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| **UČNI NAČRT PREDMETA / COURSE SYLLABUS** | | | | | | | | | | | | | | | | | |
| **Predmet:** | | | Virtualni merilni sistemi | | | | | | | | | | | | | | |
| **Course title:** | | | Virtual measurement systems | | | | | | | | | | | | | | |
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| **Študijski program in stopnja**  **Study programme and level** | | | | | **Študijska smer**  **Study field** | | | | | | | | **Letnik**  **Academic year** | | **Semester**  **Semester** | | |
| Doktorski študijski program tretje stopnje Elektrotehnika | | | | | Ni smeri | | | | | | | | 1 | |  | | |
| 3rd cycle: doctoral study programme Electrical Engineering | | | | |  | | | | | | | |  | |  | | |
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| **Vrsta predmeta / Course type** | | | | | | | | | | | | Izbirni/elective | | | | | |
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| **Univerzitetna koda predmeta / University course code:** | | | | | | | | | | | | 64858 | | | | | |
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| **Predavanja**  **Lectures** | **Seminar**  **Seminar** | | | **Vaje**  **Tutorial** | | | **Klinične vaje**  **work** | | | | **Druge oblike študija** | | | **Samost. delo**  **Individ. work** | |  | **ECTS** |
| **30** | **60** | | |  | | |  | | | | **10** | | | **25** | |  | **5** |
|  | | | | | | | | | | | | | | | | | |
| **Nosilec predmeta / Lecturer:** | | | | | prof.dr. Jovan Bojkovski | | | | | | | | | | | | |
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| **Jeziki /**  **Languages:** | | **Predavanja / Lectures:** | | | | **Slovenščina/Angleščina** | | | | | | | | | | | |
| **Vaje / Tutorial:** | | | |  | | | | | | | | | | | |
| **Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:** | | | | | | | | |  | **Prerequisits:** | | | | | | | |
| Priporočeno znanje osnov računalništva in matematike | | | | | | | | |  | Recommended knowledge of basics of computer science and mathematics | | | | | | | |
| **Vsebina:** | | | | | | | |  | | **Content (Syllabus outline):** | | | | | | | |
| * Osnovni koncept virtualnega merilnega instrumenta * Programska orodja za izdelavo virtualnih merilnih instrumentov, grafično programiranje, koncept podatkovnega toka * Strojna oprema za izdelavo virtualnih merilnih instrumentov, komunikacijska vodila, večfunkcijske vgradne kartice * Osnove zajemanja podatkov * Sintetični merilni instrumenti * Krmiljenje virtualnih instrumentov preko TCP/IP omrežja * Koncept celostnih rešitev za avtomatizacijo merilnega laboratorija na osnovi osrednje podatkovne baze * Koncepti in dobra programerska praksa pri razvoju virtualnih merilnih instrumentov * Metode za preskušanje in validacijo virtualnih merilnih instrumentov, Omejitve preskušanja programskih proizvodov * Povezava med kakovostjo programske opreme in ostalimi standardi vezanimi na kakovost. * Zanesljivost programske opreme: Definicija, primerjava zanesljivosti strojne in programske opreme, odpovedovanje programske opreme, stroški povezani z odpravljanjem napak, ocenjevanje zanesljivosti, predikcija zanesljivosti * Napredne tehnike preskušanja programske opreme * Izbira testnih primerov: Metoda mejnih primerov, Metoda preskušanja poti, Naključna izbira, Ugibanje napak, Vzročno posledični diagram * Vloga in razvoj programske opreme zasnovane na odprti kodi (Linux, BSD, Android...) | | | | | | | |  | | * Basic concepts of virtual measurement instrument * Software for programming virtual measurement instruments, graphical programming, data flow concept * Hardware for virtual measurement instruments, communication bus, plug in data acquisition board * Basic of data acquisition * Synthetic measurement instruments * Control of virtual instruments via TCP/IP network * Automation of measurement laboratory based on the central database approach * Development of Virtual instruments – good practice guides * Methods of testing and validation of virtual measurement instruments, limitation of software testing * Software quality and other quality standards * Reliability of software * Advanced software testing techniques * How to prepare good test case * Different testing methods * Open source code and quality (Linux, BSD, Android, ...) | | | | | | | |

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| **Temeljni literatura in viri / Readings:** | | | | | |
| [1] Virtual Instrument no Virtual Reality but Real PC Based Measuring System, Vladimir Haasz et al, IEEE 2005  [2] Virtual Instrumentation and Traditional Instruments, National instruments, 2012  [3] Computerized Instrumentation, Tran Tien Lang, Wiley, 1991  [4] Synthetic Instrumentation: Contemporary architectures and applications, Peter Pragastis et al, RF Design, 2004  [5] Glenford J. Myers, Corey Sandler, Tom Badgett, and Todd M. Thomas: “The Art of Software Testing”, John Wiley & Sons, 2011  [6] Debra S. Herrmann: “Software Safety and Reliability: Techniques, Approaches, and Standards of Key Industrial Sectors”, Wiley-IEEE Computer Society Pr, 2000  [7] P. Ciarlini, A.B. Forbes, F. Pavese, D. Richter: “Advanced Mathematical & Computational Tools in Metrology IV,V,VI, VII, VIII and IX”, World Scientific Publishing Co, 2000-2012  [8] Ian Sommerville: ”Software Engineering”, Adison Wesley, 2011  [9] ISO/IEC 25000 Software Engineering -- Software product Quality Requirements and Evaluation (SQuaRE) -- Guide to SquaRE, 2014 | | | | | |
| **Cilji in kompetence:** | |  | | **Objectives and competences:** | |
| Predstavljeni bodo osnovni koncepti virtualnega merilnega instrumenta in osnovni ter napredni načini ugotavljanja kakovosti programske opreme, koncepti in dobra programerska praksa pri razvoju virtualnih merilnih instrumentov, metode za preskušanje in validacijo virtualnih merilnih instrumentov, načini izbire testnih primerov, povezave med programsko opremo in standardi kakovosti, osnovni elementi programske opreme zasnovani na odprti kodi (Linux, BSD, Android licenca). | |  | | Basic concept of virtual measurement instrument, basic and advanced methods of software quality assurance, concepts and good programming practice, testing and validation of software methods, methods for preparing test cases, link between software quality and quality standards, Open source code and quality (Linux, BSD, Android, ...) | |
| **Predvideni študijski rezultati:** | | |  | **Intended learning outcomes:** | |
| Znanje in razumevanje:   * Koncepta virtualnih merilnih instrumentov * Grafičnih orodij za programiranje virtualnih merilnih instrumentov * Različnih metod preskušanja programske opreme | | |  | Knowledge and understanding:   * Concept of virtual measurement instruments * Graphical software tools for programming virtual measurement instruments * Different methods of software testing | |
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| **Metode poučevanja in učenja:** | | |  | **Learning and teaching methods:** | |
| Predavanja, seminar, samostojno delo | | |  | Lectures, seminar, individual work | |
| **Načini ocenjevanja:** | Delež (v %) /  Weight (in %) | | | | **Assessment:** |
| Način (pisni izpit, ustno izpraševanje, naloge, projekt):  Ustno izpraševanje  Projekt | 50 %  50 % | | | | Type (examination, oral, coursework, project):  Oral  Project |
| **Reference nosilca / Lecturer's references:** | | | | | |
| BATAGELJ V, ŽUŽEK V, DRNOVŠEK J, BOJKOVSKI J (2015) A numerical and experimental investigation of the heat losses in thermometric fixed-point cells. International journal of heat and mass transfer, vol. 85, pp. 321-335  BATAGELJ V, BOJKOVSKI J, DRNOVŠEK J (2010) Accu-T-Cal 1.03.1. Ljubljana: Faculty of Electrical Engineering, Laboratory of Metrology and Quality, software  BATAGELJ V, BOJKOVSKI J, DRNOVŠEK J (2008) Software integration in national measurement-standards laboratories. IET science, measurement & technology, vol. 2, no. 2, pp. 100-106  BOJKOVSKI J, DRNOVŠEK J, PUŠNIK I, TASIĆ T (2000) Automation of a precision temperature calibration laboratory. IEEE trans. instrum. meas., vol. 49, no. 3, pp. 596-601  BATAGELJ V, MIKLAVEC A, BOJKOVSKI J (2014) Validation of calculations in a digital thermometer firmware. International journal of thermophysics, vol. 35 , no. 3-4 , pp. 681-692, | | | | | |