

## UČNI NAČRT PREDMETA/COURSE SYLLABUS

<b>Predmet:</b>	NEPORUŠNO TESTIRANJE MATERIALOV IN KONSTRUKCIJ
<b>Course title:</b>	NON DESTRUCTIVE TESTING OF MATERIALS AND CONSTRUCTIONS

<b>Študijski programi in stopnja</b>	<b>Študijska smer</b>	<b>Letnik</b>	<b>Semestri</b>
Strojništvo, tretja stopnja, doktorski	Proizvodno inženirske znanosti, kibernetika in mehatronika (smer)		Celoletni

Univerzitetna koda predmeta/University course code:

Predavanja	Seminar	Vaje	Klinične vaje	Druge oblike študija	Samostojno delo	ECTS
90					160	10

Nosilec predmeta/Lecturer:

Izvajalci predavanj:	<input type="text" value="Tomaž Kek"/>
Izvajalci seminarjev:	<input type="text"/>
Izvajalci vaj:	<input type="text"/>
Izvajalci kliničnih vaj:	<input type="text"/>
Izvajalci drugih oblik:	<input type="text"/>
Izvajalci praktičnega usposabljanja:	<input type="text"/>

Vrsta predmeta/Course type:

<b>Jeziki/Languages:</b>	Predavanja/Lectures:	Slovenščina, Angleščina
	Vaje/Tutorial:	Slovenščina, Angleščina

<b>Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:</b>	<b>Prerequisites:</b>
Veljajo splošni pogoji za doktorski študij.	General prerequisites for the third level studies.

### Vsebina:

Vizualno testiranje: fizikalne osnove, opazovanje brez ali z optičnimi pripomočki, kriteriji za uspešno vizualno ocenjevanje.  
Boreskopija: fizikalne osnove, optični sistemi za osvetljevanje, optični sistemi za prenos slike, ocenjevanje stanja površine, kriteriji za uspešno oceno površin.  
Optična mikroskopija: fizikalne osnove, priprava odtiskov ali replik, opazovanje replik pod mikroskopom, ocenjevanje stanja površine in mikrostrukture.  
Penetrantske metode: fizikalne osnove, preiskovalne metode, pripomočki pri opazovanju površin, ocenjevanje stanja površine, dokumentiranje stanja površin, procedure za testiranje.  
Preiskave površinskih napak z magnetnimi metodami: fizikalne osnove, načini magnetenja in načini razmagnetanja preizkuševalcev, vrste magnetnih sredstev, sistemi za kontrolo in prikaz rezultatov,

### Content (Syllabus outline):

Visual testing: basic physical concepts, observations without and with optical instruments, criteria for visual assessment.  
Borescopy: basic physical concepts, illumination systems, optical systems for distant image processing, surface and flaw evaluation, criteria for surface assesment.  
Optical microscopy: basic physical concepts, preparing of replicas and impresses, microscopy of replicas, assesment of surface and microstructure.  
Liquid penetrant inspection: basic physical concepts, methods, instruments for surface observation, surface evaluation and ways of recording of surface states, types of liquid penetrant inspections.  
Magnetic methods in surface testing: basic physical concepts, magnetizing and demagnetizing of the sample, magnetic particle types, control and data display systems, surface evaluation, establishment of procedures.

<p>ocenjevanja stanja površin, izdelava procedur.</p> <p>Preiskave lastnosti materialov in napak v materialu z vrtničnimi tokovi: fizikalne osnove, postopki preizkušanja, razvoj kriterijev za ocenjevanje različnih lastnosti materialov, ocenjevanje stanja površine in površinskih slojev, testiranje korozijskih poškodb, testiranja glede na snovne lastnosti in kemično sestavo itd.. Izdelava procedur za testiranje z vrtničnimi tokovi.</p> <p>Preiskava materialov z ultrazvokom: fizikalne osnove, pridobivanje ultrazvoka, postopki preizkušanja, naprave za preizkušanje, ultrazvočne glave, posebni postopki preizkušanja materialov in stanja materialov, izdelava procedur.</p> <p>Akustična emisija: fizikalne osnove; postopki preizkušanja, metode za vrednotenje signalov in klasifikacija signalov.</p>	<p>Eddy current inspection: basic physical concepts, inspection methods, establishment of criteria for testing of different materials, assessment of surface and surface layers, testing of corrosion damage, testing with regard on material properties, chemical content etc., establishment of procedures.</p> <p>Ultrasonic inspection: basic physical concepts, ultrasound generation, ultrasonic inspection methods, ultrasonic devices, ultrasonic transducers, special ultrasonic methods for material evaluation, establishment of procedures.</p> <p>Acoustic emission: basic physical concepts, methods of testing, methods of signal evaluation and signal classification.</p>
---	--

#### Temeljna literatura in viri/Readings:

<p>[1] Conf. Proceedings of the 8th Int. Conf. of the Slovenian Society for Non-destructive Testing. Portorož, Slovenia, 2005.</p> <p>[2] ASM handbook. Vol. 17, Nondestructive evaluation and quality control / prepared under the direction of the ASM International Handbook Committee.- 5th printing, 1997.- Metal Park: ASM International, cop. 1989.</p> <p>[3] Krautkraemer, J., Krautkraemer. H.: Ultrasonic testing of materials.- 3rd ed.- Berlin: Springer-Verlag, 1983.</p> <p>[4] Proceedings of the World Conferences on Non-destructive Testing.</p> <p>[5] Journals on Non-Destructive Testing, e.g.: Nondestructive Testing and Evaluation, Materials Testing, Research in Nondestructive Evaluation.</p>
--

#### Cilji in kompetence:

<p><b>Cilji:</b> Študentu podati zadostno znanje s področja neporušnega testiranja za začetne korake samostojnega dela na tem področju.</p> <p><b>Kompetence:</b> Študent osvoji osnovne postopke NDT ter rokovanje z instrumenti. Zna izbrati in uporabiti najprimernejši postopek pri podanem materialu, možnih napakah ter opremi in času, ki mu je na voljo.</p>	<p><b>Objectives and competences:</b></p> <p><b>Goals:</b> The principal goal is to give student enough knowledge from the field of Non Destructive Testing.</p> <p><b>Competences:</b> The student acquires competence in basic NDT procedures and handling of the NDT instruments. He knows how to select and use the best suitable procedure for a given combination of material, possible defects and available resources in a sense of time and equipment available.</p>
--	---

#### Predvideni študijski rezultati:

<p>Študent osvoji osnovne postopke NDT ter rokovanje z instrumenti. Zna izbrati in uporabiti najprimernejši postopek pri podanem materialu, možnih napakah ter opremi in času, ki mu je na voljo.</p>	<p><b>Intended learning outcomes:</b> The student acquires competence in basic NDT procedures and handling of the NDT instruments. He knows how to select and use the best suitable procedure for a given combination of material, possible defects and available resources in a sense of time and equipment available.</p>
---	---

#### Metode poučevanja in učenja:

<p>Predavanja, laboratorijske vaje, seminarsko delo, e-izobraževanje, konzultacije. Seminarsko delo v čim večji meri navezuje se na področje doktorskega raziskovanja. Študij z uporabo priporočene literature.</p>	<p><b>Learning and teaching methods:</b> Lectures, laboratory practice &amp; seminar work, e-education, consulting. The seminar work is related, as much as possible, to the student's doctoral research field. Study on a recommended literature basis.</p>
---	--

#### Načini ocenjevanja:

<p>Ustni izpit, poročilo o seminarskem delu. Pogoj za opravljanje ustnega izpita je uspešno izdelano in</p>	<p><b>Delež/Weight</b></p>	<p><b>Assessment:</b> Oral exam, report on seminar work. The condition for admission to oral exam is successful</p>
---	----------------------------	---

pozitivno ocenjeno seminarsko delo. Način (pisni izpit, ustno izpraševanje, naloge, projekt): • projektni seminar (20%) • ustno izpraševanje (80%)		completion of seminar work, rewarded with a passing grade. Method (written exam, oral examination, assignments, project) • project seminar (20%) • oral examination (80%)
--	--	---

**Reference nosilca/Lecturer's references:**

**doc.dr. Tomaž KEK**

KEK, Tomaž, KUSIĆ, Dragan, GRUM, Janez. Wavelet packet decomposition to characterize injection molding tool damage. Applied sciences, ISSN 2076-3417, Feb. 2016, vol. 6, iss. 2, f. 1-13, ilustr. <http://www.mdpi.com/2076-3417/6/2/45>, doi: 10.3390/app6020045.

KEK, Tomaž, KUSIĆ, Dragan, FINC, Matej, GRUM, Janez. Detection of damaged tool in injection molding process with acoustic emission. Research in nondestructive evaluation, ISSN 0934-9847, 2016, vol. 27, nr. 2, str. 86-99, ilustr. <http://www.tandfonline.com/doi/pdf/10.1080/09349847.2015.1061074>, doi: 10.1080/09349847.2015.1061074.

FINC, Matej, KEK, Tomaž, GRUM, Janez. Quality control of crimped joint contacts with conductors through thermography. Insight, ISSN 1354-2575. [Print ed.], May 2015, vol. 57, no. 5, str. 257-265, ilustr., doi: [10.1784/insi.2015.57.5.257](http://dx.doi.org/10.1784/insi.2015.57.5.257).

MOJŠKERC, Bor, KEK, Tomaž, GRUM, Janez. Pulse-echo ultrasonic testing of adhesively bonded joints in glass façades. Strojniški vestnik, ISSN 0039-2480, Mar. 2016, vol. 62, nr. 3, str. 147-153, ilustr., doi: 10.5545/sv-jme.2015.2988.

KUSIĆ, Dragan, SVEČKO, Rajko, KEK, Tomaž, HANČIČ, Aleš, GRUM, Janez. Influence of increased injection pressure load on the captured acoustic emission signals and dimensional accuracies of polypropylene test specimens. Insight, ISSN 1354-2575. [Print ed.], Dec. 2013, vol. 55, no. 12, str. 659-664, doi: [10.1784/insi.2012.55.12.659](http://dx.doi.org/10.1784/insi.2012.55.12.659).