ZAGOTAVLJANJE KAKOVOSTI

UČNI NAČRT PREDMETA/COURSE SYLLABUS

Predmet:	Zagotavljanje kakovosti
Course title:	QUALITY ASSURANCE
Članica nosilka/UL Member:	UL FS

Študijski programi in stopnja	Študijska smer	Letnik	Semestri	Izbirnost
Strojništvo - projektno aplikativni program, prva stopnja, visokošolski strokovni	Proizvodne tehnologije (smer)	3. letnik	1. semester	obvezen

Univerzitetna koda predmeta/University course code:	0563511
Koda učne enote na članici/UL Member course code:	3060-V

Predavanja /Lectures	Seminar /Seminar	Vaje /Tutorials	Klinične vaje /Clinical tutorials	Druge oblike študija /Other forms of study	Samostojno delo /Individual student work	ECTS
30		30			40	4

Nosilec predmeta/Lecturer:	Davorin Kramar

Vrsta predmeta/Course type:	Izbirni strokovni predmet /Elective specialised course

Jeziki/Languages:	Predavanja/Lectures:	Slovenščina
	Vaje/Tutorial:	Slovenščina

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

Izpolnjevanje pogojev za vpis v Visokošolski strokovni študijski program I. stopnje Strojništvo - Projektno aplikativni program.	Meeting the enrollment conditions for the MECHANICAL ENGINEERING - Project Oriented Applied Programme.

Vsebina:	**Content (Syllabus outline):**
1. Predavanje: Uvod v kakovost ◻ kultura kakovosti ◻ definicije kakovosti ◻ 8 determinant kakovosti izdelka ◻ 5 determinant kakovosti storitve ◻ zgodovina kontrole kakovosti	1. Lecture: Introduction to quality ◻ a culture of quality ◻ definitions of quality ◻ 8 determinants of product quality ◻ 5 determinants of service quality ◻ quality control history
2. Predavanje: Pet stebrov kakovosti ◻ fokus na kupca/stranko ◻ vključenost vseh zaposlenih ◻ meritve ◻ sistemska podpora ◻ stalne izboljšave	2. Lecture: Five pillars of quality ◻ focus on customer / customer ◻ involvement of all employees ◻ measurements ◻ system support ◻ continuous improvements
3. Predavanje: Merjenje in kalibriranje za zagotavljanje kakovosti ◻ pomen merjenja za kakovost izdelka ◻ meritve v proizvodnji ◻ sodobne merilne naprave/metode za kontrolo kakovosti ◻ 3-koordinatni merilni stroj (CMM) ◻ 3D skeniranje ◻ multi-fokusni 3D mikroskop	3. Lecture: Measurement and calibration for quality assurance ◻ the importance of measurement for product quality ◻ measurements in production ◻ modern measuring instruments / methods for quality control ◻ 3-coordinate measuring machine (CMM) ◻ 3D scanning ◻ multi-focus 3D microscope
4. Predavanje: Orodja kakovosti I ◻ namen uporabe orodij, problemi pri uvedbi ◻ delitev orodij v skladu z metodologijo DMAIC (Define, Measure, Analize, Improve, Control) ◻ orodja za zbiranje/definiranje podatkov (diagram poteka, IPO diagram,...) ◻ orodja za merjenje (kontrolni list, histogram, Pareto diagram, ...)	4. Lecture: Quality Tools I ◻ purpose of use of tools, problems with implementation ◻ splitting of tools according to the DMAIC methodology (Define, Measure, Analyzes, Improve, Control) ◻ Data collection / definition tools (flowchart, IPO diagram, ...) ◻ measuring tools (checklist, histogram, Pareto diagram, ...)
5. Predavanje: Orodja kakovosti II ◻ orodja za analizo (SWOT analiza, 5xzakaj, korelacijski diagram, analiza JE/NI, ...) ◻ orodja za izboljšanje (SMED, 5S, viharjenje možganov, večkratno glasovanje,...) ◻ orodja za kontrolo (Gantt diagram, PDCA krog, Radar diagram, kontrolne karte, ...)	5. Lecture: Quality Tools II ◻ analysis tools (SWOT analysis, 5x why, correlation diagram, YES/NO analysis, ...) ◻ enhancement tools (SMED, 5S, brainstorming, multiple voting, ...) ◻ control tools (Gantt diagram, PDCA circuit, Radar diagram, control charts, ...)
6. Predavanje: Metode reševanja	

problemov v skupini ☐ izbira tima in timsko delo ☐ reševanje problema ☐ orodja timskega dela / tehnike kreativnega razmišljanja ☐ za identifikacijo in razumevanje problema ☐ za analizo problema ☐ Proces reševanja problema (metoda 8D)	6. Lecture: Team problem solving methods ☐ team selection and teamwork ☐ solving the problem ☐ teamwork tools / creative thinking techniques ☐ to identify and understand the problem ☐ to analyze the problem ☐ Problem solving process (8D method)
7. Predavanje: Stroški kakovosti (CoQ) ☐ definicija stroškov kakovosti ☐ vrste stroškov kakovosti ☐ razlike med kakovostjo izdelka in kakovostjo storitev ☐ izgube v proizvodnji	7. Lecture: Cost of quality (CoQ) ☐ definition of quality costs ☐ types of quality costs ☐ differences between product and service quality ☐ production losses
8. Predavanje: Standardizacija v kakovosti ☐ uvod v standardizacijo ☐ ISO 9001:2015; Sistem vodenja kakovosti ☐ ISO 14001:2015; Sistem ravnanja z okoljem ☐ ISO 45001:2018; Sistem vodenja varnosti in zdravja pri delu (ex. OHSAS 18001) ☐ integrirani sistemi kakovosti	8. Lecture: Standardization in quality ☐ introduction to standardization ☐ ISO 9001: 2015; Quality management system ☐ ISO 14001: 2015; Environmental management system ☐ ISO 45001: 2018; Occupational Health and Safety Management Systems (ex. OHSAS 18001) ☐ integrated quality systems
9. Predavanje: Sistemi vodenja kakovosti v avtomobilski industriji ☐ pregled standardov (IATF 16949:2016 (ex. ISO/TS 16949:2009), VDA 6.3/6.5, Toyota way,…) ☐ implementacija IATF 16949:2016 ☐ dobavitelj (tier 1, tier 2) in proizvajalec originalne opreme (OEM)	9. Lecture: Quality management systems in the automotive industry ☐ review of standards (IATF 16949: 2016 (ex. ISO / TS 16949: 2009), VDA 6.3/6.5, Toyota way, …) ☐ implementation of IATF 16949: 2016 ☐ Supplier (tier 1, tier 2) and OEM (OEM)
10. Predavanje: Kontrola variacij v procesu (QVC) ☐ kakovost in variacije ☐ robustnost in variabilnost ter zanesljivost ☐ analiza izdelka in procesa ☐ stabilnost, sposobnost procesa ☐ osnove DOE	10. Lecture: Process Variation Control (QVC) ☐ quality and variation ☐ robustness and variability and reliability ☐ product and process analysis ☐ stability, process capability ☐ DOE basics
11. Predavanje: Statistični nadzor procesa (SPC) ☐ uvod v statistični nadzor kakovosti (SQC) in procesa (SPC) ☐ opisna statistika ☐ kontrolne karte za atribute in variable	11. Lecture: Statistical Process Control (SPC) ☐ introduction to statistical quality (SQC) and process (SPC) control ☐ descriptive statistics ☐ control charts for attributes in variables ☐ acceptance sampling

▢ prevzemno vzorčenje	12. Lecture: Measurement System Analysis (MSA)
12. Predavanje: Analiza merilnih sistemov (MSA)	▢ use, description, restrictions, process
▢ uporaba, opis, omejitve, postopek	▢ location, latitude and systematic deviations
▢ lokacijska, širinska in sistemska odstopanja	▢ the statistical characteristics of the measurement systems
▢ statistične lastnosti merilnih sistemov	▢ study of the measurement system
▢ študija merilnega sistema	
13. Predavanje: Analiza možnih napak in njihovih posledic (FMEA)	13. Lecture: Analysis of possible errors and their consequences (FMEA)
▢ ocena tveganja	▢ risk assessment
▢ stopnja pomembnosti napake (Risc Priority Number - RPN)	▢ Risk Priority Number (RPN)
▢ FMEA proizvoda / konstrukcije (DFMEA)	▢ FMEA Product / Construction (DFMEA)
▢ FMEA procesa (PFMEA)	▢ FMEA Process (PFMEA)
▢ FMEA ekologije (EFMEA)	▢ FMEA Ecology (EFMEA)
14. Predavanje: Odgovornost za izdelke z napako	14. Lecture: Liability for defective products
▢ razvoj področja odgovornosti	▢ developing the area of responsibility
▢ garancija	▢ guarantee
▢ direktiva 2006/42/ES	▢ Directive 2006/42 / EC
▢ CE znak	▢ CE mark
15. Predavanje: Uporaba in nadgradnja akademskega znanja v praksi (predavanje iz prakse)	15. Lecture: Use and upgrade of academic knowledge in practice (lecture from practice)

Temeljna literatura in viri/Readings:

R. Basu: Implementing Quality – A Practical Guide to Tools and Techniques, Thomson Learning, London, 2004

R. Dan Reid, Nada R. Sanders-Operations Management; 2012 Wiley

J. Marolt, B. Gomišček: Management kakovosti, Moderna organizacija, Kranj, 2005

Montgomery D. C.: Introduction to statistical quality control, Seventh ed. Arizona State University 2011, John Wiley& Sons, Inc.

Cilji in kompetence:	**Objectives and competences:**
Cilji:	Goals:
spoznati osnovna orodja kakovosti in tehnike statističnega nadzora procesa (SPC)	1. Learn the basic quality tools and techniques of statistical process control (SPC)
spoznati področje merjenja in kalibriranja ter metodo za analizo merilnih sistemov (MSA)	2. Know the field of measurement and calibration and the method of analysis of measurement systems (MSA)
spoznati stroške kakovosti	3. Know the cost of quality
	4. Learn about quality standardization

spoznati standardizacijo na področju kakovosti s poudarkom na avtomobilski industriji	with a focus on the automotive industry
	5. Learn the methods of group problem solving
spoznati metode reševanja problemov v skupini	Competences:
Kompetence:	1. S1-PAP, S6-PAP, S9-PAP, P3-PAP, P7-PAP: use of basic tools and quality assurance techniques at all stages of product/service creation.
S1-PAP, S6-PAP, S9-PAP, P3-PAP, P7-PAP: uporaba osnovnih orodij in tehnik zagotavljanja kakovosti v vseh fazah nastanka proizvoda/storitve.	2. S2-PAP, S6-PAP, S9-PAP, P3-PAP: recognition of quality in various fields of mechanical engineering - design of products, energy devices and systems, manufacturing technologies, process control, measurements.
S2-PAP, S6-PAP, S9-PAP, P3-PAP: prepoznava kakovosti na različnih področjih strojništva – načrtovanje proizvodov, energetskih naprav in sistemov, izdelovalnih tehnologij, nadzora procesov, meritev.	3. S2-PAP, S6-PAP, S9-PAP, P3-PAP, P6-PAP: the ability to analyze cost of quality.
S2-PAP, S6-PAP, S9-PAP, P3-PAP, P6-PAP: sposobnost analize stroškov kakovosti.	4. S2-PAP, S6-PAP, S9-PAP, P3-PAP, P5-PAP: ability to apply standards and standardization in relation to quality, environment, safety and health, and its implementation in the automotive industry.
S2-PAP, S6-PAP, S9-PAP, P3-PAP, P5-PAP: sposobnost uporabe standardov in standardizacije v povezavi s kakovostjo, okoljem ter varnostjo in zdravjem in implementacija v avtomobilski industriji.	5. S2-PAP, S6-PAP, S9-PAP, P3-PAP: ability to solve group problems and use tools and techniques of creative thinking.
S2-PAP, S6-PAP, S9-PAP, P3-PAP: sposobnost reševanja problemov v skupini in uporaba orodij in tehnik kreativnega razmišljanja.	

Predvideni študijski rezultati:	**Intended learning outcomes:**
Znanja:	Knowledge:
Z1: Poglobljeno strokovno teoretično in praktično znanje s področja zagotavljanja kakovosti, ki vključuje različne vidike kakovosti, sisteme vodenja kakovosti kot tudi primerna orodja in tehnike za dosego zahtevanih ciljev.	Z1: In-depth professional theoretical and practical knowledge in the field of quality assurance, incorporating various aspects of quality, quality management systems as well as appropriate tools and techniques to achieve the required objectives.
Spretnosti:	Skills:
S1.1 Izvajanje analize izvora in reševanja problemov, ki vključujejo uporabo metodoloških orodij.	S1.1 Perform problem source analysis and solving involving the use of methodological tools.
S1.3 Diagnosticiranje in reševanje problemov v različnih specifičnih delovnih okoljih, povezanih z	S1.3 Diagnosis and problem solving in various specific work environments related to quality assurance.

zagotavljanjem kakovosti.	

Metode poučevanja in učenja: **Learning and teaching methods:**

P1 Avditorna predavanja z reševanjem izbranih - za področje značilnih - teoretičnih in praktično uporabnih primerov. P4 Laboratorijske vaje z namenskimi didaktičnimi pripomočki (merilni instrumenti in računalniško podprta orodja za analizo) P5 Uporaba študijskega gradiva v obliki knjig in skripta in e-verzije predstavitve predavanj. P7 Študij literature in razprava P9 Skupinsko delo – viharjenje možganov P10 Uporaba anket v realnem času	P1 Lectures by solving selected – typical for study area - theoretical and practical examples. P4 Laboratory exercises with dedicated teaching aids (measuring instruments and computer-aided analysis tools) P5 Use of study materials in the form of books and scripts and e-versions of lecture presentation. P7 Literature studies and discussion P9 Teamwork - Brainstorming P10 Use real-time surveys

Načini ocenjevanja: **Delež/ Weight**   **Assessment:**

Teoretične vsebine (predavanja).	50,00 %	Theoretical content (lectures).
Samostojno delo na vajah	20,00 %	Independent work in exercises
Delo na laboratorijskih vajah (vključno s poročili).	30,00 %	Laboratory work (including reports).

Reference nosilca/Lecturer's references:

Davorin Kramar:

ZIVKOVIC, Srdjan, ČERČE, Luka, KOSTIC, Julija, MAJSTROVIC, Vidosav, **KRAMAR, Davorin**. Reverse engineering of turbine blades Kaplan's type for small hydroelectric power station. V: MORONI, Giovanni (ur.), PETRÒ, Stefano (ur.). The 15th CIRP Conference on Computer Aided Tolerancing, CIRP CAT 2018, 11-13 June 2018, Milan, Italy, 15th CIRP Conference on Computer Aided Tolerancing, CIRP CAT 2018, 11-13 June 2018, Milan, Italy, (Procedia CIRP, ISSN 2212-8271, Vol. 75). [Amsterdam etc.]: Elsevier. 2018, vol. 75, f. 379-384, ilustr. doi: 10.1016/j.procir.2018.04.037. [COBISS.SI-ID 16209435]

VUJOVIĆ, Aleksandar, JOVANOVIĆ, Jelena, KRIVOKAPIĆ, Zdravko, PEKOVIĆ, Sanja, SOKOVIĆ, Mirko, **KRAMAR, Davorin**. The relationship between innovations and quality management system. Tehnički vjesnik, ISSN 1330-3651, 2017, vol. 24, no. 2, str. 551-556, ilustr. doi: 10.17559/TV-20150528100824. [COBISS.SI-ID 15481371]

ENIKO, Peter, SOKOVIĆ, Mirko, **KRAMAR, Davorin**. Influence of non-productive operations on product quality. Strojniški vestnik, ISSN 0039-2480, Mar. 2016, vol.

62, no. 3, str. 197-204, SI 29, ilustr., doi: 10.5545/sv-jme.2015.3109. [COBISS.SI-ID 14547227]

ENIKO, Peter, SOKOVIĆ, Mirko, **KRAMAR, Davorin**. Using quality tools for process development and improvement : case study on cylinder manufacturing. Advanced quality, ISSN 2217-8155. [Tisk. izd.], 2016, vol. 44, nr. 1, str. 27-32, ilustr. [COBISS.SI-ID 14679323]

ENIKO, Peter, PLESEC, Božo, SOKOVIĆ, Mirko, **KRAMAR, Davorin**. Multicriteria optimization of cilinder manufacturing using quality tools. V: MAJSTOROVIĆ, Vidosav D. (ur.). Proceedings, the 8th International Working Conference Total Quality Management - Advancedand Intelligent Approaches, 1st-5th June 2015 Belgrade. 2015, str. 347-360, ilustr. [COBISS.SI-ID 14034459]