

UČNI NAČRT PREDMETA / COURSE SYLLABUS

Predmet:	KEMIJA IN TEHNOLOGIJA KERAMIKE IN SILIKATOV
Course Title:	CHEMISTRY AND TECHNOLOGY OF CERAMICS AND SILICATES

Študijski program in stopnja Study Programme and Level	Študijska smer Study Field	Letnik Academic Year	Semester Semester
MAG Kemijsko inženirstvo, 2. stopnja	/	2.	4.
USP Chemical Engineering, 2 nd Cycle	/	2 nd	4 th

Vrsta predmeta / Course Type: izbirni strokovni / Elective Professional

Univerzitetna koda predmeta / University Course Code: IN2108

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

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

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

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:

Keramika:
 Ponovitev osnov, kristalografske značilnosti in osnovne strukture, visokotemperaturna fazna ravnovesja, reakcijska kinetika, sintranje, razvoj mikrostrukture, proizvodne tehnologije, inženirska in elektronska keramika, kompoziti, biokeramika, sodobni keramični materiali in nanotehnologije

Stekla:
 zgodovinski pregled stekel, Evansova, Zachariasova in Goldschmitova teorija, struktura stekla, strukturni elementi, nukleacija in kristalizacija, ločevanje v faze, viskoznost in površinska napetost, optične in mehanske lastnosti, vrste stekel, tehnologije

Content (Syllabus outline):

Ceramics:
 Revision of fundamentals, crystallographic properties and basic structures, high-temperature phase equilibria, reaction kinetics, development of the microstructure, production technologies, engineering and electronic ceramics, composites, bioceramics, modern ceramic material and nano technologies.

Glass:
 Historical overview of glass making, Evans, Zacharias and Goldschmit theory, structure of glass, structural elements, nucleation and crystallisation, phase separation, viscosity and surface tension, optical and mechanical properties, types of glass, technology of glass

izdelave stekel, uporaba stekel, steklokeramika, biostekla, vlakna, glazure, emajli.
Hidravlična veziva:
zgodovinski pregled, surovine, reakcijski produkti, hidratacija, vezenje in strjevanje, tipi cementa, mineralna sestava, kemijske in fizikalne lastnosti, tehnologija izdelave, Portlandski cement, aluminatni cement, pucolanski in elektrofilterski cement.

making, applications, glass ceramics, fibres, glazes, enamels.
Hydraulic binders:
Historical overview, raw materials, reaction products, hydration, bonding and solidification, types of cement, mineral composition, chemical and physical properties, production technology, Portland cement, aluminate cement, pozzolan and fly-ash cement.

Temeljna literatura in viri / Readings:

1. Ceramic Materials, Science and Engineering, C.B. Carter, M.G.Norton, 2nd ed., Springer, 2013 (60%) 764 strani (60%)
2. Introduction to Glass Science and Technology, J.E.Shelby, The Royal Society of Chemistry, Cambridge, 2005 297 strani (20%)
3. Concrete – Microstructure, Properties, and Materials, P.Kumar Mehta, Paulo J.M.Monteiro, 4th ed., McGraw-Hill Education, 2014, 675 strani (20%)

Cilji in kompetence:

Cilji:
Predmet študente spoznava s področjem anorganskih nekovinskih materialov, ki je pomembno za številne slovenske industrijske organizacije. Vsebina predmeta uvaja študente v sestavo, strukturo, vrste in lastnosti ter tehnologije izdelave keramik in stekel. Seznanja ga z osnovnimi kemijskimi in fizikalnimi lastnostmi, principi izdelave in procesiranjem ter z načini uporabe anorganskih nekovinskih materialov. Predmet podaja tudi osnovna znanja o glazurah in emajlih ter hidravličnih vezivih.

Specifične kompetence:

Med izvajanjem predmeta se bo študent naučil logično povezovati sestavo in strukturo anorganskih nekovinskih materialov ter jih povezati z lastnostmi in možnostmi uporabe. Seznanil se bo tudi z vrstami in mehanizmi utrjevanja hidravličnih veziv s poudarkom na cementih. S tem bo pridobil znanja, ki jih lahko uporabi v proizvodnih in razvojnih enotah s področja materialov.

Objectives and Competences:

Introduction to inorganic non-metal materials, relevant to Slovenian industry. Students learn about the composition, structure, types, properties and technology of making ceramics and glass. This involves basic chemical and physical properties, technological principles and processing and applications of inorganic non-metal materials. The course provides bases on glazes and enamels and hydraulic binders. Subject-specific competences include: Making logical correlations between the composition and structure of inorganic non-metal materials and properties with possible applications; types and mechanisms of hardening of hydraulic binders with special emphasis on cements; making use of the knowledge acquired in processing and development units in the area of materials.

Predvideni študijski rezultati:

Intended Learning Outcomes:

<u>Znanje in razumevanje</u> Predmet študentu daje znanje potrebno za razumevanje strukture in lastnosti keramike in stekel ter procesov njihove izdelave.	<u>Knowledge and Comprehension</u> Knowledge needed to correlate structure and processing parameters with properties of ceramics and glasses.
<u>Uporaba</u> Študent pridobi ustrezna osnovna znanja za razvojno in/ali tehnološko delo v različnih industrijskih ali raziskovalnih institucijah.	<u>Application</u> Students obtain necessary basic knowledge for integration in R&D and engineering groups in industrial and R&D institutions.
<u>Refleksija</u> Študent bo pridobil teoretična spoznanja s področja anorganskih nekovinskih materialov, ki jih bo lahko praktično uporabil v tehnologiji.	<u>Analysis</u> Students should be able to use theoretical knowledge in the field of ceramics, glasses and concrete for solving technological problems.
<u>Prenosljive spretnosti</u> Iskanje primerne literature in pisanje seminarskih nalog; kritična izbira informacij iz literature za opis in razlago specifičnega problema; predstavitev seminarjev ostalim študentom.	<u>Skill-transference Ability</u> Literature search; preparation and presentation of seminars; critical evaluation and selection of important data from literature for given specific problem.

Metode poučevanja in učenja:

Predavanja in seminarji.

Learning and Teaching Methods:

Lectures and seminar.

Načini ocenjevanja:

Pisni in ustni izpit 80%
Seminar 20%

Delež (v %) /

Weight (in %) **Assessment:**

Reference nosilca / Lecturer's references:

- MARINŠEK, Marjan**, MEDEN, Anton, SKALAR, Tina, POČKAJ, Marta. The novel crystal structure with $Zr_{60}O_{4(OH)_4}$ core and hydrazine carboxylate ligands, and its thermal properties. Acta chimica slovenica, 2014, vol. 61, no. 3, str. 439-446
- MARINŠEK, Marjan**. Ni-YSZ substrate degradation during carbon deposition. Boletín de la Sociedad Española de Cerámica y Vidrio, 2011, vol. 50, no. 3, str. 117-124
- MAČEK, Jadran, NOVOSEL, Barbara, **MARINŠEK, Marjan**. Ni-YSZ SOFC anodes : minimization of carbon deposition. V: MAČEK, Marjeta (ur.), SUVOROV, Danilo. Refereed reports of IX Conference & Exhibition of the European Ceramic Society : 19-23 June 2005, Portorož, Slovenia, (Journal of the European ceramic society, vol. 27, no. 2-3, 2007). Amsterdam: Elsevier, 2007, vol. 27, no. 2/3, str. 487-491