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| **UČNI NAČRT PREDMETA / COURSE SYLLABUS** | | | | | | | | | | | | | | | | | |
| **Predmet:** | | | Modul B: Tehniška kakovost | | | | | | | | | | | | | | |
| **Course title:** | | | Module B: Quality Engineering | | | | | | | | | | | | | | |
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| **Študijski program in stopnja**  **Study programme and level** | | | | | **Študijska smer**  **Study field** | | | | | | | | **Letnik**  **Academic year** | | **Semester**  **Semester** | | |
| Podiplomski magistrski študijski program druge stopnje Elektrotehnika | | | | | Vse smeri | | | | | | | | 1 | | 2 | | |
| 2nd cycle masters study programme in Electrical Engineering | | | | | All study fields | | | | | | | | 1 | | 2 | | |
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| **Vrsta predmeta / Course type** | | | | | | | | | | | | Izbirni-strokovni /elective professional | | | | | |
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| **Univerzitetna koda predmeta / University course code:** | | | | | | | | | | | | 64261 | | | | | |
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| **Predavanja**  **Lectures** | **Seminar**  **Seminar** | | | **Vaje**  **Tutorial** | | | **Klinične vaje**  **work** | | | | **Druge oblike študija** | | | **Samost. delo**  **Individ. work** | |  | **ECTS** |
| 45 |  | | | 30 | | |  | | | |  | | | 75 | |  | 6 |
|  | | | | | | | | | | | | | | | | | |
| **Nosilec predmeta / Lecturer:** | | | | | Janko Drnovšek, Gaber Begeš | | | | | | | | | | | | |
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| **Jeziki /**  **Languages:** | | **Predavanja / Lectures:** | | | | slovenski / Slovenian  angleški / English | | | | | | | | | | | |
| **Vaje / Tutorial:** | | | | slovenski / Slovenian  angleški / English | | | | | | | | | | | |
| **Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:** | | | | | | | | |  | **Prerequisits:** | | | | | | | |
| Vpis v letnik predmeta | | | | | | | | |  | Enrolment in the year of the course | | | | | | | |
| **Vsebina:** | | | | | | | |  | | **Content (Syllabus outline):** | | | | | | | |
| a) Tehniška kakovost kot temeljna inženirska disciplina  (b) Pojmi kakovosti in spremljajoča področja (standardizacija, certificiranje,..)  (c) Sistemi vodenja kakovosti  (d) Celovito vodenje kakovosti (TQM), tehnike reševanja problemov in krog kakovosti  (e) Postopki in osnovna orodja zagotavljanja kakovosti (kontrolne karte, integracija zahtev kupca v proizvod - QFD, analiza možnih napak in njihovih posledic - FMEA, nadzor procesov - SPC statistična procesna kontrola, načrtovanje optimalnega eksperiment, itd.)  (f) Kakovost in standardizacija po področjih (proizvodnja, laboratoriji, storitve, okolje, varnost, zdravstvo, itd.)  (g) Tehnike reševanja problemov in krog kakovosti  (h) Izobraževanje, motivacija in nenehno izboljševanje  (i) Zanesljivost in vzdrževanje sistemov  (j) Materiali, klasifikacija in temeljne fizikalno kemijske lastnosti. | | | | | | | |  | | (a) Technical quality as basic engineering discipline  (b) Quality concept and accompany fields (standardization, certification, etc.)  (c) Quality system management  (d) Total quality management (TQM), techniques for solving problems and quality circle  (e) Procedures and basic tools for quality assurance (control charts, Quality Function Deployment QFD, Failure mode and effect analysis - FMEA, statistical process control - SPC, optimal experiment planning, etc.)  (f) Quality and standardization (production, laboratory, service, environment, safety, health care, etc.)  (g) Techniques for solving problems and quality circle  (h) Education, motivation and continuous training  (i) System reliability and maintenance  (j) Materials, classification and basic physical and chemical properties. | | | | | | | |

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| **Temeljni literatura in viri / Readings:** | | | | | |
| 1. www.sist.si, www.iso.org, www.iec.ch, www.iecee.org, www.cenelec.org, www.itu.int, www.cenorm.be, www.gov.si/sa, www.ilac.org, www.mirs.si, www.euramet.eu, www.wto.org, www.ansi.org, http://ts.nist.gov, www.conformityassessment.org, www.wssn.net, www.oiml.org, www.asq.org, http://ec.europa.eu/enterprise/newapproach/ 2. Drnovšek, J.; Pušnik, I.; Bojkovski, J.; Begeš, G.; Kakovost sistemov. Ljubljana: Fakulteta za elektrotehniko 2007 3. Pond, R.J.: Fundamentals od Statistical Quality Control. New York: Macmillan College Publishing Company 1994 4. Montgomery, D.C.: Introduction to Statistical Quality Control. 4. izdaja. New York: John Wiley & Sons Inc. 2001 5. O`Connor, P.D.T.: Practical Reliability Engineering. 4. izdaja. New York: John Wiley & Sons Inc. 2002 6. Feigenbaum, A.V.: Total Quality Control. 3. pregl. jubilejna izdaja. New York: McGraw-Hill, Inc. 1991 7. Robin E. Mcdermott, Raymond J. Mikulak, Michael R. Beauregard: The Basic of FMEA. Portland, USA 8. John Terninko: Step-by Step QFD. Boca Raton, Florida, St. Lucie Press 1997 9. Lou Chen: Quality Function Deployment, Addison Wesley Longman, 1995 10. A.J.Marlow: Quality control for Technical Documentation, Amazon, 2005 11. QualSoft: Busines Improvement Software, Birmingham, 2000 12. Yoi Akao: QFD, Portland, Oregon, Productivity Press, 2000 13. VIM - International Vocabulary of Terms in Legal Metrology (OIML, 2000) 14. Slovenski inštitut za standardizacijo: SIST EN 45020 - Standardizacija in z njo povezane dejavnosti - Splošni slovar, 2007 | | | | | |
| **Cilji in kompetence:** | |  | | **Objectives and competences:** | |
| Cilj predmeta je seznaniti in usposobiti študente s konkretnimi znanji o zagotavljanju in doseganju tehniške kakovosti proizvodov in storitev na osnovi merjenj in preskušanj, nadzora procesov in orodij za celovito obvladovanje kakovosti. Študent se pri predmetu nauči različnih tehnik reševanja problemov s pomočjo modernih principov in orodij za zagotavljanje in celovito upravljanje kakovost, spozna se z elementi zanesljivosti in osnovami vzdrževanja sistemov.  Tehniška kakovost v elektrotehniki in elektroniki temelji tudi na fizikalnih in kemijskih lastnostih materialov, zaradi tega so podane tudi osnove o njihovi strukturi in lastnostih. Razložene so lastnosti polimerov, kovin, keramike in kompozitov in specifične lastnosti pomembne v elektrotehniki, kot so električna in toplotna prevodnost pa tudi obstojnost v različnih okoljih.  Osnovne specifike, zahteve in rešitve tehniške kakovosti spoznajo študentje na praktičnih primerih in problemih. | |  | | Aim of the course is to get acquainted with concrete knowledge on technical quality of product and services assurance and achievement on the basis of measurement and testing, processes supervision, tools for total quality management. Student is trained for solving problems with different modern principles and tools for total quality assurance. Candidate become aware of reliability elements and basics of system maintenance. Technical quality in electrical engineering and electronic has basis on physical and chemical properties of materials that is why in this course basic properties are presented. Explained are polymers, metals, ceramics and composites properties and specific properties for electrical engineering, such as electrical and thermal conductivity and influence of different environment. Basic specifics, requirements and solutions for technical quality are presented on practical examples and problems. | |
| **Predvideni študijski rezultati:** | | |  | **Intended learning outcomes:** | |
| Znanje in razumevanje:  osnovni pojmi s področja tehniške infrastrukture, standardizacije, akreditacije, evropske in nacionalne zakonodaje, nastanka standarda, poznavanje vrst standardov, zagotavljanja kakovosti, poznavanje dela presojevalcev in certifikacijskih organov poznavanje pomena direktiv,znanje o celovitem vodenju kakovosti, sistemih vodenja kakovosti, o načinu in postopkih presoj in certificiranja sistemov, uporaba orodij za zagotavljanje kakovosti, QFD in FMEA metodi vodenja kakovosti, povezanost kakovosti na pravo, varnost in okolje, konkretno tehniško znanje na področju preskušanja, poznavanje laboratorijskega dela za zagotavljanje kakovosti in varnosti, priprava optimalnega eksperimenta, poznavanje standardov po področjih, implementacija sistema kakovosti, priprava poslovnika kakovosti v skladu s standardom | | |  | Knowledge and understanding:  basic concept of technical infrastructure, standardisation, accreditation, European national legislation, standard development, knowledge on fields of standards, quality assurance, knowing of assessor's and certification organisation work, importance of directives, knowledge on total quality management, certification systems, use of tools for quality assessment QFD and FMEA, relation of quality and law, safety and environment, concrete technical knowledge on testing, laboratory work on quality assurance and product safety, preparation of optimal experiment, knowledge on different standards, implementation of quality system, preparation of quality manual according to different standards | |
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| **Metode poučevanja in učenja:** | | |  | **Learning and teaching methods:** | |
| Predavanja, avditorne vaje, laboratorijske vaje, seminarska naloga. | | |  | Lectures, exercises, seminar work. | |
| **Načini ocenjevanja:** | Delež (v %) /  Weight (in %) | | | | **Assessment:** |
| Način: laboratorijske vaje, projekti, pisni izpit, ustni izpit.  Ocene od 1 do vključno 5 so negativne, ocene od vključno 6 do 10 so pozitivne.  Pozitivna ocena laboratorijskih vaj in projektov je pogoj za pristop k izpitu.  Prispevki k oceni:  laboratorijske vaje in projekti  ustni izpit | 50 %  50 % | | | | Type: laboratory exercises, projects, written exam, oral exam.  Negative grades: from 1 to 5, positive grades: from 6 to 10.  Positive evaluation of laboratory exercises and projects is a prerequisite for the exam.  Contributions to final grade:  laboratory exercises and projects  oral examination |
| **Reference nosilca / Lecturer's references:** | | | | | |
| 1. DRNOVŠEK, Janko, BEGEŠ, Gaber*. Tehniška kakovost : povzetek predavanj*. Ljubljana: Fakulteta za elektrotehniko, Laboratorij za metrologijo in kakovost, 2012. 253 str.  2. DRNOVŠEK, Janko, BEGEŠ, Gaber*. Tehniška kakovost : laboratorijski praktikum*. Ljubljana: Fakulteta za elektrotehniko, Laboratorij za metrologijo in kakovost, 2012. IV, 52 str..  3. BATAGELJ, Valentin, ŽUŽEK, Vincencij, DRNOVŠEK, Janko, BOJKOVSKI, Jovan. A numerical and experimental investigation of the heat losses in thermometric fixed-point cells. *International journal of heat and mass transfer*, ISSN 0017-9310. [Print ed.], Jun. 2015, vol. 85, str. 321-335.  4. BEGUŠ, Samo, BEGEŠ, Gaber, DRNOVŠEK, Janko, HUDOKLIN, Domen. A novel NIR laser-based sensor for measuring the surface moisture in polymers. *Sensors and actuators. A, Physical*, ISSN 0924-4247, Jan. 2015, vol. 221, str. 53-59.  5. BEGEŠ, Gaber, DRNOVŠEK, Janko, OGOREVC, Jaka, BOJKOVSKI, Jovan. Influence of different temperature sensors on measuring energy efficiency and heating-up time of hobs. V: *TEMPMEKO 2013 special issue 3 : selected papers of the 12th International Symposium on Temperature, Humidity, Moisture and Thermal Measurements in Industry and Science*, (International journal of thermophysics, ISSN 0195-928X, vol. 36, no. 2/3, Mar. 2015). New York: Plenum Press, 2015, str. 493-507. | | | | | |