

UČNI NAČRT PREDMETA / COURSE SYLLABUS

Predmet:	Razvoj sodobnih materialov
Coursetitle:	Advanced materials development

Študijski program <i>Studyprogrammeandlevel</i>	Študijska smer <i>Studyfield</i>	Letnik <i>Academic year</i>	Semester <i>Semester</i>
Inženiring in avtomobilska industrija		prvi	prvi
Engineering and Automotive Industry		first	first

Vrsta predmeta / Coursetype	Obvezni	Obligatory
------------------------------------	---------	------------

Univerzitetna koda predmeta / Universitycoursecode	MAG_21003
---	-----------

Predavanja <i>Lectures</i>	Seminar <i>Seminar</i>	Sem. vaje <i>Tutorial</i>	Lab. vaje <i>Laboratorywork</i>	Teren. vaje <i>Fieldwork</i>	Samost. delo <i>Individ. work</i>	ECTS
45	-	-	30	-	135	7

Nosilec predmeta / Lecturer:	doc. dr. Marica Prijanovič Tonkovič
So-nosilec:	

Jeziki / Languages:	Predavanja / Lectures:	Vaje / Tutorial:
	Slovenski	Slovenski
	Slovenian	Slovenian

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

Perequisites:

- vpis v prvi letnik študija.	- Enrollment in the first year of the study.
-------------------------------	--

Vsebina:

Content (Syllabusoutline):

<ul style="list-style-type: none"> - Uvod: znanost o materialih; razvrstitev materialov; kriteriji za izbiro materialov; smeri razvoja materialov v avtomobilski industriji. - Zgradba materialov: atomi in kemijske vezi; vpliv tipov vezi, jakosti vezi in kristalne zgradbe na lastnosti materialov. - Kovinski materiali: kristalna struktura kovinskih materialov; mikrostruktura; karakterizacija mikrostrukture in površin kovinskih materialov s sodobnimi metodami in analitskimi tehnikami; Difuzija v trdnih raztopinah (v kovinah in zlitinah) Binarni fazni diagrami; fazne spremembe; - Nanostrukturirana jekla: - Razvoj visoko trdnostnih jekel tretje generacije; Razvoj novih orodnih jekel; - Osnove toplotneobdelave: - Nerjavnejekla; Orodna in hitroreznajekla; - Jeklenelitine 	<ul style="list-style-type: none"> - Introduction: Material Science; classification of materials; criteria for materials selection; trends of the development of materials in automotive industry. - Structure of materials: atoms and chemical bonds; the impact of types of bonds, bond strength and crystal structure on the properties of materials. - Metallic materials: crystal structure of metallic materials; microstructure and characterization of microstructure and surface analysis of metallic materials using advanced methods and analytical techniques; - Diffusion in solid metals and alloys; Binary phase diagrams; transformation reactions; - Nanostructured steels: - Development of the third generation of HSS
--	--

<ul style="list-style-type: none"> – Metalurgija prahov: – Magnetne lastnosti kovin in zlitin; – Neželezne kovine: Al in Al zlitine v avtomobilski industriji; Mg zlitine, Ti in Ti zlitine za uporabo v avtomobilski industriji – Korozija: oksidacija; bio korozija; visokotemperaturna korozija; – Polimerni materiali: delitev polimernih materialov, postopki predelave polimernih materialov, lastnosti in uporaba najbolj uporabne vrste polimernih materialov v avtomobilski industriji – Keramični materiali: zgradba keramike; steklo, sintranje in mikrostruktura keramičnih materialov; inženirska oksidna in neoksidna keramika; elektronska in magnetna keramika. – Materiali za optoelektroniko, mikroelektroniko, – Grafen v avtomobilski industriji 	<ul style="list-style-type: none"> – Development of the new tool steels – Basics of heat treatment: – Stainless steels; Tool and high speed steels; Cast steels – Powder metallurgy: – Magnetic properties of metals and alloys; – Nonferrous metals: Al and Al alloys Mg and Mg alloys and Ti and Ti alloys in automotive industry – Corrosion, oxidation bio corrosion, high temperature corrosion; – Polymer materials: Polymer materials classification, production methods of polymeric materials, properties and use in automotive industry – Ceramic materials: ceramic structure, glass, sintering and microstructure of ceramic materials, engineering oxide and non-oxide ceramics; electronic and magnetic ceramics. – Materials for optoelectronics and microelectronics, – Graphene in automotive industry
---	--

Temeljni literatura in viri / Readings:

- Laughlin, D. E., Hono, H. (Ed.) (2014). *Physical Metallurgy* (5. Ed.). Elsevier: Amsterdam.
- Vodopivec, F. (2002). *Kovine in zlitine*. Inštitut za kovinske materiale in tehnologije: Ljubljana.
- Ule, B. (2004). *Fizikalna metalurgija, rešene naloge*. IMT: Ljubljana.
- Tuma, J.V. (2002). *Mehanske lastnosti kovin*, UL, FGG: Ljubljana.
- Sperling, L. H. (2006). *Introduction to Physical Polymer Science*. Wiley: Hoboken.
- Glavič, P. (2006). *Gradiva*. Fakulteta za kemijo in kemijsko tehnologijo Maribor: Maribor.
- Zupanič, F., Anžel, I. (2007). *Gradiva*. Fakulteta za strojništvo Maribor: Maribor.
- Žnidaršič, A. (2009). *Tehnologija keramike*. Fakulteta za kemijo in kemijsko tehnologijo: Maribor.
- Kolar, D. (1993). *Tehnična keramika I. in II.* Univerza v Ljubljani: Ljubljana.
- Askeland, D. R., Phule, P. P. (2003). *The Science and Engineering of Materials* (4. Ed.). Thomson Learning: Brooks Cole.
- Zupanič, F. (2006). *Gradiva*. Zbirka nalog in tabel. Fakulteta za strojništvo Maribor: Maribor.
- Tonkovič, P., M. (2008). *Gradiva*. Novo mesto: Šolski center.
- Kovač, M. (2001). *Gradiva*. Zaprski predavanj. Fakulteta za strojništvo: Ljubljana.
- Kosec, M., Malič B. (2009). *Multifunkcionalni materiali*. Institut Jožef Stefan: Ljubljana. (<http://www.namat.si/dmdocuments/malic.pdf>).
- E-gradiva predmeta | E-Course material

Priporočljiva literatura / Recommended Textbooks

- Ghassemieh, E. *Materials in Automotive Application, State of the Art and Prospects*. www.intechopen.com
- Sachdev, K., Fang, Y., & Girshov, V. (2012). *Titanium for Automotive Applications: Challenges and Opportunities in Materials and Processing*, JOM, Vol. 64, No. 5.
- Baluch, N., Udin, Z. M., Che Sobry, A. (2014). *Advanced High Strength Steel in Auto Industry: an Overview Engineering, Technology & Applied Science Research* Vol. 4, No. 4, 686-689.
- Bouaziz, O., Zurob, H., & Huan, M. (2013). *Driving Force and Logic of Development of Advanced High Strength Steels for Automotive Applications*, steel research int. 84. No. 10.
- Steven, A. (2014). *Graphene composites for cars*. SAE International.

- Elmarakbi, A., Azoti, W. L. (2015). *Novel composite materials for automotive applications: Concepts and challenges for energy-efficient and safe Vehicles*. 10th International Conference on Composite Science and Technology ICCST/10 © IDMEC.
- Dume´e, L. F. et al. (2015). *Growth of nano-textured graphene coatings across highly porous stainless steels support towards corrosion resistant coatings*. CARBON 87.395–408.

Cilji in kompetence:

Objectives and competences:

<p>Cilji:</p> <ul style="list-style-type: none"> – študenti spoznajo soodvisnost med zgradbo, mikrostrukturo in lastnostmi materialov. Ob tem spoznajo tudi pomembnejše kovinske, polimerne, keramične in sestavljene materiale, ki jih uporabljamo v avtomobilski industrijski praksi in drugih dejavnostih in se podrobno seznanijo z razvojem novih sodobnih materialov. <p>Kompetence</p> <p>Splošne kompetence</p> <ul style="list-style-type: none"> – sposobnost izdelave in uporabe sodobnih metod in orodij, – sposobnost projektno-timskega dela, – sposobnost raziskovalnega dela, – sposobnost vodenja tehnoloških procesov ter vpeljevanje sodobnih metod, – usposobljenost za uporabo raziskovalnih metod ter njihovo aplikacijo v praksi. <p>Predmetno specifične kompetence</p> <ul style="list-style-type: none"> – izberejo ustrezno material za konkreten izdelek, – odločajo o primernosti izbranega materiala za ustrezen element, – razumejo strjevanje zlitin in toplotno obdelavo – izbirajo med alternativni materiali, – poznajo nekovinske in kovinske materiale in njihove lastnosti. 	<p>Objectives:</p> <ul style="list-style-type: none"> – students learn the relationship between structure, microstructure and properties of materials. At the same time they learn about the major metal, plastic, ceramic and composite materials, which are used in automotive industry practice and other activities and that they learn about the development of the new advanced materials. <p>Competences</p> <p>General competences</p> <ul style="list-style-type: none"> – ability of managing modern methods, procedures and processes, – ability of project-team work, – ability of research work, – ability to manage technological processes and introduce modern methods, – ability to use research methods and put them into practice. <p>Subject-specific competencies</p> <ul style="list-style-type: none"> – choose the appropriate material for the specific product, – decide on the suitability of the material chosen for the relevant element, – understand solidification of alloys and heat treatment, – choose from alternative materials, – know non-metallic and metallic materials and their properties.
--	---

Predvideni študijski rezultati:

Intended learning outcomes:

<p>Študent/študentka</p> <ul style="list-style-type: none"> – Pridobivajo celovita znanja zlasti o kemijskih in fizikalnih lastnostih materialov, ki so potrebna za osnovno oceno uporabnosti in ustreznosti določenih materialov za posamezne funkcije v avtomobilski industriji. V praktičnem delu se naučijo osnovnih prijemov za karakterizacijo materialov. 	<p>Student</p> <ul style="list-style-type: none"> – gain a comprehensive knowledge of the particular chemical and physical properties of the materials, needed for a basic assessment of the usefulness and appropriateness of certain materials for specific functions in automotive industry. In practical work they learn the basic approaches for the characterization of materials.
--	--

Metode poučevanja in učenja:

Learning and teaching methods:

<ul style="list-style-type: none"> - Klasična predavanja - AV predstavitve - obravnava študijskih primerov - delo v laboratoriju - aktivno skupinsko delo <p>Predmet je oblikovan na kombinirani način študija, ki vključuje aktivnosti preko elektronskega (on-line) okolja: te aktivnosti so sestavljene iz samostojnih in skupinskih aktivnosti z uporabo učnega okolja Moodle in drugih elektronskih vsebin. Praviloma vključujejo diskusije v forumih, spletne strani, ogled posnetih predavanj in vaj, preverjanje znanja, odgovori na vprašanja, iskanje po spletu (bazah) itd.</p>	<ul style="list-style-type: none"> - Lectures - AV presentation - case studies - laboratory work - actively teamwork <p>The course is designed as blended learning that includes online activities: Online activities consist of independent and group activities using the LMS Moodle and other electronic or online content. Activities usually include discussions in forums, websites, viewing of recorded lectures and tutorials, assessments, answering questions, searching the web (databases), etc.</p>
---	---

Načini ocenjevanja:

Delež/Weight (%)

Assessment:

<p>Pogoj za opravljanje pisnega izpita so pozitivno ocenjene vaje.</p> <ul style="list-style-type: none"> - Pisni izpit <p>Ocenjevalna lestvica je skladna z ECTS in Pravilnikom o preverjanju in ocenjevanju znanja FINI NM.</p>	<p>100</p>	<p>The condition for taking written are positively assessed.</p> <ul style="list-style-type: none"> - written exam <p>Evaluation scale in accordance with ECTS and the Rules on the Evaluation and Assessment of Knowledge FINI NM.</p>
--	------------	--

Reference nosilca / Lecturer's references:

<ul style="list-style-type: none"> - TONKOVIČ-PRIJANOVIČ, Marica, KOSEC, Ladislav. Mikrostrukturalne spremembe karbidov med navarjanjem z lasrjem in mikroplazmo. V: POLAJNAR, Ivan (ur.), SUBAN, Marjan (ur.). <i>Avtomatizacija in robotizacija v varilni tehniki : zbornik predavanj</i>, Dan varilne tehnike 2014, Novo mesto, 11. september 2014. Novo mesto: Šolski center, 2014, str. 123-126. - TONKOVIČ-PRIJANOVIČ, Marica, GOJIĆ, Mirko, KARPE, Blaž, KOSEC, Ladislav. Secondary ledeburite formation during various welding techniques. <i>Journal of mining and metallurgy. Section B, Metallurgy</i>, ISSN 1450-5339, 2015, vol. 51, no. 2 B, str. 117-123. - TONKOVIČ-PRIJANOVIČ, Marica, LAMUT, Jakob, GONTAREV, Vasilij. Mechanism of the oxidation of the Fe-Si-Zr-C alloys = M. P. Tonkovič, J. Lamut, V. Gontarev. <i>Metall (Berl. West)</i>, 2001, jg. 55, no. 4, str. 201-205. [COBISS.SI-ID 255583] - TONKOVIČ-PRIJANOVIČ, Marica, KOSEC, Ladislav, LAMUT, Jakob, GONTAREV, Vasilij, SAMARDŽIJA, Zoran. Mechanism of the oxidation of the Fe-C-Si-Al-Zr alloys. <i>Metallurgija (Sisak)</i>, 2002, jg. 41, no. 1, str.17-22. [COBISS.SI-ID 311391]

- YEBUAH, Robert, TONKOVIČ-PRIJANOVIČ, Marica, KASTELEC, Silvo. Conversion of elongation values for cold-rolled low carbon steel sheets. *J. test. eval.*, 2005, vol. 33, no. 2, str.130-134. [COBISS.SI-ID 693855]
- TONKOVIČ-PRIJANOVIČ, Marica, KOSEC, Ladislav. Heat affected zone in surfacing chromium ledeburitic steel. *Metallurgy*, 2009
- TONKOVIČ-PRIJANOVIČ, Marica, VRANJKOVIČ, Jovo, MIHOKOVIČ, Igor. The effect of inoculants on hardness and machinability of grey cast iron with flak graphite = Vpliv cepljenja sive litine z lamelnim grafitom na trdoto in obdelavnost. *RMZ-mater. geoenviron.*, 2009, vol. 56, no. 4, str. 521-530. [COBISS.SI-ID 984927]
- TONKOVIČ-PRIJANOVIČ, Marica. Praktično izobraževanje na višji strokovni šoli. Novo mesto: Šolski center, Višja strokovna šola, 2007. ISBN 978-961-6496-21-6. [COBISS.SI-ID 234830592]
- LAMUT, Jakob, APAT, Jože, PETOVAR, Stanko, TONKOVIČ PRIJANOVIČ, Marica. Peneče žlindre v električni obločni peči. V: *Zbornik XXXIX. posveta o metalurgiji in kovinskih gradivih*, [v Portorožu 6. in 7. oktobra 1988]. Ljubljana: Metalurški inštitut, 1988, str. 267-268. [COBISS.SI-ID 7948288]
- SETNIKAR, Franc, TONKOVIČ-PRIJANOVIČ, Marica, PANJAN, Peter. Analysis of millers protected with hard PVD coatings. V: BEZJAK, Jožica (ur.). *Technical creativity in school's curricula with the form of project learning "From idea to the product" : from the kindergarten to the technical faculty : proceedings : 5th International science symposium : od vrtca do fakultetnega tehniškega študija : zbornik prispevkov : 5. Mednarodni znanstveni posvet, 18.-20. april 2007, Portorož, Slovenia*. Ljubljana: Somaru, 2007, str. 92-98. [COBISS.SI-ID 701279]
- TONKOVIČ-PRIJANOVIČ, Marica. *Gradiva*. 3. ponatis. Novo mesto: Višja strokovna šola, 2008. 210 str., ilustr., preglednice. ISBN 961-90756-6-8. [COBISS.SI-ID 241873152].

