UČNI NAČRT PREDMETA / COURSE SYLLABUS	
Predmet:	ZGRADBA IN LASTNOSTI TRDNIN
Course Title:	STRUCTURE AND PROPERTIES OF SOLIDS

Študijski program in stopnja Study Programme and Level	Študijska smer Study Field	Letnik Academic Year	Semester Semester
UŠP Kemija, 1. stopnja	**/**	**1.**	**2.**
USP Chemistry, 1st Cycle	**/**	**1st**	**2nd**

Vrsta predmeta / Course Type:	obvezni / Mandatory
Univerzitetna koda predmeta / University Course Code:	KE110

Predavanja Lectures	Seminar Seminar	Vaje Tutorial	Klinične vaje Work	Druge oblike študija	Samost. delo Individual Work	ECTS
30	**15**	**30 LV**	**/**	**/**	**75**	**5**

Nosilec predmeta / Lecturer:	izr. prof. dr. Amalija Golobič / Dr. Amalija Golobič, Associate Professor
Jeziki / Languages:	**Predavanja / Lectures:** **slovenski / Slovenian** **Vaje / Tutorial:** **slovenski / Slovenian**

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:	**Prerequisites:**
Študent oz. kandidat mora imeti predmet opredeljen kot študijsko obveznost.	The course has to be assigned to the student.

Vsebina:	**Content (Syllabus outline):**
Amorfna in kristalinična zgradba trdnin, osnove kristalografije (periodičnost kristalov, kristalna mreža, osnovna celica, centriranost, simetrija, simetrijski elementi in njihove kombinacije, točkovne skupine, prostorske skupine). Mehanske, optične, električne in magnetne lastnosti trdnin in njihov izvor. Pregled in primerjava osnovnih strukturnih tipov anorganskih trdnin (kovine in zlitine, najgostejša sklada, strukture elementov, ionske strukture s stehiometrijami od AX do A2BX4, silikati). Pri vseh strukturah tudi primerjava njihovih lastnosti in možnosti načrtnega spreminjanja le-teh z modifikacijo	Amorphous and crystalline structure of solids, basics of crystallography (periodicity, crystallographic net, unit cell, centering, symmetry, symmetry elements ant their combinations, point groups, space groups). Mechanical, optical, electrical and magnetic properties of solids and their origin. Overview and comparison of the basic structural types of inorganic solids (metals and alloys, closest packing, structures of the elements, ionic structures with stoichiometries from AX to A_2BX_4, silicates). Comparison of structures and properties of solids and possibilities of planned changes of properties by structural modifications. Defects in crystals and their

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sestave oz. strukture. Napake v kristalih in njihov vpliv na lastnosti. Teorija difrakcijskih metod (rentgenski žarki, nevtroni, pospešeni elektroni, sipanje na elektronih in atomih, interferenca, kristalne ravnine, indeksi, Braggova enačba, Braggov pogoj, nastanek uklonske slike na monokristalu in polikristaliničnem materialu, recipročna mreža, interpretacija uklonske slike). Uporaba difrakcije (rentgenski praškovni difraktogram, kvalitativna in kvantitativna fazna analiza, indeksiranje, natančno merjenje parametrov osnovne celice). Uporaba elektronske mikroskopije za karakterizacijo trdnin.	influence on properties. Theory of diffraction methods (X-rays, neutrons, electrons, scattering on electrons and atoms, interference, crystal planes, Miller indices, Bragg equation, Bragg condition, diffraction pattern of single crystal and polycrystalline material, reciprocal net, interpretation of the diffraction pattern). Application of diffraction (X-ray powder pattern, qualitative and quantitative phase analysis, indexing, precise determination of unit cell parameters). Application of electron microscopy for the characterization of solids.

Temeljna literatura in viri / Readings:

R. Tilley: Crystals and crystal structures, John Wiley and Sons, Chicester, England 2007, pp. 1-180 of 255.
U. Mueller: Inorganic Structural Chemistry, John Wiley & Sons, pp 36-60, 93-115, 146-183 of 264.
A. Meden, A. Golobič: Zgradba in lastnosti trdnin – vaje, 2011

Cilji in kompetence:	**Objectives and Competences:**
Cilji: Razumevanje osnovnih načel atomske zgradbe trdnih snovi ter povezave med zgradbo in lastnostmi. Poznavanje strukturnih tipov in lastnosti široko uporabljanih trdnin. Poznavanje osnov difrakcijske teorije in elektronske mikroskopije. **Kompetence:** Sposobnost interpretacije atomske zgradbe in na njeni osnovi zmožnost načrtovanja spreminjanja lastnosti danega materiala. Samostojna interpretacija rentgenskega praškovnega difraktograma in izvedba kvalitativne fazne analize. Sposobnost osnovne interpretacije in uporabe rezultatov vrstične in transmisijske elektronske mikroskopije.	*Objectives:* Understanding the basic principles of the atomic structure of solids and the dependence of the properties on the structure. Knowledge of the structure types and properties of commonly used solids. Knowledge of the basic principles of diffraction and electron microscopy. *Competences:* Ability to interpret atomic structure and on this basis predict simple structure-property changes. Interpretation of X-ray powder diffraction pattern and accomplishment of qualitative phase analysis. Basic ability to interpret and use the results of the scanning and transmission electron microscopy.

Predvideni študijski rezultati:	**Intended Learning Outcomes:**
<u>Znanje in razumevanje</u> Poznavanje osnovnih strukturnih tipov trdnin in njihovih glavnih lastnosti. Razumevanje odvisnosti lastnosti trdnin od njihove atomske zgradbe.	<u>Knowledge and Comprehension</u> Knowledge of basic structural types of solids and their main properties. Understanding of the dependence of the properties of solids on their structure.

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Osnovno razumevanje rentgenske difrakcije in elektronske mikroskopije.	Basic understanding of X-ray diffraction and electron microscopy.
Uporaba Načrtovanje ciljnega spreminjanja lastnosti trdnin. Identifikacija prisotnih faz v polikristalinični zmesi. Uporaba rezultatov elektronske mikroskopije za karakterizacijo trdnin.	Application The planning of changing of properties of solids. Phase identification of polycrystalline mixtures. The application of results of electron microscopy for the characterisation of solids.
Refleksija Identifikacija problemov, ki so rešljivi z uporabo kristalografskih metod ali elektronske mikroskopije ali kombinacije obojega.	Analysis The identification of problems, which can be solved by the application of crystallographic methods or by electron microscopy or by the combination of both.
Prenosljive spretnosti Samostojno in skupinsko delo za dosego določenega cilja (rezultata). Samostojno iskanje podatkov in virov znanja v literaturi, bazah podatkov in na spletu.	Skill-transference Ability Individual and group work for achieving results. Individual search for data and sources of knowledge in the literature, databases and world wide web.

Metode poučevanja in učenja:	**Learning and Teaching Methods:**
Predavanja, vaje (samostojne in v paru), prostovoljne individualne naloge.	Lectures, tutorials (individual and in pairs) and voluntary individual exercises.

Načini ocenjevanja:	Delež (v %) / Weight (in %)	**Assessment:**
- Pisni izpit (izpit je mogoče opraviti tudi s pozitivno oceno dveh pisnih testov, ki se pišeta sredi in ob koncu semestra). Pogoj za pristop k pisnemu izpitu so opravljene vaje, vključno s pozitivnim kolokvijem iz vaj.	**60**	- Written exam (written exam can be accomplished also by achieving positive grades from two written tests). Positive grade of tutorial work (including with positive colloquium) is necessary before writing the exam.
-Kolokvij iz vaj.	**40**	- Colloquium from tutorial work.
-Testi pripravljenosti na vaje.		- Tests of preparedness for tutorial work.
- Ocena: 6-10 (pozitivno) in 1-5 (negativno)		- Grade: 6-10 (pozitive) and 1-5 (negative)

Reference nosilca / Lecturer's references:

- GOLOBIČ, Amalija*, ŠKAPIN, Srečo D., SUVOROV, Danilo, MEDEN, Anton. Solving structural problems of ceramic materials. *Croatica chemica acta*, ISSN 0011-1643, 2004, vol. 77, no. 3, str.

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435-446.
- KASUNIČ, Marta, MEDEN, Anton, ŠKAPIN, Srečo D., SUVOROV, Danilo, **GOLOBIČ, Amalija***. Order-disorder of oxygen anions and vacancies in solid solutions of La2TiO5 and La4Ga2O9. *Acta crystallogr., B Struct. sci***.,** 2009, vol. B65, no. 5, str. 558-566.
- KASUNIČ, Marta, MEDEN, Anton, ŠKAPIN, Srečo D., SUVOROV, Danilo, **GOLOBIČ, Amalija***. Structure of LaTi2Al9O19 and reanalysis of the crystal structure of La3Ti5Al15O37. *Acta crystallogr., B Struct. sci.*, 2011, vol. B67, no. 6, str. 455-460.

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