> - <u>Tutorials and Lab works</u> Tutorials are intended to deepen the theoretical knowledge with solving problems, which appear in practice Lab works are intended to acquire practical experiences in measurements of electric as well as non-electric quantities.
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Temeljni literatura in viri / Readings:

<ul style="list-style-type: none"> - R. Pušenjak: Meritve in merilne naprave, elektronsko učno gradivo, Fakulteta za industrijski inženiring Novo mesto, 2014 - E-gradiva predmeta / E-Course material <p>Priporočena literatura/ Recommended readings:</p> <ul style="list-style-type: none"> - Hoffmann: Taschenbuch der Messtechnik, Carl Hanser verlag, 2007 - E. O. Doebelin: Measurement Systems: Application and Design, McGraw-Hill Higher Education, 2005

Cilji in kompetence:

Objectives and competences:

<p>Cilji</p> <ul style="list-style-type: none"> - Seznanitev z osnovami merilne tehnike, spoznavanje osnovnih principov merjenja fizikalnih veličin, - uporaba le-teh v proizvodnji, - seznanitev z osnovnimi zakonitostmi meroslovja. <p>Kompetence</p> <ul style="list-style-type: none"> - sposobnost razčlenitve problemov, izvedbe njihove analize in sinteze, - sposobnost obvladanja standardnih razvojnih metod, postopkov in procesov, - sposobnost uporabe pridobljenega teoretičnega znanja v praksi, - avtonomnost v strokovnem delu s področja tehnologij in sistemov, - sposobnost razumevanja in uporabe sodobnih teorij s področja tehniških, tehnoloških in naravoslovnih ved, - sposobnost matematičnega razumevanja tehničnih problemov in uporaba matematike pri reševanju le-teh, - sposobnost stalne uporabe sodobne informacijske in komunikacijske tehnologije na svojem strokovnem področju. 	<p>Objectives</p> <ul style="list-style-type: none"> - Conquest of measurement technique fundamentals, - Conquest of basic measurement methods for physical quantities and their use in production. - Conquest of basic topics of metrology. <p>Competences</p> <ul style="list-style-type: none"> - ability to analyze problems of engineering and to perform their synthesis, - ability to master standard development methods, procedures and processes, - ability to apply acquired theoretical knowledge in practice, - professional autonomy in the field of technologies and systems, - ability to understanding and use of modern theory of engineering, technology and natural sciences, - ability to use the mathematical methods in solving problems in engineering, - ability to use modern information and communication technologies.
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Predvideni študijski rezultati:

Intended learning outcomes:

<p>Znanje in razumevanje:</p> <ul style="list-style-type: none"> - pozna in razume osnove merilne tehnike in izrazoslovje, - pozna osnove metrologije in postopke meritev mehanskih in električnih veličin, - pozna postopke in metode vrednotenja in razvrščanja merilnih rezultatov, 	<p>Knowledge and understanding:</p> <ul style="list-style-type: none"> - understands basic classification of measurements techniques and terminology, - knows fundamentals of metrology and measurement principles for measuring of mechanical and electrical quantities,
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<ul style="list-style-type: none"> – zna načrtovati, uporabiti standarde, uporabiti literaturo 	<ul style="list-style-type: none"> – knows procedures and methods of evaluation of measurement data, – knows projecting and using standards as well as literature.
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Metode poučevanja in učenja:
Learning and teaching methods:

<ul style="list-style-type: none"> – predavanja z aktivno udeležbo študentov, ki vsebujejo razprave, diskusije, odgovore na vprašanja in reševanje nalog ob pomoči sodobnih pedagoških pripomočkov, – seminarske vaje za poglobljanje teoretičnih osnov in reševanje praktičnih problemov stroke – individualno in skupinsko delo s študenti v obliki konzultacij, – laboratorijske vaje, ki potekajo v ustrezno opremljenem laboratoriju. <p>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.</p>	<ul style="list-style-type: none"> – lectures with active attendance of students, which incorporate discussions, answers on the questions and solving of exercises with application of the contemporary pedagogical aids – tutorials with deepening of theoretical knowledge and solving problems, which appear in practice – individual and collective work in the form of consultations, – lab works, which are performed in a suitable equipped laboratory. <p>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.</p>
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Načini ocenjevanja:
Delež /Weight (%)
Assessment:

<p>Pred izpitom mora študent(ka) uspešno opravljene laboratorijske vaje.</p> <ul style="list-style-type: none"> – pisni izpit <p>Ocenjevalna lestvica je skladna z ECTS in Pravilnikom o preverjanju in ocenjevanju znanja FINI NM.</p>	<p>100%</p>	<p>Before accession to the exam student must successfully performed lab works.</p> <ul style="list-style-type: none"> – written exam <p>Evaluation scale in accordance with ECTS and the Rules on the Evaluation and Assessment of Knowledge FINI NM.</p>
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Reference nosilca / Lecturer's references:

<ul style="list-style-type: none"> – VRANČIĆ, Damir. Rapid prototyping environment for control systems implementation. V: STRMČNIK, Stanko (ur.), JURičIĆ, Đani (ur.). Case studies in control : putting theory to work, (Advances in industrial control, ISSN 1430-9491). London [etc.]: Springer. 2013, str. 289-326. [COBISS.SI-ID 26893095] – KOS, Tomaž, PETROVČIČ, Janko, ŠAPONIA, Zoran, MUSIZZA, Bojan, PODRŽAJ, Gregor, STRAJNAR, Sašo, VRANČIĆ, Damir. Razvoj in preizkus delovanja inteligentnega diferenčnega tlačnega pogona s sistemom za odpravo nihanj iSET. Ventil : revija za fluidno tehniko in avtomatizacijo, ISSN 1318-7279. [Tiskana izd.], apr. 2019, letn. 25, št. 2, str. 140-[146], ilustr. [COBISS.SI-ID 32336167] – KOS, Tomaž, ROJAC, Tadej, PETROVČIČ, Janko, VRANČIĆ, Damir. Control system for automated drift compensation of the stand-alone charge amplifier used for low-frequency measurement. AIP advances, ISSN 2158-3226, 2019, vol. 9, no. 3, str. 035133-1-035133 -9, doi: 10.1063/1.5064631. [COBISS.SI-ID 32207143] – 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. [Print ed.], [in press] 2018, 8 str., doi: 10.1109/TCST.2018.2853739. [COBISS.SI-ID 31573799]
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- VREČKO, Darko, NERAT, Marko, VRANČIĆ, Damir, DOLANC, Gregor, DOLENC, Boštjan, PREGELJ, Boštjan, MEYER, Fabien, AU, Siu Fai, MAKKUS, Robert, JURIČIĆ, Dani. Feedforward-feedback control of a solid oxide fuel cell power system. International journal of hydrogen energy, ISSN 0360-3199. [Print ed.], 2018, vol. 43, no. 12, str. 6352-6363, doi: 10.1016/j.ijhydene.2018.01.203. [COBISS.SI-ID 31267367]
- NERAT, Marko, VRANČIĆ, Damir. A novel fast-filtering method for rotational speed of the bldc motor drive applied to valve actuator. IEEE/ASME transactions on mechatronics, ISSN 1083-4435, 2016, vol. 21, no. 3, str. 1479-1486, doi: 10.1109/TMECH.2015.2505321. [COBISS.SI-ID 29087783]
- RAUBAR, Edvin, VRANČIĆ, Damir. Anti-sway system for ship-to-shore cranes. Strojniški vestnik, ISSN 0039-2480, maj 2012, vol. 58, no. 5, str. 338-344, SI 66, ilustr., doi: 10.5545/sv-jme.2010.127. [COBISS.SI-ID 25941543]
- SVETEK, Aleš, VRANČIĆ, Damir, KRANČAN, Samo, ŠAPONIA, Zoran. Adaptivni inteligentni ventil. Ventil : revija za fluidno tehniko in avtomatizacijo, ISSN 1318-7279. [Tiskana izd.], jun. 2010, letn. 16, št. 3, str. 252-258, ilustr. [COBISS.SI-ID 11465243]
- VRANČIĆ, Damir, STRMČNIK, Stanko, KOCIJAN, Juš, MOURA OLIVEIRA, Paulo. Improving disturbance rejection of PID controllers by means of the magnitude optimum method. ISA transactions, ISSN 0019-0578, 2010, vol. 49, no. 1, str. 47-56. [COBISS.SI-ID 23246887]
- VRANČIĆ, Damir, LIESLEHTO, J., STRMČNIK, Stanko. Designing a MIMO PI controller using the multiple integration approach. Process control and quality, ISSN 0924-3089, 2001, vol. 11, str. 455-468. [COBISS.SI-ID 16517159], [JCR, WoS do 3. 12. 2017: št. citatov (TC): 1, čistih citatov (CI): 0]
- VRANČIĆ, Damir. Magnitude optimum techniques for PID controllers. V: PANDA, Rames C. (ur.). Introduction to PID colntrollers : theory, tuning and application to frontiers areas. Rijeka: InTech. cop. 2012, str. 75-102. [COBISS.SI-ID 25734695]
- GLAVAN, Miha, VRANČIĆ, Damir, GRADIŠAR, Dejan, HUMAR, Iztok, UMBERGER, Mark, LUMBAR, Satja. Sistem in postopek za upravljanje električne moči hladilnega sistema z reguliranjem temperature izdelkov in temperature zraka : patent SI 25557 A. Ljubljana: Urad RS za intelektualno lastnino, 31 maj 2019. [COBISS.SI-ID 31051815]
- PETROVČIČ, Janko, VRANČIĆ, Damir. Reducing oscillations in a control system : patent EP 2356522 B1. München: European Patent Office, 6. jan. 2016. [COBISS.SI-ID 22631463] patentna družina: Patentna prijava WO 2010/054657A1, 2010-05-20
- VRANČIĆ, Damir, NERAT, Marko, KRANČAN, Samo. Postopek hitrega filtriranja signala rotacijske hitrosti s samodejnim izločanjem periodičnega odmika : patent SI 24580 (A), 2015-06-30. Ljubljana: Urad RS za intelektualno lastnino, 30. jun. 2015. [COBISS.SI-ID 27428391] patentna družina: Patentna prijava P-201300435, 2013-12-19