

UČNI NAČRT PREDMETA / COURSE SYLLABUS

Predmet: IZBRANA POGLAVJA IZ INŽENIRSTVA MATERIALOV
Course Title: SELECTED TOPICS IN MATERIALS ENGINEERING

Študijski program in stopnja Study Programme and Level	Študijska smer Study Field	Letnik Academic Year	Semester Semester
DR Kemijske znanosti, 3. stopnja	/	1.	1. in 2.
Doctoral programme in Chemical Sciences, 3 rd Cycle	/	1 st	1 st and 2 nd

Vrsta predmeta / Course Type: izbirni/Elective

Univerzitetna koda predmeta / University Course Code: KZ321

Predavanja Lectures	Seminar Seminar	Vaje Tutorial	Klinične vaje Work	Druge oblike študija	Samost. delo Individual Work	ECTS
30	45	/	/	/	75	5

Nosilec predmeta / Lecturer: prof. dr. Marjan Marinšek /Dr. Marjan Marinšek, Associate Full Professor

Jeziki / Languages: **Predavanja / Lectures:** slovenski / Slovenian
Vaje / Tutorial: slovenski / Slovenian

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

Študent oz. kandidat mora imeti predmet opredeljen kot študijsko obveznost.

Prerequisites:

The course has to be assigned to the student.

Vsebina:

Študent skupaj z mentorjem izbere vsebine v obsegu 5 KT izmed spodaj navedenih glede na področje svojega raziskovalnega dela pa poglobi znanja z izborom ožje teme.

Nosilec predmeta skladno z izbranimi vsebinami koordinira izvajanje, če je izvajalcev več.

- Razumevanje splošnih odvisnosti med strukturo in lastnostmi materialov.

Poudarek je dan osnovam teorije mehanske lastnosti materialov, metode mehanskega utrjevanja, plastičnosti polikristaliničnih

Content (Syllabus outline):

At the beginning of school year Student and course coordinator select specific topics from the course content, relevant for dissertation with the total of 5 ECTS.

Course coordinator is responsible for appropriate organization of the course in case there are more than two lecturers on the programme.

- *Materials properties:*

The emphasis is on the underlying relationship and deeper understanding of the microstructure-composition-synthesis-processing relationships. Tensile test and the

materialov, lezenju in kinetiki faznih transformacij. Dodatna izbrana poglavja vključujejo znanja potrebna za razumevanje električnih, magnetnih in optičnih lastnosti materialov, biokeramike ter nanomaterialov in nanotehnologij.

A. - Načrtovanje materialov z določenimi lastnostmi

Vsi primeri so obdelani na posebnih študijskih primerih. Od materialov so posebej obravnavani: jekla (ogljikova in zlitine), aluminij, keramika, steklo, polimerni kompoziti, keramični kompoziti, kompoziti s kovinsko matrico, napredni keramični materiali (LTCC, FGM..).

B. - Načrtovanje in izbor materialov ter procesov za njihovo pripravo.

Obravnavane so lastnosti materialov, ki so izrazito pomembne za krojenje (dizajn) elementov in sklopov strukture, splošna metodologija izdelave konstrukcij, metodologija izbora materialov in kriteriji ter orodja za izbor materialov s posebnim poudarkom na obravnavi propada-korozije gradiv. Obravnavani so naslednji procesi za pripravo materialov: sinteza in določitev sestave ter lastnosti materialov, metode priprave prahov, načini oblikovanja, sušenje, sintranje; procesi za izboljšanje in krojenje lastnosti: termična, kemijska in mehanska obdelava. Vsi navedeni procesi so obravnavani na mikro in nano skali velikosti gradnikov (delcev, plasti, itd).

Karakterizacija strukture in funkcionalnih lastnosti materialov. Študent izbere primere posebnih sodobnih fizikalnih in kemijskih sinteznih metod, ki jih obdela v seminarski nalogi.

information that can be derived from it, elastic and plastic deformation, concept of slip, dislocations and their role in plastic deformation, Schmidt's law, creep, kinetics of phase transformations, strengthening mechanisms and hardness will be studied.

Additional knowledge needed to understand electrical, magnetic and optical properties of materials, bioceramics and nanomaterials will be worked out as seminars.

- Principles of materials design:

Seminars will be prepared as specific case studies for: steels and alloys, aluminum, ceramics, glass, polymer composites, continuous ceramic fibers composites, metal matrix composites, advanced ceramic materials (LTCC, FGM...).

- Principles of materials selection for engineering design:

When the material is designed for a specific application, a number of factors must be taken into account. Specific properties of materials with high relevance to the design of components and structures will be studied. Materials must be designed with required physical or mechanical properties, their fabrication should be simple and cost effective. Methodology for materials selection, including the selection criteria, and specific tools for selection of corrosion resistant materials functioning under specific conditions will be presented. Monitoring the processes for manufacturing will be studied: synthesis and analysis of composition and properties, specific methods for powder preparation and characterization, shaping, drying, sintering; processes for property improvement and design: thermal, chemical and mechanical treatments... All processes will be studied on micro and nano levels. Special case studies of the use of contemporary physical and chemical synthetic routes will be elaborated by the students in seminar form.

Temeljna literatura in viri / Readings

- T. Fischer, Materials Science for Engineering Students, Academic Press, 2009, ISBN: 978-0-12-373587-4
- R. Askeland, The Science and Engineering of Materials, 4th Edition, 2003 Thompson Learning, ISBN-0-534-95373-5
- P.L. Mangonon, The Principles of Materials Selection for Engineering Design, Prentice Hall, 1999, ISBN-0-13-242595-5
- J.K.Wessel, Handbook of Advanced Materials Enabling New Designs, Whilley Interscience, 2004, ISBN-471-45475-3
- U. Bröckel, W. Meier, G. Wagner, Product Design and Engineering, Wiley-VCH, Vol.1, Vol.2, 2007, ISBN: 978-3-527-31529-1
- Študent bo poleg navedene literature uporabljal tudi najnovejša literaturo (monografije, članki) z izbranega študijskega področja. / Students will use also the newest literature (monographies, papers) from the selected field.

Cilji in kompetence:

Razumevanje splošnih odvisnosti med strukturo in lastnostmi materialov. Poleg tega v okviru tega predmeta študent pridobi specialistična znanja z ožjega področja. Ta znanja zadostujejo za samostojno vodenje znanstvene raziskave na izbranem raziskovalnem področju.

Objectives and Competences:

Basic chemistry and materials engineering data are given to understand correlations between the structure and properties of materials. Advanced knowledge on selected topics is presented as a basis of student's ability to solve scientific and engineering problems.

Predvideni študijski rezultati:

Znanje in razumevanje

Študent je sposoben samostojno pregledati najnovejšo literaturo s področja materialov ter pripraviti literaturni pregled o izbrani tematiki.

Uporaba

Pridobljena znanja je sposoben samostojno uporabljati na področju inženirstva materialov

Refleksija

Študent je sposoben samostojno definirati problem, načrtovati vsebino raziskovalnega dela ter zastaviti raziskovalne cilje,

Prenosljive spretnosti

Študent je sposoben sintetizirati različna znanja, zagovarjati rezultate ter aktivno sodelovati v razpravah.

Intended Learning Outcomes:

Knowledge and Comprehension

Student comprehends scientific literature in the field of materials engineering and is able to prepare literature survey on selected topics.

Application

Student is able to use gained knowledge for research and development in the field of engineering of materials

Analysis

Student defines problems, proposes the content of projects and uses research techniques to achieve proposed goals

Skill-transference Ability

Student has ability to synthesize various inputs, to defend obtained results and actively participate in discussions.

Metode poučevanja in učenja:

Metode so prilagojene študentu oziroma skupini: predavanja, študij ustrezne strokovne literature, laboratorijsko delo na

Learning and Teaching Methods:

Methods are adapted to a student or group of students: lectures, study of literature,

izbranem področju, seminar in razprave v ožji skupini.

laboratory work in the selected field, seminars and group discussions.

Delež (v %) /

Načini ocenjevanja:

Weight (in %) **Assessment:**

Predloženo poročilo o projektnem delu ali seminar v pisni obliki	50	Seminar or preparation of a written project report
Ustni zagovor projektne naloge	50	Oral presentation of project and defence of project

Reference nosilca / Lecturer's references:

PECOVSKA-GJORGJEVICH, Margareta, ALEKSOVSKA, Slobotka, **MARINŠEK, Marjan**, DIMITROVSKA-LAZOVA, Sandra. Impedance and AC conductivity of $GdCr_{1-x}Co_xO_3$ ($x = 0, 0.33, 0.5, 0.67$ and 1) perovskites. *Journal of the American Ceramic Society*, ISSN 0002-7820, no. 12, dec. 2014, str. 3864-3871

ANŽLOVAR, Alojz, **MARINŠEK, Marjan**, CRNJAK OREL, Zorica, ŽIGON, Majda. Basic zinc carbonate as a precursor in the solvothermal synthesis of nano-zinc oxide. *Materials & design*, ISSN 0264-1275, Dec. 2015, vol. 86, str. 347-353

ŠTUKOVNIK, Petra, **MARINŠEK, Marjan**, MIRTič, Breda, BOKAN-BOSILJKOV, Violeta. Influence of alkali carbonate reaction on compressive strength of mortars with air lime binder. *Construction & building materials*, ISSN 0950-0618. [Print ed.], Jan. 2015, vol. 75, str. 247-254

MARINŠEK, Marjan, ŠALA, Martin, JANČAR, Boštjan. A study towards superior carbon nanotubes-supported Pd-based catalysts for formic acid electro-oxidation : preparation, properties and characterisation. *Journal of power sources*, ISSN 0378-7753, 2013, vol. 235, no. 1, str. 111-116