

# NEPORUŠNO TESTIRANJE MATERIALOV IN KONSTRUKCIJ

## 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>Članica nosilka/UL Member:</b>	UL FS

Študijski programi in stopnja	Študijska smer	Letnik	Semestri	Izbirnost
Strojništvo, tretja stopnja, doktorski	Proizvodno inženirske znanosti, kibernetika in mehatronika (smer)	1. letnik, 2. letnik	Celoletni	izbirni

**Univerzitetna koda predmeta/University course code:**

0033460

**Koda učne enote na članici/UL Member course code:**

7305

Predavanja /Lectures	Seminar /Seminar	Vaje /Tutorials	Klinične vaje /Clinical tutorials	Druge oblike študija /Other forms of study	Samostojno delo /Individual student work	ECTS
90					160	10

**Nosilec predmeta/Lecturer:**

Tomaž Kek

**Izvajalci predavanj:**

Tomaž Kek

**Izvajalci seminarjev:**

**Izvajalci vaj:**

**Izvajalci kliničnih vaj:**

**Izvajalci drugih oblik:**

**Izvajalci praktičnega usposabljanja:**

**Vrsta predmeta/Course type:**

Izbirni predmet /Elective course

**Jeziki/Languages:**

Predavanja/Lectures:

Angleščina, Slovenščina

Vaje/Tutorial:

Angleščina, Slovenščina

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

**Prerequisites:**

Veljajo splošni pogoji za doktorski študij.

General prerequisites for the third level studies.

**Vsebina:**

**Content (Syllabus outline):**

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, ocenjevanja stanja površin, izdelava procedur.

Preiskave lastnosti materialov in napak v materialu z vrtničnimi tokovi: fizikalne osnove, postopki preizkušanja, razvoj kriterijev za ocenjevanje različnih

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, assessment 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.

Eddy current inspection: basic physical concepts, inspection methods, establishment of criteria for testing of

<p>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 vrtinčnimi 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>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>
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### **Temeljna literatura in viri/Readings:**

- [1] NDE handbook : non-destructive examination methods for condition monitoring, London [etc.] : Butterworths, 1987, cop. 1989 COBISS.SI-ID - 2508059
- [2] Basic non-destructive testing glossary , Ljubljana : Slovenian Society for Non-Destructive Testing, 2001 COBISS.SI-ID - 115247360
- [3] Non-destructive testing of fibre-reinforced plastics composites., London ; New York : Elsevier, cop. 1987 Vol. 1  
COBISS.SI-ID - 1513755
- [4] Non-destructive testing of fibre-reinforced plastics composites, London ; New York : ElsevierVol. 2  
COBISS.SI-ID - 1514011
- [5] Introduction to the non-destructive testing of welded joints, Abington, Cambridge : Abington : Woodhead, 1996 COBISS.SI-ID - 2539803

### **Cilji in kompetence:**

#### **Cilji:**

Študentu podati zadostno znanje s področja neporušnega testiranja za začetne korake samostojnega dela na tem področju.

#### **Kompetence:**

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.

### **Objectives and competences:**

#### **Goals:**

The principal goal is to give student enough knowledge from the field of Non Destructive Testing.

#### **Competences:**

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.

**Predvideni študijski rezultati:**

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.

**Intended learning outcomes:**

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.

**Metode poučevanja in učenja:**

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.

**Learning and teaching methods:**

Lectures, laboratory practice & 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.

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

Ustni izpit, poročilo o seminarskem delu. Pogoji za opravljanje ustnega izpita je uspešno izdelano in pozitivno ocenjeno seminarsko delo. Način (pisni izpit, ustno izpraševanje, naloge, projekt): • projektni seminar (20%) • ustno izpraševanje (80%)

Oral exam, report on seminar work. The condition for admission to oral exam is successful completion of seminar work, rewarded with a passing grade. Method (written exam, oral examination, assignments, project) • project seminar (20%) • oral examination (80%)

**Ocenjevalna lestvica:****Grading system:**

5 - 10, pri čemer velja, da je pozitivna ocena od 6 - 10

5 - 10, a student passes the exam if he is graded from 6 to 10

**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](https://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](https://doi.org/10.1784/insi.2012.55.12.659).