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| **UČNI NAČRT PREDMETA / COURSE SYLLABUS** | | | | | | | | | | | | | | | | | |
| **Predmet:** | | | Merilna instrumentacija | | | | | | | | | | | | | | |
| **Course title:** | | | Measurement Instrumentation | | | | | | | | | | | | | | |
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| **Študijski program in stopnja**  **Study programme and level** | | | | | **Študijska smer**  **Study field** | | | | | | | | **Letnik**  **Academic year** | | **Semester**  **Semester** | | |
| Univerzitetni študijski program prve stopnje Elektrotehnika | | | | | **Ni smeri** | | | | | | | | 2. | | letni | | |
| 1st cycle academic study programme Electrical Engineering | | | | | **/** | | | | | | | | **2.** | | **summer** | | |
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| **Vrsta predmeta / Course type** | | | | | | | | | | | | Obvezni – strokovni/compulsory professional | | | | | |
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| **Univerzitetna koda predmeta / University course code:** | | | | | | | | | | | | 64116 | | | | | |
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| **Predavanja**  **Lectures** | **Seminar**  **Seminar** | | | **Vaje**  **Tutorial** | | | **Klinične vaje**  **work** | | | | **Druge oblike študija** | | | **Samost. delo**  **Individ. work** | |  | **ECTS** |
| **30** |  | | | **30** | | |  | | | |  | | | **65** | |  | **5** |
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| **Nosilec predmeta / Lecturer:** | | | | | Dušan Agrež, Janko Drnovšek | | | | | | | | | | | | |
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| **Jeziki /**  **Languages:** | | **Predavanja / Lectures:** | | | | slovenski/Slovenian | | | | | | | | | | | |
| **Vaje / Tutorial:** | | | | slovenski/Slovenian | | | | | | | | | | | |
| **Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:** | | | | | | | | |  | **Prerequisits:** | | | | | | | |
| Vpis v letnik študija | | | | | | | | |  | Enrolment in the year of the course | | | | | | | |
| **Vsebina:** | | | | | | | |  | | **Content (Syllabus outline):** | | | | | | | |
| a) zgradba merilnih instrumentov in sistemov (struktura in elementi, statične in dinamične karakteristike, vplivne veličine, analogno in digitalno prilagajanje in obdelava signalov)  b) elektronski merilni instrumenti (multimeter, analogni in digitalni elektronski osciloskop, univerzalni števec, instrument z računalnikom) z ustreznimi prilagoditvenimi vezji  c) merilni komunikacijski vmesniki, protokoli in programska oprema  d) virtualni merilni instrumenti in sistemi (zgradba, strojna in programska oprema)  e) Merjenje električnih veličin in ugotavljanje karakteristik merilnih pretvornikov;  f) mostična vezja in zmanjšanje vplivov motilnih in šumnih signalov;  g) karakteristični merilni instrumenti in naprave po področjih (telekomunikacije, energetika, elektronika,..) za materiale (specifične prevodnosti, ...) ter magnetna merjenja. | | | | | | | |  | | a) Structure of measuring instruments and systems (structure and elements, static and dynamic characteristics, influence quantities, analog and digital conditioning and signal processing).  b) Electronic measurement instruments (multi-meter, analog and digital electronic osciloscop, universal counter, instrument with computer) and suitable condioning circuts.  c) Measurement communication interfaces, protocols and software;  d) Virtual measuring instruments and systems (structure, hardware, and software);  e) Measurement of electrical quantities and caracteristics of measurement transducers;  f) Measurement bridges and reduction of the influence of disturbing and noise signals;  g) Characteristic measurement instruments and devices for different electrical fields (telecommunications, energetics, electronics …), for materials (specific conductivity), and for magnetic measurements. | | | | | | | |

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| **Temeljni literatura in viri / Readings:** | | | | | |
| 1. Morris A.S., Measurement and Instrumentation Principles, Third Edition, Oxford: Butterworth-Heinemann, 2010.  2. Bhuyan M., Intelligent Instrumentation: Principles and Applications, CRC Press, 2010.  3. Bentley, J.P., Principles of Measurement Systems (4. edition), Pearson, Prentice Hall, 2005.  4. Agrež D. in ostali, Meritve in merilna instrumentacija - laboratorijski praktikum (ver. 4), University of Ljubljana, Faculty of Electrical Engineering, 2014.  5. Tumanski S., Principles of Electrical Measurement, Taylor & Francis, CRC Press, 2006. | | | | | |
| **Cilji in kompetence:** | |  | | **Objectives and competences:** | |
| a) spoznati osnovno zgradbo merilnih instrumentov in sistemov, njihovih statičnih in dinamičnih lastnosti ter odvisnost od vplivnih veličin  b) uvesti osnovne principe digitalizacije merjenih signalov v časovnem in frekvenčnem prostoru  c) spoznati programsko in strojno opremo in elemente za avtomatizacijo merilnih sistemov  d) spoznati napredne komunikacijske protokole in vmesnike  e) analizirati vpliv električnih in elektronskih merilnih instrumentov na razmere v vezju  f) spoznati nekatere osnovne značilnosti merjenj po področjih (energetika, telekomunikacije, elektronika...,) in (magnetnih) materialov. | |  | | a) To learn basic structure of measuring instruments and systems, their static and dynamic performances, and dependence on the influence quantities;  b) To introduce the basic principles of digitalization of the measurement signals in the time and frequency domain;  c) To get acquainted with software and hardware and the elements for automation of measurement systems;  d) To learn advanced communication protocols and interfaces;  e) To analyse the influences of electrical and electronic measuring instruments onto the circuit properties;  f) To learn basic characteristics of measurements for different electrical fields (telecommunications, energetics, electronics …), and for (magnetic) materials. | |
| **Predvideni študijski rezultati:** | | |  | **Intended learning outcomes:** | |
| a) razumevanje osnovne zgradbe klasičnih, elektronskih in merilnih instrumentov podprtih z računalnikom,  b) kako delujejo instrumenti in njihove omejitve glede na vplive okolice. | | |  | a) Understanding of basic structures of clasical, and electrical instruments, and measuring instruments supported by computer;  b) Understanding how measuring instruments work and their limitations in the context of the environment influence. | |
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| **Metode poučevanja in učenja:** | | |  | **Learning and teaching methods:** | |
| predavanja, laboratorijske vaje | | |  | lectures, laboratory tutorials. | |
| **Načini ocenjevanja:** | Delež (v %) /  Weight (in %) | | | | **Assessment:** |
| Način: laboratorijske vaje, pisni izpit, ustni izpit.  Ocene od 1 do vključno 5 so negativne, ocene od vključno 6 do 10 so pozitivne.  Pozitivna ocena laboratorijskih vaj je pogoj za pristop k izpitu.  Prispevki k oceni:   * laboratorijske vaje, * pisni izpit, * ustni izpit. | 30%,  50%  20% | | | | Type: laboratory exercises, written exam, oral exam.  Negative grades: from 1 to 5, positive grades: from 6 to 10.  Positive evaluation of laboratory exercises is a prerequisite for the exam.  Contributions to final grade:   * Laboratory exercises, * Written exam, * Oral examination. |
| **Reference nosilca / Lecturer's references:** | | | | | |
| 1. Agrež D., "Weighted multi-point interpolated DFT to improve amplitude estimation of multi-frequency signal", IEEE Transactions on Instrumentation and Measurement, 2002, vol. 51, no. 2., pp. 287-292. 2. Štremfelj J., Agrež D., "'Nonparametric estimation of power quantities in the frequency domain using Rife-Vincent windows", IEEE Transactions on Instrumentation and Measurement, 2013, vol. 62, no. 8, pp. 2171-2184. 3. Beguš S., Bojkovski J., Drnovšek J., Geršak G., "Magnetic effects on thermocouples", Measurement science & technology, 2014, vol. 3, no. 25, pp. 1-11. 4. Žužek V., Batagelj V., Drnovšek J., Bojkovski J., "Effect of bushings in thermometric fixed-point cells", Measurement, 2016, vol. 78, pp. 289-295. 5. D. Agrež, "A/D Conversion with Non-uniform Differential Quantization", Design, Modeling and Testing of Data Converters, P.Carbone et all (eds.), pub. by Springer-Verlag Berlin Heidelberg, 2014, pp. 277-306. | | | | | |