

UČNI NAČRT PREDMETA / COURSE SYLLABUS

Predmet:	Materiali
Course title:	Materials

Študijski program in stopnja Study programme and level	Študijska smer Study field	Letnik Academic year	Semester Semester
Tehnologije in sistemi – prva stopnja	/	prvi	prvi
Technologies and Systems – 1st cycle	/	first	first

Vrsta predmeta / Course type obvezni/obligatory

Univerzitetna koda predmeta / University course code: TS 1 UN 3

Predavanja Lectures	Seminar Seminar	Vaje Tutorial	Laboratorijske vaje work	Druge oblike študija	Samost. delo Individ. work	ECTS
45		15	15		93	6

Nosilec predmeta / Lecturer: doc. dr. Gorazd Hlebanja

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

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

- vpis v prvi letnik študija,
- pred izpitom mora študent/študentka uspešno opraviti praktične vaje.

Prerequisites:

- enrollment in the first year of study,
- before the exam, the student must successfully complete practical tutorials.

Vsebina:

- *Zgradba atoma in kemijske vezi.*
Zgradba atoma, elektronska zgradba atomov, periodni sistem elementov, kemijske vezi: molekulska Van der Waalsova, ionska, kovalentna, kovinska.
- *Zgradba trdnih snovi.*
Razpored atomov v trdnih snoveh, simetrija in kristalni sistemi, označevanje lege atomov, kristalografskih ravnin in smeri; Kovinski kristali, polimerni kristali.

Content (Syllabus outline):

- *Atom and chemical bond structure.*
Atomic structure, electronic structure of atoms, periodic table of elements, chemical bonds: molecular Van der Waals, ionic, covalent, metallic.
- *Structure of solids.*
Arrangement of atoms in solids, symmetry and crystal systems, labelling the position of atoms, crystallographic planes and directions;

- *Napake v kristalni zgradbi.*
Točkaste napake, črtne napake: robne in vijačne dislokacije, gibanje dislokacij, dislokacijsko utrjevanje; ploskovne napake: kristalne meje, meje dvojčkov; prostorske napake.
- *Mikrostruktura materialov.*
Vrste faz, vrste mikrostruktur.
Osnovne materialografske raziskovalne metode: optična, elektronska mikroskopija, mikroanaliza, rentgenska strukturna analiza.
- *Difuzija.*
Makroskopski opis difuzije, Fickova zakona, Mehanizmi difuzije.
- *Fazni diagrami.*
Fazna ravnotežja, fazno pravilo, termična analiza.
Binarni fazni diagrami: izomorfni fazni diagram popolne topnosti, fazni diagram z evtektično, peritektično in monotektično fazno reakcijo. Fazni diagram z evtektoidno, peritektoidno fazno reakcijo. Fazni diagram železo – ogljik. Vzvodno pravilo.
- *Strjevanje, nukleacija, rast faz, cepljenje.*
- *Fazne transformacije v trdnem.*
- *Plastična deformacija, deformacijsko utrjevanje, žarjenje.*
- *Mehanske lastnosti materialov.*
- *Jekla in neželezne kovine.*
- *Korozija.*
- *Materiali iz prahov.*
- *Polimerni materiali.*
- *Keramika.*
- *Kompoziti.*

- Metal crystals, polymer crystals.
- *Defects in crystal structure.*
Point defects, line defects: edge and screw dislocations, dislocation motion, dislocation hardening; planar defects: crystal boundaries, twin boundaries; spatial errors.
 - *Microstructure of materials.*
Types of phases, types of microstructures.
Basic materialographic research methods: optical and electron microscopy, microanalysis, X-ray structural analysis.
 - *Diffusion.*
Macroscopic description of diffusion, Fick's law, Mechanisms of diffusion.
 - *Phase diagrams.*
Phase equilibria, phase rule, thermal analysis.
Binary phase diagrams: isomorphous complete solubility phase diagram, phase diagram with eutectic, peritectic and monotectic phase reaction. Phase diagram with eutectoid, peritectoid phase reaction. Iron-carbon phase diagram. The lever rule.
 - *Solidification, nucleation, phase growth, splitting.*
 - *Phase transformations in the solid state.*
 - *Plastic deformation, strain hardening, annealing.*
 - *Mechanical properties of materials.*
 - *Steel and non-ferrous metals.*
 - *Corrosion.*
 - *Materials from powders.*
 - *Polymer materials.*
 - *Ceramics.*
 - *Composites.*

Temeljni literatura in viri / Readings:

Temeljna literatura/Basic literature

Kraut, B. (2019). Krautov strojniški priročnik. Ljubljana: Littera picta.

Obvezna:

Callister Jr, W. D. (2011). Materials Science and Engineering, John Willey & Sons, Inc, New York.

Abramovich, H. (2021). Intelligent Materials and Structures. Walter de Gruyter GmbH & Co KG.

Priporočljiva literatura/Recommended

Zupanič, F., Anželj, I. (2007) *Gradiva*. Maribor: Fakulteta za strojništvo.

Jež, M. et al. (1998). Strojno tehnološki priručnik. Ljubljana: Tehniška založba Slovenije.
Glavič, P. (2001). Gradiva. Maribor: Fakulteta za kemijo in kemijsko tehnologijo.
Ashby, M.F. (2011). Materials Selection in Mechanical Design, London: Elsevier.

Cilji in kompetence:

Cilji: spoznati teoretične osnove materialov, pridobiti znanje za samostojno analizo in sintezo različnih materialov, ki se danes uporabljajo doma in v tujini.

Učna enota prispeva predvsem k razvoju naslednjih splošnih in specifičnih kompetenc:

- sposobnost evidentiranja problema in njegove analize ter predvidevanja operativnih rešitev v tehnološkem smislu,
- sposobnost obvladovanja standardnih razvojnih metod, postopkov in procesov,
- sposobnost uporabe pridobljenega teoretičnega znanja v praksi,
- avtonomnost v strokovnem delu s področja tehnologij in sistemov,
- sposobnost razumevanja in uporabe sodobnih teorij s področja tehniških, tehnoloških in naravoslovnih ved,
- sposobnost matematičnega razumevanja tehničnih problemov in uporaba matematike pri reševanju le-teh,
- sposobnost reševanja konkretnih delovnih problemov na področju tehnologij, materialov in uporabe različnih materialov v praksi,
- sposobnost stalne uporabe informacijske in komunikacijske tehnologije na svojem strokovnem področju,
- poznavanje mehanskih in kemičnih lastnosti materialov, njihove uporabe in metod predelave,
- aktivno in kritično spremljanje razvoja novih metod uporabe materialov na področju tehnologij in sistemov s poudarkom na ekologiji.

Objectives and competences:

Objectives: to learn the theoretical basis of materials, to acquire knowledge for independent analysis and synthesis of various materials that are used today at home and abroad.

The learning unit mainly contributes to the development of the following general and specific competences:

- the ability to grasp and analyse a problem, as well as foresee operational solutions in the technological sense or in the process of organisation and management;
- the ability to master standard development methods, procedures and processes;
- the ability to use acquired theoretical knowledge in practice;
- autonomy in professional work in the field of technologies and systems;
- the ability to understand and apply modern theories in the fields of technical, technological and natural sciences,
- the ability to mathematically understand technical problems and use mathematics to solve them,
- the ability to solve concrete work problems in the fields of technologies, materials and the use of various materials in practice,
- the ability to continuously use information and communication technology in one's professional field,
- knowledge of the mechanical and chemical properties of materials, their use and processing methods,
- active critical monitoring of the development of new methods of using materials in the field of technologies and systems with an emphasis on ecology and sustainable development.

Predvideni študijski rezultati:

Znanje in razumevanje:

Študent/študentka:

- pozna in razume osnovne zakonitosti materialov,
- pozna delitev jekel ter njihovo uporabo in obdelovalnost,
- pozna delitev ostalih železnih zlitin in njihovo uporabo,
- se seznani z neželeznimi kovinami in njihovimi zlitinami ter uporabo,
- se seznani s tehnologijo pridobivanja sintranih gradiv in uporabo le-teh,
- spozna polimerne materiale in se seznani z njihovo uporabo,
- spozna keramične in ostale materiale,
- sposoben bo oceniti in izbrati najugodnejši material za konstrukcije, orodja, izdelke itd.,
- na osnovi preiskave materiala in laboratorijskih vaj zna oceniti obnašanje materiala, vgrajenega v izdelek,
- zna načrtovati, uporabiti standarde, uporabiti literaturo in samostojno načrtovati proizvodni proces s področja izdelave in uporabe materialov,
- razume proces korozije in jo zna preprečiti na izdelkih.

Intended learning outcomes:

Knowledge and understanding:

Student:

- knows and understands the basic laws of materials,
- knows the classification of steels and their use and processing,
- knows the classification of other iron alloys and their use,
- knows the non-ferrous metals and their alloys and their use,
- learns the technique of extraction of sintered materials and their use,
- learns about polymeric materials and their use,
- gets acquainted with ceramic and other materials,
- is able to evaluate and select the most favorable material for constructions, tools, products, etc.,
- is able to evaluate the behavior of the material used in the product on the basis of material test and laboratory exercises,
- knows how to plan, apply standards, use literature and independently plan the production process in the field of manufacturing and use of materials,
- understands the process of corrosion and knows how to prevent it on products.

Metode poučevanja in učenja:

- predavanja z aktivno udeležbo študentov (razlaga, diskusija, vprašanja, reševanje nalog) ob pomoči sodobnih pedagoških pripomočkov,
- avditorne vaje za poglobljanje teoretičnih osnov,
- individualne in skupinske konzultacije,
- laboratorijske vaje, ki potekajo v ustrezno opremljenem laboratoriju.

Learning and teaching methods:

- lectures with the active participation of students (explanation, discussion, questions, solving tasks) with the help of modern teaching aids,
- auditory tutorials to deepen the theoretical foundations,
- individual and group consultations,
- laboratory tutorials that take place in an appropriately equipped laboratory.

Načini ocenjevanja:	Delež (v %) / Weight (in %)	Assessment:
<p>Način (pisni izpit, ustno izpraševanje, naloge, projekt):</p> <ul style="list-style-type: none"> • pogoj za opravljanje pisnega izpita so pozitivno ocenjene laboratorijske vaje, • končna ocena izpita je povprečje rezultata pisnega dela in ustnega zagovora. 		<p>Type (examination, oral, coursework, project):</p> <ul style="list-style-type: none"> • a condition for passing the written exam is positively evaluated laboratory tutorials, • the final grade of the exam is the average of the results of the written work and the oral defense.