UČNI NAČRT PREDMETA / COURSE SYLLABUS	
Predmet:	ANALIZNA KEMIJA 1
Course Title:	ANALYTICAL CHEMISTRY 1

Študijski program in stopnja Study Programme and Level	Študijska smer Study Field	Letnik Academic Year	Semester Semester
VSŠP Kemijska tehnologija, 1. stopnja	/	2.	3.
PSP Chemical Technology, 1st Cycle	/	2nd	3rd

Vrsta predmeta / Course Type: obvezni / Mandatory

Univerzitetna koda predmeta / University Course Code: KT115

Predavanja Lectures	Seminar Seminar	Vaje Tutorial	Klinične vaje Work	Druge oblike študija	Samost. delo Individual Work	ECTS
45	15	15 LV	/	/	75	5

Nosilec predmeta / Lecturer: doc. dr. Mitja Kolar / Dr. Mitja Kolar, Assistant 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):
- Uvod (opredelitev in pomen analizne kemije, delitve na področju analizne kemije in temeljni analizni pojmi, kemik analitik pričakovane lastnosti). - Stopnje celovitega analiznega procesa (splošno opredeljen problem, analizno oblikovano vprašanje, izbira metode, odvzem vzorca, transport in shranjevanje, priprava vzorca, meritev, vrednotenje rezultatov, oblikovanje sklepov in dokumentacija). - Rezultat v analizni kemiji in vrednotenje rezultatov (aritmetična sredina, mediana, modus, zaokroževanje in signifikantna mesta, standardni odklon in izpeljanke, merilna negotovost, pravilnost in ponovljivost rezultatov, vrste napak, zagotavljanje sledljivosti rezultatov do osnovnega merskega sistema, zahteva po zanesljivih rezultatih). - Metode kalibracije (metoda kalibracijske premice,	- Introduction (definition and role of analytical chemistry, classifications in analytical chemistry, terminology, essential skills and abilities of an analytical chemist). - The total analytical process (general definition of a problem, specific analytical statement of a problem, selection of a procedure, sampling, sample transport and storage, sample preparation, measurement, evaluation of data, conclusions and report). - Results in analytical chemistry – evaluation and presentation (arithmetic mean, median, mode, significant figures, standard deviation and derived statistical parameters, measurement uncertainty, accuracy, precision, sources and types of errors, traceability,

metoda standardnih dodatkov, metoda internega standarda, linearna regresija). - Izbira in vpeljava analizne metode (parametri za vrednotenje metode, vidik ekonomičnosti, pomen validacije metode, zagotavljanje kakovosti, nadzorni grafi). - Razvojne smeri v analizni kemiji (miniaturizacija in on-line senzorji, spremljanje meritev na daljavo, avtomatizacija in robotizacija, vezave instrumentov v mreže, resnično inteligentni analizni sistemi, kompleksne metode za reduciranje podatkov). - Gravimetrija (stopnje gravimetričnega postopka, vzroki nečistoč, primeri gravimetričnih določitev). - Titrimetrija (Delitev glede na merjeno količino za nadzor nad dodanim titrirnim sredstvom, kemijsko osnovo in načine ugotavljanje končne točke. Obarjalne titracije: potek titracijske krivulje, načini ugotavljanja končne točke, primeri določitev. Nevtralizacijske titracije: potek titracijske krivulje za različne primere titracij, analizna uporaba in omejitve. Kompleksometrične titracije: titritna sredstva, načini ugotavljanja končne točke, analizne aplikacije. Redoks titracije: potek titracijske krivulje, vrste indikatorjev, analizne aplikacije.) Vaje: Identifikacijske reakcije analiznega pomena.	requirements for reliable results). - Methods of calibration (method of calibration function, method of standard additions, method of internal standard, linear regression). - Selecting and introducing analytical methods into laboratory practice (characteristics of analytical methods, method validation, quality assurance and quality control, control charts, financial aspects). - Development in analytical chemistry (miniaturisation, on-line sensors, remote sensing, automatization, robotization, intelligent analytical systems, networking of analytical instruments, complex methods of data reduction). - Gravimetric analytical methods (gravimetric procedure, sources of impurities, examples of analytical applications) - Titrimetric analytical methods (Subcategories concerning measuring quantity, end point determination and chemical background. Precipitation titrations: titration curve, indication of the end point of titration, analytical applications. Neutralisation titrations: titration curve, applications and limitations. Complexometric titrations: titration reagents, indication of the end point of titration, analytical applications. Reduction-oxidation titrations: titration curve, types of indicators, analytical applications.) Laboratory practical – identification reactions of analytical importance.

Temeljna literatura in viri / Readings:

- Gary D. Christian, Analytical Chemistry, Willey, 5th edition or later. 228 pages.

Cilji in kompetence:	**Objectives and Competences:**
Pri predmetu študent osvoji temelje analizne kemije, spozna analizni pristop in temelje in uporabo klasičnih analiznih metod ter se usposobi za vrednotenje rezultatov in uporabo metod kalibracije.	Student learns the fundamentals of analytical chemistry, analytical approach and classical analytical methods and develops skills necessary for evaluation of analytical results and calibration.
Predvideni študijski rezultati:	**Intended Learning Outcomes:**
Znanje in razumevanje Študent razume temelje analizne kemije in analizni pristop ter osnovo in uporabo klasičnih analiznih	Knowledge and Comprehension Student understands the fundamentals of analytical chemistry, analytical approach and

metod.	background and applications of classical analytical methods.
Uporaba Študent zna podajati in vrednotiti analizne rezultate ter razlikuje med različnimi metodami kalibracije. Študent obvlada računske vidike obravnavanih analiznih metod.	Application Student develops ability of presenting and evaluating analytical results and differentiates calibration methods. Student masters calculation procedures related to the classical analytical methods.
Refleksija Študent ima kritičen odnos do analiznega rezultata in obravnavanih analiznih metod.	Analysis Student develops critical attitude towards analytical results and analytical methods.
Prenosljive spretnosti Zmožnost statističnega vrednotenja rezultatov, uporaba linearne regresije.	Skill-transference Ability Statistical evaluation of results and linear regression.

Metode poučevanja in učenja:	**Learning and Teaching Methods:**
Predavanja, vodeni razgovor, sodelovalno učenje, reševanje problemov.	Lectures, guided discussions, cooperative learning, problem solving.

Načini ocenjevanja:	Delež (v %) / Weight (in %)	**Assessment:**
Vaje: uspešno opravljen praktični preizkus iz identifikacije ionov je predpogoj za uspešno opravljene vaje in pristop h kolokviju. Praktični preizkus in kolokvij imata enako težo pri končni oceni vaj. Predmet: Pisni izpit. Predpogoj za izpit so uspešno zaključene vaje.	Končna ocena: Vaje 33,3 % Izpit 66,7 %	Tutorial: successfully accomplished assessment in identification of ions is a precondition to sit the written assessment. Both assessments contribute equally to the grade of the tutorial. Lectures: Written exam. Successfully accomplished tutorial is a precondition to sit the exam.

Reference nosilca / Lecturer's references:

- JERENEC, Simona, ŠIMIĆ, Mario, SAVNIK, Aleš, PODGORNIK, Aleš, **KOLAR, Mitja**, TURNŠEK, Marko, KRAJNC, Peter. Glycidyl methacrylate and ethylhexyl acrylate based polyhipe monoliths : morphological, mechanical and chromatographic properties. Reactive & functional polymers, ISSN 1381-5148. [Print ed.], 2014, vol. 78, str. 32-37, doi: 10.1016/j.reactfunctpolym.2014.02.011. [COBISS.SI-ID 17661718]
- BRGLEZ, Polonca, HOLOBAR, Andrej, PIVEC, Aleksandra, **KOLAR, Mitja**. Spin-coating for optical-oxigen-sensor preparation = Uporaba spinskega nanosa pri izdelavi optičnih senzorjev za kisik. Materiali in tehnologije, ISSN 1580-2949. [Tiskana izd.], mar.-apr. 2014, letn. 48, št. 2, str. 181-188. [COBISS.SI-ID17746454],
- **KOLAR, Mitja**, DOLIŠKA, Aleš, ŠVEGL, Franc, KALCHER, Kurt. Tungsten - tungsten trioxide electrodes for the long-term monitoring of corrosion processes in highly alkaline media and concrete-based materials. Acta chimica slovenica, ISSN 1318-0207. [Tiskana izd.], 2010, vol. 57, no. 4, str. 813-820, graf. prikazi.http://acta.chem-soc.si/57/57-4-813.pdf. [COBISS.SI-ID 14701078]

UČNI NAČRT PREDMETA / COURSE SYLLABUS	
Predmet:	ANALIZNA KEMIJA 2
Course Title:	ANALYTICAL CHEMISTRY 2

Študijski program in stopnja Study Programme and Level	Študijska smer Study Field	Letnik Academic Year	Semester Semester
VSŠP Kemijska tehnologija, 1. stopnja	/	2.	4.
PSP Chemical Technology, 1st Cycle	/	2rd	4th

Vrsta predmeta / Course Type: obvezni / Mandatory

Univerzitetna koda predmeta / University Course Code: KT130

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

Nosilec predmeta / Lecturer: doc. dr. Mitja Kolar / Dr. Mitja Kolar, Assistant 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):
Elektrokemijske metode: - Potenciometrija (značilnosti metode, merilni sistem, referenčne, konvencionalne in ionskoselektivne elektrode ter njihova analizna uporaba, prijemi za potenciometrično določanje koncentracije neke zvrsti, potenciometrične titracije) - Voltametrija (značilnosti metode, merilni sistem, voltamogram, polarografija, hidrodinamska voltametrija, uporaba v pretočnih in titracijskih sistemih, voltametrični oz. amperometrični senzorji) - Konduktometrija (značilnosti metode, analizna uporaba) - Kulometrija (značilnosti metode, analizna uporaba) Spektroskopske metode:	Electrochemical methods: - Potentiometry (method characteristics, measuring system, types of electrodes, approaches for determining concentration, potentiometric titrations) - Voltametry (method characteristics, measuring system, voltamogram, polarography, hydrodynamic voltametry, applications in flow systems and titrimetry, voltametric/amperometric sensors) - Conductometry (method characteristics, analytical applications) - Coulometry (method characteristics, analytical applications) Spectroscopic methods: - Molecular absorption spectrometry (method

- Molekularna absorpcijska spektrometrija (značilnosti metode, različne gradnje spektrometrov in preverjanje spektrometra, Beer-Lambertov zakon in njegova veljavnost, uporaba spektrometrije v UV-VIS in IR področju, diferenčna spektrometrija) - Molekularna fluorescenčna spektrometrija (temelj metode, instrument, uporaba) - Plamenska emisijska spektrometrija (temelj metode, plamenski spektormeter, značilnosti metode in uporaba) - Atomska emisijska spektromerija (spektrografska analiza, spektroskopske tehnike na osnovi induktivno sklopljene plazme) - Atomska absorpcijska spektrometrija (temelj metode, atomski absorpcijski spektrometer s plamensko oz. elektrotermično atomizacijo, značilnosti metode in uporaba) - Pregled drugih pogostih spektroskopskih metod Vaje osvetlijo praktične vidike analiznih vsebin obravnavanih v tem in predhodnem semestru. Pri vajah se študent usposobi za uporabo klasičnih in instrumentalnih analiznih metod ter uporabi že pridobljena znanja s področja kalibracije in vrednotenja rezultatov.	characteristics, different types of spectrometers, testing performance of a spectrometer, Beer-Lambert's Law and its limitations, UV-VIS and IR spectrometry, measurements at two or more wavelengths) - Molecular fluorescence spectrometry (fundamentals, instrumentation, applications) - Flame emission spectrometry (fundamentals, instrumentation, applications, characteristics of the method) - Atomic emission spectrometry (spectrographic analyses, spectroscopic techniques based on the inductively coupled plasma) - Atomic absorption spectrometry (fundamentals, spectrometer with flame and electrothermal atomisation, characteristics of the method, applications) - Other spectroscopic methods – an overview. Practical: Classical and instrumental analytical methods. Calibration and evaluation of analytical results.

Temeljna literatura in viri / Readings:

- Francis, Rouessac, Annick Rouessac, Chemical Analysis - Modern Instrumental Methods, Wiley, 2000, Chichester. Or later editions. Chapters 11 to 16 and 18 and 19. 153 pages.

Cilji in kompetence:	**Objectives and Competences:**
Študent pridobi znanja o elektrokemijskih in spektroskopskih analiznih metodah ter njihovi uporabi. Pri vajah se usposobi za praktično izvedbo klasičnih in instrumentalnih analiznih metod.	Students are acquainted with electrochemical and spectroscopic analytical methods and their applications and develop laboratory skills in classical and instrumental analytical methods.

Predvideni študijski rezultati:	**Intended Learning Outcomes:**
<u>Znanje in razumevanje</u> Študent razume temelje in uporabo obravnavanih analiznih metod.	<u>Knowledge and Comprehension</u> Student fosters understanding of fundamentals and applications of analytical methods.
<u>Uporaba</u> Študent zna izvesti analizne postopke in meritve vezane na obravnavane analizne metode ter ovrednotiti dobljene rezultate.	<u>Application</u> Application Student is able to perform analyses and evaluate analytical results.
<u>Refleksija</u> Študent je kritičen do dobljenih rezultatov in se zaveda omejitev analiznih metod.	<u>Analysis</u> Student develops a critical attitude towards analytical result and is aware of the limitation of

	analytical methods.
Prenosljive spretnosti Laboratorijske spretnosti, statistično vrednotenje in pravilno podajanje rezultatov.	Skill-transference Ability Laboratory skills, statistical methods, expression of analytical results.

Metode poučevanja in učenja:	**Learning and Teaching Methods:**
Predavanja, vodeni razgovor, sodelovalno učenje, reševanje problemov.	Lectures, guided discussions, cooperative learning, problem solving.

Načini ocenjevanja:	Delež (v %) / Weight (in %)	**Assessment:**
Vaje: kakovost analiznih rezultatov (33,3 %) in kolokvij (66,7 %). Uspešno zaključen praktični del je predpogoj za kolokvij. Predmet: Pisni izpit. Predpogoj za izpit so uspešno zaključene vaje.	Končna ocena: Vaje 33,3 % Izpit 66,7 %	Tutorial: quality of analytical results (33.3 %) written assessment (66.7 %). Successfully accomplished laboratory work is a precondition to sit the written assessment. Lectures: Written exam. Successfully accomplished tutorial is a precondition to sit the exam.

Reference nosilca / Lecturer's references:

1. HUŠ, Sebastjan, KOLAR, Mitja, KRAJNC, Peter. Separation of heavy metals from water by functionalized glycidylmethacrylate poly (high internal phase emulsions). Journal of chromatography. A, ISSN 0021-9673, 2016, vol. 1437, str. 168-175.
2. JERENEC, Simona, ŠIMIĆ, Mario, SAVNIK, Aleš, PODGORNIK, Aleš, KOLAR, Mitja, TURNŠEK, Marko, KRAJNC, Peter. Glycidyl methacrylate and ethylhexyl acrylate based polyhipe monoliths : morphological, mechanical and chromatographic properties. Reactive & functional polymers, ISSN 1381-5148. [Print ed.], 2014, vol. 78, str. 32-37.
3. KOLAR, Mitja, DOBČNIK, Danilo, RADIĆ, Njegomir. Chemically treated silver electrodes for the determination of cysteine. Mikrochimica acta, ISSN 1436-5073. [Online ed.], 2002, vol. 138, no 1-2, str. 23-27 15.

UČNI NAČRT PREDMETA / COURSE SYLLABUS	
Predmet:	ANALIZNA KEMIJA 3
Course Title:	ANALYTICAL CHEMISTRY 3

Študijski program in stopnja Study Programme and Level	Študijska smer Study Field	Letnik Academic Year	Semester Semester
VSŠP Kemijska tehnologija, 1. stopnja	**/**	**3.**	**5.**
PSP Chemical Technology, 1st Cycle	**/**	**3rd**	**5th**

Vrsta predmeta / Course Type: obvezni / Mandatory

Univerzitetna koda predmeta / University Course Code: KT131

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

Nosilec predmeta / Lecturer: izr. prof. dr. Nataša Gros / Dr. Nataša Gros, 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):
Separacijske metode: - Temelji kromatografije in delitev kromatografskih tehnik - Tekočinska kromatografija visoke ločljivosti (enote HPLC sistema, vrste polnitev kolon, normalno-fazna, reverzno-fazna, velikostno izključitvena kromatografija, vrste detektorjev, analizne aplikacije) - Ionska kromatografija (delitve ionske kromatografije, enote ionskega kromatografa, polnitve kolon, analizne aplikacije) - Tenkoplastna kromatografija (temeljni pojmi in izvedbe, identifikacija in kvantifikacija ločenih komponent, analizne aplikacije) - Plinska kromatografija (enote plinskega kromatografa, različne izvedbe injektorjev, vrste	Separation methods: - Fundamentals of chromatography, different chromatographic methods – an overview - High performance liquid chromatography (HPLC system, chromatographic columns, different techniques in HPLC, detection, analytical applications) - Ion chromatography (classification in ion chromatography, ion chromatographic systems, chromatographic columns, analytical applications) - Thin layer chromatography (terminology, designs, identification and quantification, analytical applications) - Gas chromatography (instrumentation, columns, detectors, analytical applications)

kolon, detektorji, analizne aplikacije) - Kapilarna elektroforeza (elektroforezne tehnike, elektro-osmotski tok, elektroferogram, analizne aplikacije) - Sklopitve kromatografskih tehnik z masnim spektrometrom Prikaz, vrednotenje in interpretacija analiznih rezultatov. - Box and Whisker graf, histogramski in poligonski prikazi, test normalne porazdelitve - Interval zaupanja in statistični testi (F-test, različne izvedbe t-testa, Q-test) - Uporaba linearne regresije za primerjavo rezultatov dveh metod. Vaje nadgradijo in razširijo nabor instrumentalnih analiznih metod, ki so jih študentje uporabljali pri vajah v drugem letniku in vključijo dodatne vidike vrednotenja in interpretacije rezultatov.	- Capillary electrophoresis (techniques, electro-osmotic flow, electroferogram, analytical applications) - Hyphenation of chromatographic techniques with mass spectrometry Presentation, evaluation and interpretation of analytical results - Box and Whisker graph, histogram, polygon, test of normal distribution - Confidence interval, statistical tests (F-test, t-test, Q-test) - Use of linear regression for a comparison of the results of two analytical methods. Laboratory class: Instrumental analytical methods and evaluation and interpretation of results.

Temeljna literatura in viri / Readings:

- Francis, Rouessac, Annick Rouessac, Chemical Analysis - Modern Instrumental Methods, Wiley, 2000, Chichester. Or later editions. Chapters 1 to 5 and 8. 106 pages.
- James N. Miller, Jane C. Miller, Statistics and Chemometrics for Analytical Chemistry, 6th Edition, Pearson Education, 2010, Harlow. Chapters 2, 3, 5.10, 6.2. 65 pages.

Cilji in kompetence:	**Objectives and Competences:**
Študent pridobi znanja o separacijskih analiznih metodah. Pri vajah se usposobi za praktično izvedbo dodatnega nabora instrumentalnih analiznih metod. Zmožnost predstavitve, vrednotenja in interpretacije rezultatov osvojene v drugem letniku študent razširi z dodatnimi statističnimi prijemi.	Understanding and knowledge of separation methods. Experimental skills and ability of using instrumental analytical methods. Upgraded knowledge in interpretation and evaluation of analytical results.

Predvideni študijski rezultati:	**Intended Learning Outcomes:**
<u>Znanje in razumevanje</u> Študent razume temelje in uporabo obravnavanih analiznih metod. Študent osvoji dodatna znanja za predstavitev, vrednotenje in interpretacijo analiznih rezultatov.	<u>Knowledge and Comprehension</u> Student fosters understanding of fundamentals and applications of analytical methods. Ability of evaluating, presenting and interpreting analytical results.
<u>Uporaba</u> Študent zna izvesti analizne postopke in meritve vezane na obravnavane analizne metode ter ovrednotiti dobljene rezultate.	<u>Application</u> Student is able to perform analyses and evaluate analytical results.

Refleksija Študent je kritičen do dobljenih rezultatov in se zaveda omejitev analiznih metod.	Analysis Student develops a critical attitude towards analytical result and is aware of the limitation of analytical methods.
Prenosljive spretnosti Laboratorijske spretnosti, statistično vrednotenje in interpretacija rezultatov.	Skill-transference Ability Laboratory skills, statistical methods, interpretation of analytical results.

Metode poučevanja in učenja:	**Learning and Teaching Methods:**
Predavanja, vodeni razgovor, sodelovalno učenje, reševanje problemov.	Lectures, guided discussions, cooperative learning, problem solving.

Načini ocenjevanja:	Delež (v %) / Weight (in %)	**Assessment:**
Vaje: Esej: »Ovrednotenje kakovosti naravne vode«. Predmet: Pisni izpit. Predpogoj za izpit so uspešno zaključene vaje.	Končna ocena: Vaje 33,3 % Izpit 66,7 %	Tutorial: Essay: "Evaluation of a natural water quality". Lectures: Written exam. Successfully accomplished tutorial is a precondition to sit the exam.

Reference nosilca / Lecturer's references:

- **GROS, Nataša**. Microdiffusion-based UV-LED spectrometric setup for determining low levels of ethanol in fruit juice. Talanta, ISSN 0039-9140. [Print ed.], 2011, vol. 87, no. 1, str. 174-179.
- **GROS, Nataša**, CAMÕES, Maria Filomena, OLIVEIRA, Cristina, SILVA, M. C. R. Ionic composition of seawaters and derived saline solutions determined by ion chromatography and its relation to other water quality parameters. Journal of chromatography. A, ISSN 0021-9673, 2008, vol. 1210, no. 1, str. 92-98.
- **GROS, Nataša**, VRTAČNIK, Margareta. A small-scale low-cost gas chromatograph. Journal of chemical education, ISSN 0021-9584, 2005, vol. 82, no. 2, str. 291-293 + supplemental material. [COBISS.SI-ID 1246044]

UČNI NAČRT PREDMETA / COURSE SYLLABUS	
Predmet:	ANORGANSKA KEMIJA
Course Title:	INORGANIC CHEMISTRY

Študijski program in stopnja Study Programme and Level	Študijska smer Study Field	Letnik Academic Year	Semester Semester
VSŠP Kemijska tehnologija, 1. stopnja	/	1.	2.
PSP Chemical Technology, 1st Cycle	/	1st	2nd

Vrsta predmeta / Course Type:	obvezni / Mandatory
Univerzitetna koda predmeta / University Course Code:	KT107

Predavanja Lectures	Seminar Seminar	Vaje Tutorial	Klinične vaje Work	Druge oblike študija	Samost. delo Individual Work	ECTS
60	15	/	/	/	75	5

Nosilec predmeta / Lecturer:	doc. dr. Saša Petriček / Dr. Saša Petriček, Assistant 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):
Periodni sistem kot osnova sistematike elementov in anorganskih spojin. **Vodik in kisik ter njune spojine** Vodik. Kisik. Voda. Vodikov peroksid. **VII. skupina periodnega sistema** Elementi VII. skupine. Spojine elementov VII. skupine z vodikom. Spojine s kisikom, oksokisline in oksosoli. **VI. skupina periodnega sistema** Elementi VI. skupine. Spojine elementov VI. skupine z vodikom. Oksidi in oksospojine žvepla. Spojine s halogeni.	Introduction: Periodic table of the elements. Hydrogen and oxygen and their compounds. Group 17 elements, hydrogen halides and their salts, oxoacids and their salts. Group 16 elements, compounds of sulphur. Group 15 elements, compounds of nitrogen and phosphorus. Group 14 elements, compounds of carbon, silicon, tin and lead. Group 13 elements, compounds of boron and aluminium. Group 1and 2 elements and their compounds. Compounds of d-elements, coordination and organometalic compounds.

V. skupina periodnega sistema
Elementi V. skupine periodnega sistema. Spojine elementov V. skupine z vodikom. Oksidi in oksospojine.

IV. skupina periodnega sistema
Elementi IV. skupine periodnega sistema. Spojine elementov IV. skupine z vodikom. Oksidi, oksospojine in soli.

III. skupina periodnega sistema
Elementi III. skupine periodnega sistema. Bor in njegove spojine. Aluminij in njegove spojine.

II. in I. skupina periodnega sistema
Elementi I. in II. skupine periodnega sistema. Kemizem zemeljskoalkalijskih kovin. Kemizem alkalijskih kovin.

Pregled kemije prehodnih elementov
d-orbitale in njihova vloga v kemiji prehodnih elementov. Sistematika prehodnih elementov. Elementi in njihove kemijske lastnosti. Oksidi, hidroksidi in oksokisline prehodnih elementov. Koordinacijske spojine.

Temeljna literatura in viri / Readings:

Temeljna literatura in viri / Readings:
- F. Lazarini, J. Brenčič: Splošna in anorganska kemija, Založba FKKT, Ljubljana, 2004, pages 262-513.

Cilji in kompetence:

Študenti pri predmetu spoznajo lastnosti elementov periodnega sistema in njihovih spojin. Periodni sistem elementov je študentu osnova razumevanja in ureditev velikega števila kemijskih zakonitosti in dejstev v obvladljivo shemo. Specifično, znanje anorganske kemije je kot osnovno kemijsko znanje potrebno za večino predmetov nadaljnjega študija. To znanje študentu omogoča strokoven pristop k analizi in reševanju problemov, s katerimi se bo kot kemik srečal pri delu.

Objectives and Competences:

Objectives: Understanding the basic principles of the properties and reactivity of inorganic compounds.
Competences: Ability to use periodic table of the elements for the systemization of properties of substances and their reactivity. The basic knowledge of inorganic chemistry is needed for most of the later courses and allows the students analysis and solving of chemical problems.

Predvideni študijski rezultati:

Znanje in razumevanje
Študent dobi osnovno znanje iz anorganske kemije, ki se nadgradi na predznanje iz predmeta Splošna kemija. Z uporabo zakonitosti splošne kemije je

Intended Learning Outcomes:

Knowledge and Comprehension
To the basic knowledge from General Chemistry course, the students add the understanding of the basic principles of the properties and

sposoben razumeti in v nekaterih primerih predvideti lastnosti anorganskih spojin.	reactivity of inorganic compounds.
Uporaba Znanje anorganske kemije je študent sposoben uporabiti pri drugih kemijskih predmetih. To znanje potrebuje pri reševanju problemov, za komunikacijo o kemijskih temah in za splošno strokovno izobrazbo.	Application The students are able to use the knowledge in other chemical courses, to solve chemical problems and to get broad chemical education.
Refleksija Študent je sposoben oceniti pomen teoretskega znanja za razlago eksperimentalnih dejstev in izkušenj. Pereča kemijska vprašanja bo znal ovrednotiti in najti potrebne dodatne podatke in znanja.	Analysis The student understand the importance of theoretical knowledge and experiments. They will be able to find additional data and knowledge to solve their tasks.
Prenosljive spretnosti Študent spozna, da je obstoječe znanje anorganske kemije nastalo z raziskovanjem snovi in da je raziskovalni način nastajanja znanja skupen večini področij. Znal bo ovrednotiti poplavo podatkov na spletu in najti relevantne vire podatkov. Sposoben bo zasnovati poskuse, znal bo izmeriti veličine in jih dokumentirati. Rezultate bo sposoben oceniti in razložiti.	Skill-transference Ability The students learned that vast amount of knowledge on inorganic compounds was gained by experimental work and that similar is valid for most scientific disciplines. He will be able to find relevant data on his topic of interest. He will be able to design experiments, document the measurements and evaluate the results.

Metode poučevanja in učenja:	**Learning and Teaching Methods:**
Predavanja in seminarji.	Lectures and seminars.

Načini ocenjevanja:	Delež (v %) / Weight (in %)	**Assessment:**
Pisni izpit.		Written exam.

Reference nosilca / Lecturer's references:

- DEMŠAR, Alojz, KOŠMRLJ, Janez, **PETRIČEK, Saša**. Variable-temperature nuclear magnetic resonance spectroscopy allows direct observation of carboxylate shift in zinc carboxylate complexes. Journal of the American Chemical Society, 2002, vol. 124, no. 15, str. 3951-3958, ISSN 0002-7863.
- **PETRIČEK, Saša**. Syntheses of lanthanide bromide complexes from oxides and the crystal structures of [LnBr[sub]3(DME)[sub]2] (Ln = Pr, Nd, Sm, Eu), [LnBr[sub]3(THF)[sub]4] (Ln = Pr, Sm) and [EuBr[sub]2(THF)[sub]5][EuBr[sub]4(THF)[sub]2]. Polyhedron, 2004, vol. 23, no. 14, str. 2293-2301, ISSN 0277-5387.
- **PETRIČEK, Saša**, DEMŠAR, Alojz. Syntheses and crystal structures of manganese, nickel and zinc chloride complexes with dimethoxyethane and di(2-methoxyethyl) ether. Polyhedron, 2010, vol. 29, no. 18, str. 3329-3334, ISSN 0277-5387.
- **PETRIČEK, Saša**. Syntheses and crystal structures of lanthanide chloride complexes with diglyme. Zeitschrift für anorganische und allgemeine Chemie, 2008, no. 2, vol. 634, str. 377-381, ISSN 0044-2313.
- **PETRIČEK, Saša**. Octahedral and tetrahedral cobalt(II) sites in cobalt chloride complexes with polyethers. Croatica chemica acta, 2011, vol. 84, no. 4, str. 515-520, ISSN 0011-1643.

UČNI NAČRT PREDMETA / COURSE SYLLABUS	
Predmet:	BIOTEHNOLOŠKI PROCESI IN NAPRAVE
Course Title:	PROCESSES AND EQUIPMENT IN BIOTECHNOLOGY

Študijski program in stopnja Study Programme and Level	Študijska smer Study Field	Letnik Academic Year	Semester Semester
VSŠP Kemijska tehnologija, 1. stopnja	/	2.	4.
PSP Chemical Technology, 1st Cycle	/	2nd	4th

Vrsta predmeta / Course Type: izbirni strokovni / Elective Professional

Univerzitetna koda predmeta / University Course Code: KTSI5

Predavanja Lectures	Seminar Seminar	Vaje Tutorial	Klinične vaje Work	Druge oblike študija	Samost. delo Individual Work	ECTS
45	15	15 LV	/	/	75	5

Nosilec predmeta / Lecturer: prof. dr. Polona Žnidaršič Plazl / Dr. Polona Žnidaršič Plazl, Full Professor
izr. prof. dr. Andreja Žgajnar Gotvajn / Dr. Andreja Žgajnar Gotvajn, 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):
Biotehnološki procesi proizvodnje antibiotikov in izbranih biotransformacij. Kvalitativni in kvantitativni opis posameznih faz postopka: priprava surovin, bioreakcija, imobilizacija biokatalizatorja, izolacija produkta. Procesna shema postopka. Posamezne osnovne operacije in naprave v izbranih biotehnoloških procesih: uporaba kemijsko inženirskih principov pri analizi in razvoju procesa. **Proces ravnanja z nastalimi odpadki**. Viri in vrste nastalih odpadkov (plinasti, tekoči, trdni) v biotehnološkem procesu. Odpadki kot surovina in	**Biotechnological process of antibiotics production and selected biotransformations**. Qualitative and quantitative description of individual phases of the process: upstream, bio-reaction, biocatalyst immobilization and downstream. Process flow diagram. Unit operations and equipment in the selected biotechnological processes: application of chemical engineering principles in the analysis and development of the process. **Waste management**. Sources and types of wastes (gas, liquid, solid), generated in

energent, njihova možna predelava (kompostiranje, anaerobna stabilizacija), recikliranje, ponovna uporaba. Vpliv odpadkov na okolje, problematika farmacevtskih učinkovin in mikropolutantov v okolju, hormonski motilci. Napredne tehnologije čiščenja specifičnih tehnoloških odpadnih vod. Metode minimizacije nastalih odpadkov.	biotechnological process. Wastes as material and energy source, recovery options (composting, anaerobic stabilization), recycling, reuse. Environmental impact of wastes, pharmaceuticals, micro-pollutants and endocrine disrupting chemicals in the environment. Advanced processes for the treatment of specific industrial wastewaters. Waste minimisation approaches.

Temeljna literatura in viri / Readings:

- P. Raspor (ur.), Biotehnologija –osnovna znanja, Bia, d.o.o., Ljubljana, 1996 (40 %)
- M. Roš, Sodobni postopki čiščenja odpadnih vod, Fit media, Velenje, 2015

Cilji in kompetence:	**Objectives and Competences:**
Cilj predmeta je da študent med študijem pridobljeno znanje uporabi pri analizi tipičnega biotehnološkega procesa in procesa ravnanja z nastalimi odpadki. Predmetno specifične kompetence: - študent spozna integralno vlogo osnovnih operacij v izbranem kemijsko tehnološkem procesu - obvlada procesno shemo, sestavljeno iz osnovnih operacij oziroma aparatov za izbrani tehnološki proces. - spozna metodologijo ravnanja z nastalimi trdnimi, tekočimi in plinastimi odpadki	The objective is that the student uses the acquired knowledge to analyse a typical biotechnological as well as waste management process. Specific competences are: - student recognizes the integral role of unit operations in a selected biotechnological process, - student acquaints a process scheme, composed of unit operations and equipment for a selected biotechnological process, - student acquaints a methodology od solid, liquid and gas waste management.

Predvideni študijski rezultati:	**Intended Learning Outcomes:**
<u>Znanje in razumevanje</u> Študent zna integrirati kemijsko inženirska znanja pri vodenju tehnoloških procesov in reševanju problemov ki pri tem nastanejo.	<u>Knowledge and Comprehension</u> Student is able to integrate chemical engineering knowledge during the control of a biotechnological process and solve the arised problems.
<u>Uporaba</u> Pridobljena znanja je sposoben uporabiti pri reševanju posameznih praktičnih primerov in problemov v biotehnološki proizvodnji in industrijskih procesih ravnanja z odpadki.	<u>Application</u> Student is able to use the acquired knowledge to solve the particular practical problems and cases in a biotechnological and waste treatment process.
<u>Refleksija</u> Uporaba splošnih znanj in osnovnih principov kemijskega inženirstva, analiza in kritično ovrednotenje tehnološkega procesa oziroma posameznega postopka in naprave v laboratorijskem in industrijskem merilu.	<u>Analysis</u> Use of general knowledge and basic principles of chemical engineering, analysis and critical evaluation of a biotechnological process as well as particular operation and equipment on a laboratory and industrial scale.

Prenosljive spretnosti	Skill-transference Ability
Razvita sposobnost identifikacije in reševanja problemov, kritičnega razmišljanja in logičnega sklepanja. Sposobnost uporabe literature, zbiranja in interpretacije podatkov in njihove kritične evalvacije.	Developed skill to identify and solve problem, critical thinking and making logical conclusions. Ability of literature data using, data collection and interpretation as well as their critical evaluation.

Metode poučevanja in učenja:	**Learning and Teaching Methods:**
Predavanja, laboratorijske vaje in seminarji.	Lectures, seminars, practical training.

Načini ocenjevanja:	Delež (v %) / Weight (in %)	**Assessment:**
pisni izpit,	**70 %**	written exam
laboratorijske vaje,	**15 %**	laboratory exercises
seminarska naloga	**15 %**	seminar project

Reference nosilca / Lecturer's references:

prof. dr. Polona Žnidaršič Plazl

- M. Bajić, I. Plazl, R. Stloukal, **P. Žnidaršič Plazl**. Development of a miniaturized packed bed reactor with ω-transaminase immobilized in LentiKats®. Process Biochem., 2017, 52: 63-72,
- N. Miložič, M. Lubej, M. Lakner, **P. Žnidaršič Plazl**, I. Plazl. Theoretical and experimental study of enzyme kinetics in a microreactor system with surface-immobilized biocatalyst. Chem. Eng.J., 2017, 313:374-381
-R. Wohlgemuth, I. Plazl, **P. Žnidaršič Plazl**, K. V. Gernaey, J. M. Woodley. Microscale technology and biocatalytic processes: opportunities and challenges for synthesis. Trends Biotechnol., 2015, 33: 302-314

izr. prof. dr. Andreja Žgajnar Gotvajn

- KORICA, Predrag, POŽGAJ, Đurđica, CIRMAN, Andreja, **ŽGAJNAR GOTVAJN, Andreja**. Decomposition analyses of the municipal waste generation and management in Croatian and Slovenian regions. Journal of material cycles and waste management, ISSN 1438-4957, 2016, doi: 10.1007/s10163-016-0573-1. [COBISS.SI-ID 1537314243].
- RAČIČ KOZMUS, **Aleksandra, ŽGAJNAR GOTVAJN**, Andreja, LOBNIK, Aleksandra, NOVAK, Nina, KLASINC, Aljaž, ZUPANČIČ, Gregor Drago. Anaerobic treatment to improve sludge recovery at a deinked fiber pulp and paper mill. Tappi journal, ISSN 0734-1415, Feb. 2016, vol. 15, no. 2, str. 127-137, ilustr. [COBISS.SI-ID 1536809411].
- ČEHOVIN, Matej, MEDIC, Alojz, SCHEIDELER, Jens, MIELCKE, Joerg, RIED, Achim, KOMPARE, Boris, **ŽGAJNAR GOTVAJN, Andreja**. Hydrodynamic cavitation in combination with the ozone, hydrogen peroxide and the UV-based advanced oxidation processes for the removal of natural organic matter from drinking water. Ultrasonics Sonochemistry, ISSN 1350-4177, 2017, vol. 37, str. 394-404, ilustr. http://www.sciencedirect.com/science/article/pii/S1350417717300457, doi: 10.1016/j.ultsonch.2017.01.036. [COBISS.SI-ID 1537341379].

UČNI NAČRT PREDMETA / COURSE SYLLABUS	
Predmet:	DIPLOMSKO DELO
Course Title:	DIPLOMA WORK

Študijski program in stopnja Study Programme and Level	Študijska smer Study Field	Letnik Academic Year	Semester Semester
VSŠP Kemijska tehnologija, 1. stopnja	/	3.	6.
PSP Chemical Technology, 1st Cycle	/	3rd	6th

Vrsta predmeta / Course Type: obvezni / Mandatory

Univerzitetna koda predmeta / University Course Code: D1KT

Predavanja Lectures	Seminar Seminar	Vaje Tutorial	Klinične vaje Work	Druge oblike študija	Samost. delo Individual Work	ECTS
/	/	/	/	225	/	15

Nosilec predmeta / Lecturer: /

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

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:	Prerequisites:
Odobrena tema diplomskega dela.	Approved topic.

Vsebina:	Content (Syllabus outline):
Diplomsko delo se opravlja iz področja kemijske tehnologije. Vsebina in naslov se določata v soglasju z izbranim mentorjem. Mentor je lahko učitelj na UL FKKT [t.j. zaposleni na fakulteti na učiteljskem delovnem mestu ali zaposleni na fakulteti na delovnem mestu asistenta, ki ima učiteljski naziv (docent, izredni ali redni profesor) ali nosilec predmeta na študijskem programu 1. ali 2. stopnje UL FKKT, ki ni zaposlen na fakulteti]. Mentor je praviloma učitelj na programu, ki ga je študent vpisal.	

Temeljna literatura in viri / Readings:

Knjige in članki, ki so povezani z vsebino diplomskega dela.

Cilji in kompetence: **Objectives and Competences:**

Dokončno oblikovanje pričakovanega lika diplomanta. Študent bodo ob izdelavi diplomske naloge pokazal sposobnosti iskanja in zaznavanja problemov in znal poiskati rešitev za tak problem. Pri delu bodo pokazal, da je pridobil večino kompetenc navedenih v programu študija.	

Predvideni študijski rezultati:	**Intended Learning Outcomes:**
Znanje in razumevanje Pri izdelavi diplomskega dela bo slušatelj pridobil naslednje kompetence: - usposobljenost za uporabo teoretičnega znanja in njegov prenos in uporabo v praksi, - sposobnost eksperimentiranja, zbiranja relevantnih podatkov o eksperimentu ali procesu in njihovega vrednotenja, - razumevanje meja zanesljivosti svojih eksperimentalnih podatkov, - sposobnost izvedbe manjšega projekta, za katerega ni nujno, da njegov rezultat zadošča kriterijem za objavo; - razvita profesionalna etična in okoljska odgovornost, - poznavanje in sposobnost uporabe različnih postopkov analize in karakterizacije snovi od enostavnejših analiz do kompleksnih inštrumentalnih metod, - usposobljenost za kvalitetno in varno delo v laboratoriju s poznavanjem laboratorijske opreme in ustreznih laboratorijskih tehnik, - sposobnost za delo z najzahtevnejšo laboratorijsko opremo, inštrumenti in aparaturami	Knowledge and Comprehension
Uporaba Znanje in pridobljene veščine bo diplomant lahko uporabil pri opravljanju poklica.	Application
Refleksija Povezovanje vseh pridobljenih teoretičnih znanj z reševanjem problemov na področju kemijske tehnologije ter kritični pogled na uporabnost teh znanj.	Analysis
Prenosljive spretnosti Pri delu bo diplomant pridobil znanja o metodah reševanja problemov, o načinu prezentacije teh znanj v pisani in govorjeni obliki povezani z ostalimi metodami posredovanja raziskav ugotovitev itd.	Skill-transference Ability

Metode poučevanja in učenja:	**Learning and Teaching Methods:**

Študijsko in raziskovalno delo pod vodstvom mentorja	

Načini ocenjevanja:	Delež (v %) / Weight (in %)	**Assessment:**
Ocenjuje se diplomsko delo in zagovor diplomskega dela pred komisijo, ki jo sestavljajo predsednik, mentor in en član. Lestvica ocen vsakega dela je od 1 do 10. Ocene 1 do 5 so negativne, ocene 6 do 10 pa pozitivne in sicer: 6-zadostno, 7-dobro, 8 in 9-prav dobro, 10-odlično.		

Reference nosilca / Lecturer's references:

/

UČNI NAČRT PREDMETA / COURSE SYLLABUS	
Predmet:	FIZIKA
Course Title:	PHYSICS

Študijski program in stopnja Study Programme and Level	Študijska smer Study Field	Letnik Academic Year	Semester Semester
VSŠP Kemijska tehnologija, 1. stopnja	/	1.	1.
PSP Chemical Technology, 1st Cycle	/	1st	1st

Vrsta predmeta / Course Type:	obvezni / Mandatory
Univerzitetna koda predmeta / University Course Code:	KT102

Predavanja Lectures	Seminar Seminar	Vaje Tutorial	Klinične vaje Work	Druge oblike študija	Samost. delo Individual Work	ECTS
60	/	15 SV	/	/	75	5

Nosilec predmeta / Lecturer:	doc. dr. Aleš Mohorič / Dr. Aleš Mohorič, Assistant 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):
Kinematika: Premo in krivo gibanje. Kroženje in nihanje. Dinamika delca: Newtonovi zakoni. Zakona o ohranitvi gibalne in vrtilne količine. Gravitacijski zakon. Merjenje sil. Delo in moč. Energija, izrek o ohranitvi energije. Potencialna energija. Togo telo in sistem teles: Težišče. Vrtenje, navor in vztrajnostni moment. Rotacijska energija. Ravnotežje sil in navorov. Elastomehanika: Hookov zakon, elastične konstante. Mehanika tekočin in plinov: Tlak, stisljivost, vzgon, površinska napetost, viskoznost, Bernoullijeva enačba. Sila upora, Reynoldsovo število. Valovanje: Hitrost potovanja motnje, zapis valovanja. Interferenca, odboj, lom in uklon	Kinematics: linear and general motion. Circular motion, oscillation. Dynamics: Newton's laws. Linear and angular momentum. Gravitational law. Force. Work, power. Energy, conservation of energy. Gravitational potential energy. Rigid body, system of bodies: center of gravity. Rotation, torque, moment of inertia. Rotational kinetic energy. Static: force and torque balance. Elastomechanics: Hook's law, moduli. Fluid dynamics: pressure, compressibility, buoyancy, surface tension, viscosity, Bernoulli equation. Resistance, the Reynolds number. Waves: speed, mathematical expression. Interference, reflection, refraction, diffraction. Heat:

valovanja. Toplota: Energijski zakon: Kelvinova temperaturna skala. Temperaturno raztezanje. Toplota kot energija. Specifična in latentne toplote, entalpija. Kalorimetrija. Izotermne, izobarne, izohorne in adiabatne spremembe idealnega plina. Toplotni stroji. Entropija. Prevajanje toplote. Elektrika in magnetizem: Coulombov zakon: Sile med električnimi naboji. Električno polje. Gaussov zakon. Električno delo in električna apetost. Kondenzator, kapaciteta, energija električnega polja. Snov v električnem polju, dielektričnost. Kirchoffovi zakoni. Električni tok in upor. Ohmov zakon. Merjenje toka, napetosti in upora. Viri električne napetosti. Istosmerni in izmenični tok. Magnetno polje: Magnetna sila in navor, magnetni moment. Indukcija: Indukcijski zakon (samo) induktivnost. Energija magnetnega polja. Snov v magnetnem polju: Dia-, para- in feromagnetizem. Elektromotor in generator. Transformator. Histerezna zanka. Elektromagnetna nihanja in valovanja: Nihajni krog. Elektromagnetno valovanje. Spekter elektromagnetnega valovanja. Svetloba. Geometrijska in valovna optika: Odbojni in lomni zakon. Optični instrumenti. Interferenca in uklon. Optična mreža. Polarizacija. Zgradba atoma in atomskega jedra. Jedrske sile. Vezavna energija jeder. Alfa, beta in gama razpadi. Detektorji sevanja. Zlivanje in cepitev jeder.	First law of thermodynamics. Absolute temperature. Thermal expansion. Heat as energy. Specific and latent heat, enthalpy. Calorimetry. Isothermal, iosobaric, izohoric and adiabatic changes of ideal gas. Heat engines. Entropy. Heat conduction. Electricity and magnetism: Coulomb's law, electrostatic forces. Electric field. Gauss' law. Electric work and voltage. Capacitor, capacity, electric field energy. Electric field in matter, dielectricity. Kirchhoff's laws. Electrical resistance and current. Ohm's law. Measuring current, voltage and resistivity. Electrical sources. AC, DC. Magnetic field: magnetic force and torque, magnetic dipole moment. Induction: induction law, inductance. Magnetic field energy. Magnetic field in matter, Dia, para and fero magnetism. Electric motor and generator. Transformer. Hysteresis. Electromagnetic oscillation and waves: electric oscillator circuit. EMW spectra. Light. Geometric and wave optics: refraction and reflection laws. Optical instruments. Interference, diffraction. Diffraction grating. Polarization. Atomic and nuclear composition. Nuclear forces. Bounding energy. Alpha, beta, gamma decay. Radiation detectors. Fusion and fission.

Temeljna literatura in viri / Readings:

- J. Strnad, Fizika I in II, DMFA
- R. Kladnik, Visokošolska fizika, DZS
- I. Kuščer, A. Moljk,…, Fizika za srednje šole I, II in III, DZS
- A. Mohorič, V. Babič, Fizika 1, 2 in 3, MK

Cilji in kompetence:	**Objectives and Competences:**
Cilji: Nadgradnja srednješolskih osnov fizike, razumevanje osnovnih zakonov s področja mehanike, toplote, elektrike in magnetizma, optike in atomike. Obvladovanje kvantitativnih povezav med fizikalnimi količinami v enostavnih primerih, na katere naleti diplomant pri poklicnem delu. **Kompetence**: Sposobnost poenostavitve nalog v obliko, kjer je mogoča enostavna računska obravnava. Sposobnost uporabe osnovnega matematičnega znanja pri reševanju zastavljenih nalog. Sposobnost iskanja dodatnih informacij po strokovni literaturi in na svetovnem spletu.	**Objectives**: Upgrade on the secondary school physics, comprehension of basic laws in mechanics, thermodynamics, electricity, magnetism, optics and atomics. Understanding of quantitative links between physical quantities in simple cases encountered by the graduate in his/hers profession. **Competences**: The ability to simplify the tasks of design as possible to make calculus simpler. Ability to apply mathematical knowledge in solving the set tasks. Ability to search for additional information in the literature and on the internet.

Predvideni študijski rezultati:	**Intended Learning Outcomes:**
Znanje in razumevanje Poznavanje osnovnih pojmov in zakonov fizike. Neambiciozen študent, ki se je pripravljen zadovoljiti z nizko oceno, bo obvladal povezave med posameznimi fizikalnimi količinami z memoriranjem, bolj ambiciozen študent pa bo pridobil na osnovi izpeljav enačb iz osnovnih zakonov globlji vpogled v naravne zakone, kar mu bo omogočilo temeljito razumevanje snovi.	Knowledge and Comprehension Knowledge of basic concepts and laws of physics. Unambitious student who is willing to settle for the low rating, will handle the connection between physical quantities with memorizing, more ambitious student will gain through derivation of equations from basic laws deeper insight into the laws of nature, which will allow a thorough understanding of the syllabus.
Uporaba Uporaba že osvojenega teoretičnega znanja fizike v realnih, praktičnih situacijah.	Application Applying existing theoretical knowledge of physics to real, practical situations.
Refleksija Razumevanje tehnoloških rešitev in primerov iz vsakdanjega življenja v luči fizikalnih naravnih zakonov.	Analysis Understanding of technology solutions and examples from everyday life in the light of the physical laws of nature.
Prenosljive spretnosti Predmet Fizika je najprimernejše področje, kjer študent lahko preverja in utrjuje svoje matematično znanje.	Skill-transference Ability The subject of physics is the preferred subject where students can verify and consolidate their mathematical knowledge.

Metode poučevanja in učenja:	**Learning and Teaching Methods:**
Predavanja, vaje, domače naloge, konzultacije.	Lectures, exercises, homework, consultations.

Načini ocenjevanja:	Delež (v %) / Weight (in %)	**Assessment:**
- Pisni izpit (nadomestita ga lahko dva pozitivno ocenjena kolokvija) - ustni izpit.	**50%** **50%**	- Written examination (can be replaced by two positive tests)

ocene od 6-10 (pozitivno) oz. 1-5 (negativno).		- oral examination. grades 6-10 (positive) and 1-5 (negative).

Reference nosilca / Lecturer's references:

- STEPIŠNIK, Janez, LAHAJNAR, Gojmir, ZUPANČIČ, Ivan, **MOHORIČ, Aleš**. Study of translational dynamics in molten polymer by variation of gradient pulse-width of PGSE. Journal of magnetic resonance, ISSN 1090-7807, 2013, vol. 236, str. 41-46, doi: 10.1016/j.jmr.2013.08.003. [COBISS.SI-ID 27404327]
- STEPIŠNIK, Janez, FRITZINGER, Bernd, SCHELER, Ulrich, **MOHORIČ, Aleš**. Self-diffusion in nanopores studied by the NMR pulse gradient spin echo. Europhysics letters, ISSN 0295-5075, 2012, vol. 98, no. 5, str. 57009-p1-57009-p4. http://iopscience.iop.org/0295-5075/98/5/57009. [COBISS.SI-ID 2434404]
- STEPIŠNIK, Janez, **MOHORIČ, Aleš**, SERŠA, Igor, LAHAJNAR, Gojmir. Analysis of polymer dynamics by NMR modulated gradient spin echo. V: VOLOVŠEK, Vesna (ur.), BISTRIÈIAE, Lahorija (ur.). Polymer spectroscopy July 2011, (Macromolecular Symposia, ISSN 1022-1360, Special issue, Volume 305, Issue Basel [etc.]: Hüting & Wepf Verlag, 2011, vol. 305, str. 55-62, doi: 10.1002/masy.201000120. [COBISS.SI-ID 2362212]
- VAN DEN DOEL, L. R., **MOHORIČ, Aleš**, VERGELDT, Frank, VAN DUYNHOVEN, John, BLONK, Han, VAN DALEN, Gerard, VAN AS, Henk, VAN VLIET, Lucas J. Mathematical modeling of water uptake through diffusion in 3D inhomogeneous swelling substrate. AIChE journal, ISSN 0001-1541. [Print ed.], 2009, vol. 55, no. 7, str. 1834-1848, doi: 10.1002/aic.11930. [COBISS.SI-ID 2175844]
- **MOHORIČ, Aleš**, VERGELDT, Frank, GERKEMA, Edo, VAN DALEN, Gerard, VAN DEN DOEL, L. R., VAN VLIET, Lucas J, VAN AS, Henk, VAN DUYNHOVEN, John. The effect of rice kernel microstructure on cooking behaviour : a combined [mi]-CT and MRI study. Food chemistry, ISSN 0308-8146. [Print ed.], 2009, vol. 115, str. 1491-1499, doi: 10.1016/j.foodchem.2009.01.089. [COBISS.SI-ID 2157412]
- **MOHORIČ, Aleš**, STEPIŠNIK, Janez. NMR in the Earth's magnetic field. Progress in nuclear magnetic resonance spectroscopy, ISSN 0079-6565. [Print ed.], 2009, vol. 54, str. 166-182, doi: 10.1016/j.pnmrs.2008.07.002. [COBISS.SI-ID 2157156]
- STEPIŠNIK, Janez, LASIČ, Samo, **MOHORIČ, Aleš**, SERŠA, Igor, SEPE, Ana. Velocity autocorrelation spectra of fluid in porous media measured by the CPMG sequence and constant magnetic field gradient. V: Proceedings of the 8th International Bologne Conference on Magnetic Resonancein Porous Media, Bologna, 2006, (Magnetic resonance imaging, ISSN 0730-725X, vol. 25, no. 4). New York: Pergamon Press, 2007, vol. 25, no. 4, str. 517-520. [COBISS.SI-ID 1987428]

UČNI NAČRT PREDMETA / COURSE SYLLABUS	
Predmet:	FIZIKALNA KEMIJA 1
Course Title:	PHYSICAL CHEMISTRY 1

Študijski program in stopnja Study Programme and Level	Študijska smer Study Field	Letnik Academic Year	Semester Semester
VSŠP Kemijska tehnologija, 1. stopnja	/	2.	4.
PSP Chemical Technology, 1st Cycle	/	2nd	4th

Vrsta predmeta / Course Type: obvezni / Mandatory

Univerzitetna koda predmeta / University Course Code: KT116

Predavanja Lectures	Seminar Seminar	Vaje Tutorial	Klinične vaje Work	Druge oblike študija	Samost. delo Individual Work	ECTS
40	10	25 LV	/	/	75	5

Nosilec predmeta / Lecturer: prof. dr. Ksenija Kogej / Dr. Ksenija Kogej, Full Professor

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

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):
Plini. Lastnosti plinov. Enačbe stanja, idealni in realni plini. Kritični pojavi, utekočinjanje plinov. **Prvi zakon termodinamike.** Delo in toplota. Notranja energija, entalpija. Toplotne kapacitete. Kalorimetrija. Termokemija. Odvisnost entalpije od temperature. **Drugi zakon termodinamike.** Obrnljivi in neobrnljivi procesi. Entropija. Računanje entropijskih sprememb. Tretji termodinamični zakon. Gibbsova in Helmholtzova prosta energija. Odprti sistemi. Kemijski potencial. Kriterij za snovno ravnotežje. **Fazna ravnotežja.** Clausius-Clapeyronova enačba. Fazni diagrami. Fazno pravilo. **Raztopine.** Parcialne molske količine. Idealne in neidealne raztopine. Termodinamika mešanja.	**Gasses.** Properties of gasses. Equations of state, ideal and real gasses. Critical phenomena, condensation of gasses. **The first law of thermodynamics.** Work and heat. Internal energy, enthalpy, and heat capacities. Calorimetry. Thermo-chemistry. Dependence of enthalpy on temperature. **The second law of thermodynamics.** Reversible and irreversible processes. Entropy. Calculation of entropy changes. The third law of thermodynamics. Gibbs and Helmholtz free energy. Open systems. Chemical potential. Criterion for equilibrium. **Phase equilibria.** The Clausius-Clapeyron equation. Phase diagrams. Phase rule. **Solutions.** Partial molar quantities. Ideal

Raoultov in Henryjev zakon. Diagrami parnih tlakov. Vrelni diagrami in frakcionirna destilacija. Koligativne lastnosti. **Laboratorijske vaje**: 1. Kalorimetrija 2. Parni tlak 3. Vrelni diagram 4. Določanje molske mase s krioskopsko metodo 5. Viskoznost tekočin 6. Površinska napetost.	and non-ideal solutions. Thermodynamics of mixing. Raoult's and Henry's law. Vapour pressure diagrams. Temperature-composition diagrams and fractional distillation. Colligative properties. **Laboratory practice**. 1. Calorimetry 2. Vapor pressure 3. Boiling point diagram 4. Determination of molar mass by cryoscopy 5. Viscosity 6. Surface tension.

Temeljna literatura in viri / Readings:

- R. A. ALBERTY, R. J. SILBEY: Physical Chemistry, John-Wiley, New York, 1995; 217 strani (24 %):s slikami, grafičnimi prikazi in računskimi nalogami.
- BONČINA, Matjaž, CERAR, Janez, GODEC, Andrej (avtor, urednik), HRIBAR, Barbara, JAMNIK, Andrej, LAH, Jurij, LAJOVIC, Andrej, LUKŠIČ, Miha, PODLIPNIK, Črtomir, PRISLAN, Iztok, REŠČIČ, Jurij, ŠARAC, Bojan, TOMŠIČ, Matija, VESNAVER, Gorazd. Fizikalna kemija - praktikum. 1. izd. Ljubljana: Fakulteta za kemijo in kemijsko tehnologijo, 2012. XXXII, 227 str., ilustr. ISBN 978-961-6756-32-7. [COBISS.SI-ID 261552640]

Cilji in kompetence:	**Objectives and Competences:**
Fizikalna kemija I, skupaj s Fizikalno kemijo II, je osnovni naravoslovni predmet, pri katerem študenti spoznajo temeljne fizikalno-kemijske zakonitosti. Predmet študentu pomaga pri razumevanju fizikalno-kemijskih procesov v laboratoriju in ga nauči reševanja zelo različnih problemov iz naravoslovja. Pri tem razvije sposobnost logičnega sklepanja in povezovanja znanj.	Physical chemistry I, together with Physical chemistry II, is a fundamental natural science course where students learn basic physico-chemical principles. After the completion of the course they understand physical processes and learn to solve various problems in the field of natural sciences. Students develop a critical way of thinking and uniting knowledge.

Predvideni študijski rezultati:	**Intended Learning Outcomes:**
<u>Znanje in razumevanje</u> Študent pri predmetu pridobi razumevanje osnovnih naravnih zakonitosti sistemov (npr. plinov, tekočin, raztopin neelektrolitov in elektrolitov) in fizikalno kemijskih količin (npr. dela, toplote, notranje energije, entalpije, entropije itd.). Sposoben je ločiti med funkcijami stanja in funkcijami poti. Spozna vse termodinamične zakone, pojme obrnljivi in neobrnljivi procesi in kriterije za spontanost procesov in za ravnotežje. Pridobljeno teoretično znanje je osnova za razumevanje številnih fizikalno kemijskih metod, ki se uporabljajo v analitskem in drugih laboratorijih. Študent svoje razumevanje snovi preveri v laboratoriju z merjenjem osnovnih termodinamskih	<u>Knowledge and Comprehension</u> Students acquire understanding of fundamental natural laws in various systems (e.g. gasses, liquids, nonelectrolyte and electrolyte solutions) and for various properties (e.g, work, heat etc.). They are able to distinguish between state function and path functions. They learn all thermodynamic laws, concepts of reversibility and irreversibility, criteria for spontaneity and equilibrium. The acquired theoretical knowledge is the basis for understanding numerous physicochemical methods used in analytical and other laboratories. The understanding of the subject is verified in laboratory by measuring basic thermodynamic

količin.	properties.
Uporaba Ker je fizikalna kemija temeljni naravoslovni predmet, nudi učna snov študentu široko razumevanje raznih pojavov v naravoslovju. Študij tega predmeta je nujna podlaga za to, da bo študent razumel principe določenih meritev in metod, ki jih bo uporabljal v laboratoriju.	Application As a fundamental natural science course, physical chemistry offers students broad understanding of various phenomena in nature. The obtained knowledge is necessary for understanding principals of measurements.
Refleksija Študent pridobi občutek za fizikalno-kemijski način razmišljanja in razvije zmožnost abstraktne predstave o fizikalno-kemijskih količinah in njihove interpretacije v okviru enostavnih modelov ter hipotez. S pridobljenim znanjem zna razne tehnološke probleme analizirati s stališča osnovnih zakonitosti in s tem bi moral biti zmožen kritično vrednotiti rezultate svojega dela.	Analysis Students gain the physicochemical way of thinking and develop abstract conception of physical-chemical quantities. They are able to interpret their observation in the framework of simple models and hypothesis and to analyse technological problems with basic laws. Through this they should be able to critically evaluate the results of their work.
Prenosljive spretnosti Pri študiju fizikalne kemije študenti razvijajo abstrakten, kritičen in analitičen način razmišljanja, kar jim bo koristilo pri prepoznavanju in reševanju problemov v raznih okoljih. Naučijo se iskati in uporabljati domačo in tujo literaturo ter poročati o izsledkih svojega dela. Predmet študenta navaja k povezovanju znanja kemije, fizike, matematike in ostalih tehnoloških ved.	Skill-transference Ability The abstract, critical, and analytical way of thinking helps the student in recognizing and solving problems in various environments. They learn to use literature and data basis and how to report their work. They are able to link knowledge of chemistry, physics, and mathematics with that of other technological fields.

Metode poučevanja in učenja:	**Learning and Teaching Methods:**
Predavanja. Seminarji z računskimi primeri, kjer študenti aktivno sodelujejo in tako preizkusijo, ali pravilno razumejo pridobljeno teoretično znanje. Laboratorijske vaje z vodenjem dnevnika in oddajanjem poročil o opravljenem delu in rezultatih.	Lectures. Seminars (problem solving) with active participation of students. In this way students check their theoretical knowledge. Laboratory practice, writing laboratory diary and submitting reports of measurements and obtained results.

Načini ocenjevanja:	Delež (v %) / Weight (in %)	**Assessment:**
Predavanja: pisni izpit, ki ga študenti lahko opravijo z dvema delnima kolokvijema tekom predavanj.	**60 %**	Lectures: Written examination that can be passed by two written tests during semester.
Vaje: ocena dnevnika tekom opravljanja vaj in končni pisni kolokvij iz vaj. Ocene: 6-10 (pozitivno), 1-5 (negativno).	**40 %**	Laboratory practice: grade for the laboratory diary and for the final written test. Grades: 6-10 (positive), 1-5 (negative)

Reference nosilca / Lecturer's references:

- **KOGEJ, Ksenija**, FONSECA, Sofia M., ROVISCO, J., AZENHA, M. E., LUÍSA RAMOS, M., SEIXAS DE MELO, J., BURROWS, Hugh. Understanding the interaction between trivalent lanthanide ions and stereoregular polymethacrylates through luminescence, binding isotherms, NMR, and interaction with cetylpyridinium chloride. Langmuir, ISSN 0743-7463, 2013, vol. 29, no. 47, str. 14429-14437, [COBISS.SI-ID 1656879]
- ANŽLOVAR, Alojz, CRNJAK OREL, Zorica, **KOGEJ, Ksenija**, ŽIGON, Majda. Polyol-mediated synthesis of zinc oxide nanorods and nanocomposites with poly(methyl methacrylate). Journal of nanomaterials, ISSN 1687-4110, 2012, vol. 2012, art. no. 760872 (9 str.), [COBISS.SI-ID 36033029]
- PRELESNIK, Simona, GODERIS, Bart, HANSSON, Per, **KOGEJ, Ksenija**. Phase diagram and structures in mixtures of poly(styrenesulfonate anion) and alkyltrimethylammonium cations in water : significance of specific hydrophobic interaction. The journal of physical chemistry. B, Condensed matter, materials, surfaces, interfaces & biophysical, ISSN 1520-6106, 2012, vol. 116, no. 15, str. 4634-4645, [COBISS.SI-ID 36006917]

UČNI NAČRT PREDMETA / COURSE SYLLABUS	
Predmet:	FIZIKALNA KEMIJA 2
Course Title:	PHYSICAL CHEMISTRY 2

Študijski program in stopnja Study Programme and Level	Študijska smer Study Field	Letnik Academic Year	Semester Semester
VSŠP Kemijska tehnologija, 1. stopnja	**/**	**3.**	**5.**
PSP Chemical Technology, 1st Cycle	**/**	**3rd**	**5th**

Vrsta predmeta / Course Type: obvezni / Mandatory

Univerzitetna koda predmeta / University Course Code: KT132

Predavanja Lectures	Seminar Seminar	Vaje Tutorial	Klinične vaje Work	Druge oblike študija	Samost. delo Individual Work	ECTS
35	**10**	**30 LV**	**/**	**/**	**75**	**5**

Nosilec predmeta / Lecturer: prof. dr. Ksenija Kogej / Dr. Ksenija Kogej, Full 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):**
Kemijsko ravnotežje. Sprememba Gibbsove proste entalpije in termodinamična konstanta kemijskega ravnotežja. Reakcije v plinski fazi. Vpliv temperature, tlaka in inertnega plina na kemijsko ravnotežje. Heterogeno ravnotežje. **Kemijska kinetika**. Hitrostni zakon, red reakcije in konstanta reakcijske hitrosti. Razpolovni čas. Vpliv temperature na hitrost kemijske reakcije. Aktivacijska energija. **Elektrokemija**. Galvanski členi: napetost in termodinamika galvanskih členov. Nernstova enačba. Standardni elektrodni potenciali in napetostna vrsta. **Izbrana poglavja**. Površinska kemija. Adsorpcija. Površinska napetost. Površinsko aktivne snovi.	**Chemical equilibrium**. The Gibbs free energy change and the thermodynamic equilibrium constant. Reactions in the gaseous phase. Effect of temperature, pressure and inert gas on equilibrium. Heterogeneous equilibrium. **Chemical kinetics**. Rate laws, reaction order and reaction rate constant. The half time. Effect of temperature on reaction rate. Activation energy. **Electrochemistry**. Electrochemical cells. Electromotive force (EMF) and thermodynamics of galvanic cells. The Nernst equation. EMF measurements. Standard electrode potentials. **Selected topics**. Surface chemistry. Adsorption. Surface tension. Surface active compounds.

Laboratorijske vaje: 1. Napetost in notranja upornost galvanskega člena; merjenje pH 2. Potenciometrična titracija 3. Prevodnost elektrolitov 4. Adsorpcija 5. Kemijska kinetika.	**Laboratory practice**. 1. Electromotive force and internal resistance of galvanic cells; pH measurements 2. Potentiometric titration 3. Conductivity of electrolytes 4. Adsorption 5. Chemical kinetics.

Temeljna literatura in viri / Readings:

- R. A. ALBERTY, R. J. SILBEY: Physical Chemistry, John-Wiley, New York, 1995; 217 strani (24 %):s slikami, grafičnimi prikazi in računskimi nalogami.
- BONČINA, Matjaž, CERAR, Janez, GODEC, Andrej (avtor, urednik), HRIBAR, Barbara, JAMNIK, Andrej, LAH, Jurij, LAJOVIC, Andrej, LUKŠIČ, Miha, PODLIPNIK, Črtomir, PRISLAN, Iztok, REŠČIČ, Jurij, ŠARAC, Bojan, TOMŠIČ, Matija, VESNAVER, Gorazd. Fizikalna kemija - praktikum. 1. izd. Ljubljana: Fakulteta za kemijo in kemijsko tehnologijo, 2012. XXXII, 227 str., ilustr. ISBN 978-961-6756-32-7. [COBISS.SI-ID 261552640]

Cilji in kompetence:	**Objectives and Competences:**
Fizikalna kemija II je nadaljevanje predmeta Fizikalna kemija I. Osnovni cilj učne enote Fizikalna kemija I in II je spoznavanje in razumevanje temeljnih fizikalno-kemijskih zakonitosti. V drugem delu je poseben poudarek na praktikumu, katerega poglaviten cilj je demonstracija osvojenih teoretičnih osnov na raznih fizikalno kemijskih procesih in meritvah. Študent se spozna z načinom določanja fizikalno-kemijskih količin v laboratoriju. Pri tem razvije sposobnost samostojnega eksperimentalnega dela in kritičnega vrednotenja dobljenih rezultatov.	The course in Physical Chemistry II is a continuation of Physical Chemistry I. The main goal of both courses is to provide students the knowledge and understanding of basic physicochemical principles. In Part II, the emphasis is on laboratory practice with the main goal to demonstrate the presented theoretical concepts. Students learn how to determine (measure) physicochemical properties in laboratory. Through this they acquire skills for individual experimental work and critical evaluation of results.

Predvideni študijski rezultati:	**Intended Learning Outcomes:**
<u>Znanje in razumevanje</u> Študent pri predmetu dopolni svoje znanje o osnovnih naravnih zakonitostih in fizikalno kemijskih količinah, ki ga je dobil pri študiju predmeta Fizikalna kemija I. Spozna razliko med termodinamiko in kinetiko ter nekaj pomembnih fizikalnih lastnosti tekočin ter pojavov na površinah. Študent se seznani s principi merjenja fizikalnih količin. Nauči se pravilnega izvajanja meritev in podajanja rezultatov, identificirati in vrednotiti napake pri meritvah in uporabljati enostavne modele za interpretacijo rezultatov. Pri tem razvija sposobnost kritičnega vrednotenja izmerjenih količin.	<u>Knowledge and Comprehension</u> Knowledge and Comprehension Students complete their knowledge of basic natural concepts and physicochemical quantities, which they have met already at Physical Chemistry I. They learn the difference between thermodynamics and kinetics and get to know some important physical properties and phenomena at interfaces Students learn the correct and precise way of measuring and presenting measured quantities, the way to report uncertainties in their measurements and to use simple models for interpretation of the data. Through this they learn to critically evaluate measured quantities.
<u>Uporaba</u> Teoretično in praktično znanje fizikalne kemije bo	<u>Application</u> Theoretical and practical knowledge of physical

študentu pomagalo pri uporabi analitskih metod ter pri izvajanju raznih operacij za nadziranje in usmerjanje kemijskih procesov. Nepogrešljivo je tudi pri vključevanju v razvojno in proizvodno delo, pri kontroli procesov v raznih panogah industrije in pri merjenju fizikalno-kemijskih količin v analitskem in drugih laboratorijih.	chemistry can be used in applications of analytical methods and in executing various operations in chemical processes. It is indispensable in research and production work, in controlling technological processes in industry and in measurements of physicochemical quantities in analytical and other laboratories.
Refleksija Študent pridobi občutek za fizikalno-kemijski način razmišljanja in razvije zmožnost abstraktne predstave o fizikalno-kemijskih količinah. Nauči se uporabljati teoretično pridobljeno znanje pri eksperimentalnem delu ter kritično vrednotiti rezultate in popravljati svoje napake.	Analysis Students develop the physicochemical way if thinking and ability of abstract conception of physicochemical quantities. They learn how to use the theoretical knowledge in experimental work and how to critically evaluate their experimental results and correct mistakes.
Prenosljive spretnosti Pri študiju fizikalne kemije študenti razvijajo abstrakten, kritičen in analitičen način razmišljanja, ki je osnova za kvalitetno delo na različnih tehnoloških področjih. Naučijo se kritično vrednotiti in interpretirati rezultate meritev. Poleg tega se naučijo iskati in uporabljati domačo in tujo literaturo. Pri vajah osvojijo primeren način podajanja rezultatov in poročil o opravljenem delu. Študenti se privadijo timskega dela, kar jim bo koristilo pri vsakem delu v laboratoriju ali proizvodnem obratu. Spoznajo pravila varnega dela v laboratoriju.	Skill-transference Ability In the course on Physical chemistry students develop abstract, critical and analytical way of thinking that is the basis for competent work in various technological fields. They learn to critically evaluate and interpret results of measurements, to search data bases and literature. In laboratory, students learn to correctly handle with instruments and to collect, treat and interpret results of their measurements. They learn to work in smaller teams, which can be useful for any work in laboratory or production. They also learn safety rules for the work in chemical laboratories.

Metode poučevanja in učenja:	**Learning and Teaching Methods:**
Predavanja s seminarskimi vajami. Laboratorijske vaje z vodenjem dnevnika in oddajanjem poročil o opravljenem delu in rezultatih.	Lectures and seminars (problem solving). Laboratory practice, writing laboratory diary and submitting reports of measurements and obtained results.

Načini ocenjevanja:	Delež (v %) / Weight (in %)	**Assessment:**
Predavanja: pisni izpit, ki ga študenti lahko opravijo z dvema delnima kolokvijema tekom predavanj.	**67 %**	Lectures: Written examination that can be passed by two written tests during semester.
Vaje: ocena dnevnika tekom opravljanja vaj in končni pisni kolokvij iz vaj. Ocene: 6-10 (pozitivno), 1-5 (negativno).	**33 %**	Laboratory practice: grade for the laboratory diary and for the final written test. Grades: 6-10 (positive), 1-5 (negative)

Reference nosilca / Lecturer's references:

- **KOGEJ, Ksenija**, FONSECA, Sofia M., ROVISCO, J., AZENHA, M. E., LUÍSA RAMOS, M., SEIXAS DE MELO, J., BURROWS, Hugh. Understanding the interaction between trivalent lanthanide ions and stereoregular polymethacrylates through luminescence, binding isotherms, NMR, and interaction with cetylpyridinium chloride. Langmuir, ISSN 0743-7463, 2013, vol. 29, no. 47, str. 14429-14437, [COBISS.SI-ID 1656879]
- ANŽLOVAR, Alojz, CRNJAK OREL, Zorica, **KOGEJ, Ksenija**, ŽIGON, Majda. Polyol-mediated synthesis of zinc oxide nanorods and nanocomposites with poly(methyl methacrylate). Journal of nanomaterials, ISSN 1687-4110, 2012, vol. 2012, art. no. 760872 (9 str.), [COBISS.SI-ID 36033029]
- PRELESNIK, Simona, GODERIS, Bart, HANSSON, Per, **KOGEJ, Ksenija**. Phase diagram and structures in mixtures of poly(styrenesulfonate anion) and alkyltrimethylammonium cations in water : significance of specific hydrophobic interaction. The journal of physical chemistry. B, Condensed matter, materials, surfaces, interfaces & biophysical, ISSN 1520-6106, 2012, vol. 116, no. 15, str. 4634-4645, [COBISS.SI-ID 36006917]

UČNI NAČRT PREDMETA / COURSE SYLLABUS	
Predmet:	INDUSTRIJSKI PROCESI IN TRAJNOSTNI RAZVOJ
Course Title:	INDUSTRIAL PROCESSES AND SUSTAINABLE DEVELOPMENT

Študijski program in stopnja Study Programme and Level	**Študijska smer Study Field**	**Letnik Academic Year**	**Semester Semester**
VSŠP Kemijska tehnologija, 1. stopnja	**/**	**3.**	**6.**
PSP Chemical Technology, 1st Cycle	**/**	**3rd**	**6th**

Vrsta predmeta / Course Type: obvezni / Mandatory

Univerzitetna koda predmeta / University Course Code: KT134

Predavanja Lectures	**Seminar Seminar**	**Vaje Tutorial**	**Klinične vaje Work**	**Druge oblike študija**	**Samost. delo Individual Work**	**ECTS**
45	**10**	**20 LV**	**/**	**/**	**75**	**5**

Nosilec predmeta / Lecturer: izr. prof. dr. Andreja Žgajnar Gotvajn / Dr. Andreja Žgajnar Gotvajn, 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):**
Trajnostni razvoj: definicije, terminologija, vzporednice in razlike med industrijskimi procesi in biološkimi sistemi, vpliv industrijskih sistemov na naravo in človeka, etika industrijske proizvodnje, čistejša proizvodnja za izboljšanje materialnih in energijskih izkoristkov, zaščita naravnih virov, pomen celovitega pristopa k posameznem okoljskem problemu, zakonodaja. Orodja: vrste, viri in transport onesnaženja, vrednotenje vplivov onesnaženja na okolje, konvencionalne in sodobne tehnike za preprečevanje onesnaženja in remediacijo obstoječega onesnaženja, tehnike za dosego eko-učinkovitosti industrijskega procesa ter čistejše	Sustainable development: definitions, terminology, comparison of industrial and natural processes, the impact of industrial processes to nature and mankind, ethics of industrial production, cleaner production for reduction of material and energy use, preservation of natural resources, the importance of complex approach for solving environmental problems, legislation. Tools: types, sources and environmental pathways of pollution, assessment of environmental impacts of pollution, conventional and advanced pollution prevention techniques, remediation techniques,

proizvodnje, optimiranje tehnoloških postopkov, energetska in snovna izraba odpadkov, zamenjava/minimizacija surovin, varčevanje z naravnimi viri in energijo, uporaba sekundarnih surovin, recikliranje, zaprti tehnološki procesi, koncept proizvodnje brez odpadkov, izobraževanje zaposlenih in uporabnikov proizvodov. Viri energije: konvencionalni viri energije, obnovljivi viri energije, možnosti prehoda iz obstoječih na trajnostne vire energije, problematika obnovljivih virov energije (transport, dostopnost, sezonska variacija, globalen vpliv na okolje), pričakovane smernice uporabe. Osnove industrijske ekologije: integrirana strategija preventive pred onesnaženjem, LCA (Life Cycle Assessment) izdelkov, eko-optimizacija produkta in procesa, učinkovit transport, nadzor in izboljševanje sistema, upoštevanje lokalne mikroklime, lokalen, regionalen in globalen pristop. Uporaba koncepta trajnostnega razvoja na primeru, ki bo relevanten s slovenske prostoru.	industrial eco-efficiency methods, methods for cleaner production, optimization of production processes, material and energy recovery of solid wastes, replacement/minimisation of natural resources usage, preservation of natural resources, use of secondary raw materials, recycling, implementation of closed loops, zero waste management, education of employees and product users. Energy: conventional and renewable energy sources, possibilities of renewable energy usage, problems related to renewable energy implementation (logistics, availability, variations, environmental impact), expected trends. Basics of industrial ecology: integrated pollution prevention strategies, LCA (Life Cycle Assessment) approaches, eco-optimization of products and processes, effective transportation, monitoring and improvement of existing systems, importance of local micro-conditions, local, regional and global approach. Implementation of concept of industrial ecology: A case study with product or process relevant in time and place.

Temeljna literatura in viri / Readings:

OSNOVNA LITERATURA-knjižnica:
- P. P. Rogers, K. F. Jalal, J. A. Boyd: An Introduction to Sustainable Developement, Harvard University Press, 2006, 404 strani (30%).
- G. M. Masters: Introduction to Environmental Engineering and Science, Prentice Hall, 1996, 651 strani (20%).
- J.Zagorc-Končan, A. Žgajnar Gotvajn: Zbirka nalog iz ekološkega inženirstva, UL, FKKT, 2008, 45 strani.

DODATNA LITERATURA-knjižnica:
- R.U.Ayres, L.Ayres: A Handbook of Industrial Ecology, Edward Elgar, 2002, 680 strani (15%).

Cilji in kompetence:	**Objectives and Competences:**
Cilji: Poznavanje definicij in pomena trajnostnega razvoja. Spoznanje o lokalnih in globalnih vplivih in vpetosti industrijskega procesa v lokalno in globalno okolje. Kompetence:	Objectives: Knowledge on definitions in sustainable development and awareness of its relevance in modern society. Knowledge on local and global impacts of industrial processes and their incorporation into the local and global environment.

Znanje o pristopih in metodah za dosego trajnostnega razvoja. Razumevanje osnovnih načel za načrtovanje čistejše proizvodnje v obstoječi ali na novo načrtovani proizvodnji v različnih industrijskih branžah. Zavedanje o etični in družbeni odgovornosti in potrebi po nenehnem izpopolnjevanju že postavljenega sistema.	Competences: Knowledge on approaches and methods for implementation of concept of sustainable development. Basics of design and implementation of clean production in existing or/and planned industrial processes. Awareness of ethical and social responsibility and need for constant improvement of existing systems.

Predvideni študijski rezultati:	**Intended Learning Outcomes:**
Znanje in razumevanje Razumevanje povezav in odnosov med osvojenimi pojmi. Sposobnost vrednotenja vpliva procesov (lokalno in globalno) na ljudi in okolje. Znanje za vpeljavo koncepta trajnosti v obstoječ industrijski proces.	Knowledge and Comprehension Understanding relationships between different terms. Ability to evaluate the impact of processes to environment and people locally and globally. Ability to implement the concept of sustainability into new or existing industrial process.
Uporaba Uporaba pridobljenih znanj pri reševanju okoljskih problemov. Sposobnost sinteze in interdisciplinarnega pristopa k reševanju problemov.	Application Ability of applying acquired knowledge for solving environmental problems. Ability of interdisciplinary approach to problem solving.
Refleksija Razumeti pomen izbire ustreznih tehnoloških postopkov in surovin za ohranjanje naravnih virov. Kritično vrednotiti vpliv svojega dela na lokalni in globalni ravni.	Analysis Understand the importance of selection of appropriate technologies and raw materials to protect natural resources. Evaluate the work critically on local as well as global basis.
Prenosljive spretnosti Spretnost uporabe domače in tuje literature. Spretnost identifikacije problema in pristopa k njegovemu učinkovitemu reševanju. Uporaba ustnega in pisnega načina poročanja. Spretnost sinteze na različnih področjih pridobljenih znanj. Spretnost skupinskega dela.	Skill-transference Ability Ability to search, select and apply different types of literature. Ability to independently identify various environmental problems and search for solution. Development of oral and literate skills. Developing the skill of team work.

Metode poučevanja in učenja:	**Learning and Teaching Methods:**
Predavanja Laboratorijske vaje Projektno delo	Lectures Lab course Project work

Načini ocenjevanja:	Delež (v %) / Weight (in %)	**Assessment:**
Opravljene obveznosti pri vajah.	**20%**	Accomplished lab course.
Pisni in ustni izpit.	**70%**	Written and oral exam.
Predstavitev projekta.	**10%**	Project presentation.

Reference nosilca / Lecturer's references:

- ŽGAJNAR GOTVAJN, Andreja, BISTAN, Mirjana, TIŠLER, Tatjana, ENGLANDE, A. J., ZAGORC-KONČAN, Jana. The relevance of bisphenol A adsorption during Fenton's oxidation. International journal of environmental science and technology, ISSN 1735-1472, 2013, vol. 10, no. 6, str. 1141-1148.
- ŽGAJNAR GOTVAJN, Andreja, ZAGORC-KONČAN, Jana. Bioremediation of highway stormwater runoff. V: Conference on Protection and Restoration of the Environment IX, Kefalonia, Greece, June 30-July 3, 2008. Selected papers presented at Protection and restoration of the environment, (Desalination (Amsterdam), ISSN 0011-9164, vol. 248, no. 1/3, 2009). [S. l.: s. n.], 2009, vol. 248, no. 1/3, str. 794-802.
- ŽGAJNAR GOTVAJN, Andreja, ZAGORC-KONČAN, Jana, COTMAN, Magda. Fenton's oxidative treatment of municipal landfill leachate as an alternative to biological process. Desalination, ISSN 0011-9164. [Print ed.], 2011, vol. 275, no. 1/3, str. 269-275.

UČNI NAČRT PREDMETA / COURSE SYLLABUS	
Predmet:	KEMIJA OKOLJA
Course Title:	ENVIRONMENTAL CHEMISTRY

Študijski program in stopnja Study Programme and Level	Študijska smer Study Field	Letnik Academic Year	Semester Semester
VSŠP Kemijska tehnologija, 1. stopnja	/	2.	4.
PSP Chemical Technology, 1st Cycle	/	2nd	4th

Vrsta predmeta / Course Type: obvezni / Mandatory

Univerzitetna koda predmeta / University Course Code: KT133

Predavanja Lectures	Seminar Seminar	Vaje Tutorial	Klinične vaje Work	Druge oblike študija	Samost. delo Individual Work	ECTS
30	20	25 LV	/	/	75	5

Nosilec predmeta / Lecturer: izr. prof. dr. Helena Prosen / Dr. Helena Prosen, 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):
1. Splošni pojmi, lastnosti troposfere, stratosfere. 2. Nastanek, pretvorbe in transport atmosferskih onesnaževal (trdni delci, CO, CO2, SO2, NOx, O3, ogljikovodiki). Pojav ozonskih lukenj in tople grede. Posledice onesnaževanja atmosfere (kisel dež, pojav mračenja). Ukrepi za zmanjšanje onesnaževanja. 3. Površinske in podtalne vode. Kemija in biokemija onesnaževal v hidrosferi. Razgradljiva in nerazgradljiva onesnaževala voda in njihov vpliv na zdravje ljudi. Ukrepi za zmanjševanje onesnaženja voda. 4. Zemlja in glavna onesnaževala. Problem nitratov in fosfatov v površinskih vodah in nitratov v podtalnici. Obstojna kemijska onesnaževala (klorirane spojine, policiklični aromati, fitofarmacevtska sredstva, kovine) in njihova usoda	1. General concepts, properties of troposphere and stratosphere. 2. Sources, transformations and transport of atmospheric pollutants (particulate matter, CO, CO2, SO2, NOx, O3, hydrocarbons). Ozone hole and greenhouse phenomena. Atmospheric pollution consequences (acid rain, dimming). Measures to decrease pollution. 3. Surface and ground water. Chemistry and biochemistry of pollutants in hydrosphere. Degradable and non-degradable pollutants of waters, their influence on public health. Measures to decrease water pollution. 4. Soil and its principal pollutants. Role of nitrates and phosphates in surface waters and nitrates in ground waters. Stable chemical

v okolju. 5. Trdni odpadki - viri. Problemi z odlagališči in sežiganjem odpadkov. 6. Energija in okolje. Jedrska energija in radioaktivni odpadki. 7. Določanje splošnih in specifičnih onesnaževal. Vzorčenje in tehnike priprave okoljskih vzorcev. Hitri testi in senzorji za spremljanje onesnaženja okolja. Analitske tehnike za določanje organskih in anorganskih onesnaževal v atmosferi, v vodah in v zemlji. 8. Ukrepi za zmanjševanje onesnaženja okolja. Laboratorijske vaje: določanje onesnaževal v vzorcih zraka, vode in tal z različnimi analiznimi tehnikami.	pollutants (chlorinated compounds, polycyclic aromatics, phytopharmaceuticals, metals) and their environmental fate. 5. Solid waste - sources. Problematic issues of landfills and waste incinerators. 6. Energy and environment. Nuclear energy and radioactive waste. 7. Determination of general and specific pollutants. Sampling and sample preparation techniques for environmental samples. Rapid tests and sensors for pollution monitoring. Analytical techniques for organic and inorganic pollutant determination in atmosphere, water and soil. 8. Measures to decrease environmental pollution. Laboratory work: pollutant determination in atmospheric, aqueous and soil samples with different analytical techniques.

Temeljna literatura in viri / Readings:

Temeljna literatura:

- G.W. vanLoon, S.J. Duffy: Environmental Chemistry, 3rd ed., Oxford Univ. Press, Oxford UK, 2011, 545 str.
- G. Fellenberg: The Chemistry of Pollution, Wiley 2000, 192 str. (20%)
- B.B. Kebbekus, S.Mitra: Environmental Chemical analysis, Blackie Academic&Profesional, London 1998, 330 str. (30%)

Dopolnilna literatura:

- F.W. Fifield, P.J. Haines (eds.): Environmental Analytical Chemistry, 2nd ed., Blackwell Science, Oxford UK, 2000
- J.E. Girard: Principles of Environmental Chemistry, 2nd ed., Jones and Bartlett Publ., Sudbury, MA, USA, 2010
- znanstveni in strokovni članki / scientific and professional articles

Cilji in kompetence:	**Objectives and Competences:**
Cilji: Predstaviti študentom glavna onesnaževala atmosfere, vod in zemlje, njihove vplive na okolje in njihovo analitiko v okoljskih vzorcih Kompetence: Sposobnost razumevanja osnovnih okoljskih dejstev; sposobnost opazovanja različnih pojavov; sposobnost predstavitve določenih okoljskih problemov ustno in v pisni obliki; sposobnost razreševanja konkretnih okoljskih problemov, sposobnost izbire ustrezne tehnike priprave vzorca in analize za različna onesnaževala.	Objectives: To inform the students about the principal pollutants in atmosphere, water and soil; their influence on the environment; analytical determination in environmental samples. Competences: Ability to understand basic environmental facts; ability to observe diverse phenomena; ability to present selected environmental problems in oral and written form; ability to solve particular environmental problems; ability to select an appropriate sample preparation and analytical technique for

	different pollutants.

Predvideni študijski rezultati:	**Intended Learning Outcomes:**
Znanje in razumevanje Študent bo spoznal osnovna okoljska onesnaževala. Iz lastnosti okoljskih onesnaževal, ki jih je že delno spoznal pri drugih predmetih, lahko oceni njihov vpliv na kvaliteto okolja. Iz predstavljenih procesov za zmanjševanje emisij bo znal oceniti mejne vrednosti posameznih onesnaževal v okolju in jih pravilno določiti s primerno analizno tehniko.	Knowledge and Comprehension Student will be informed about principal environmental pollutants. They can evaluate their influence on environment quality from their properties, which were in part introduced in other courses. Limit values of certain pollutants in the environment will be evaluated from the presented processes for emission lowering and accurately determined by an appropriate analytical technique.
Uporaba Študent je sposoben kritično ovrednotiti vpliv posameznega onesnaževala na okolje in oceniti nevarnost, ki jo predstavlja za ljudi.	Application Student is able to critically evaluate the influence of particular pollutant on the environment and assess the risk for the population.
Refleksija Študent bo pridobil tudi določen občutek za kritično oceno kvalitete okolja.	Analysis Student will gain a certain ability to critically evaluate the environmental quality.
Prenosljive spretnosti Študent bo znal uporabljati osnovne analizne metode za hitro določanje onesnaževal. Na osnovi teh meritev in njihove kritične ocene bo lahko sklepal o onesnaženosti okolja.	Skill-transference Ability Student will be able to apply basic analytical methods for rapid pollutant determination. They will be able to assess the environmental pollution, based on these measurements and their critical evaluation.

Metode poučevanja in učenja:	**Learning and Teaching Methods:**
Predavanja, seminarji in laboratorijske vaje	Lectures, seminars, laboratory work

Načini ocenjevanja:	Delež (v %) / Weight (in %)	**Assessment:**
pisni izpit (poz. ocena 6-10), seminarska naloga z ustno predstavitvijo, laboratorijske vaje	**60%** **30%** **10%**	written exam (pass grade 6-10), seminar work with oral presentation, laboratory work

Reference nosilca / Lecturer's references:

1. **PROSEN, Helena**, ZUPANČIČ-KRALJ, Lucija. Evaluation of photolysis and hydrolysis of atrazine and its first degradation products in the presence of humic acids. Environ. pollut. (1987) 2005, vol. 133, no. 3, 517-529.
2. **PROSEN, Helena**, FINGLER, Sanja, ZUPANČIČ-KRALJ, Lucija, DREVENKAR, Vlasta. Partitioning of selected environmental pollutants into organic matter as determined by solid-phase microextraction. Chemosphere (Oxford). 2007, vol. 66, no. 8, 1580-1589.
3. KRALJ CIGIĆ, Irena, **PROSEN, Helena**. An overview of conventional and emerging analytical methods for the determination of mycotoxins. Int. J. Mol. Sci. 2009, vol. 10, no. 1, 62-115.

Predmet:	KEMIJSKA IN PROCESNA VARNOST
Course Title:	CHEMICAL AND PROCESS SAFETY

Študijski program in stopnja Study Programme and Level	Študijska smer Study Field	Letnik Academic Year	Semester Semester
VSŠP Kemijska tehnologija, 1. stopnja	**/**	**2.**	**4.**
PSP Chemical Technology, 1st Cycle	**/**	**2nd**	**4th**

Vrsta predmeta / Course Type: obvezni / Mandatory

Univerzitetna koda predmeta / University Course Code: KT136

Predavanja Lectures	Seminar Seminar	Vaje Tutorial	Klinične vaje Work	Druge oblike študija	Samost. delo Individual Work	ECTS
45	**15**	**15 LV**	**/**	**/**	**75**	**5**

Nosilec predmeta / Lecturer: doc. dr. Barbara Novosel / Dr. Barbara Novosel, Assistant 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):
Prepoznavanje, razumevanje in obvladovanje nevarnosti zaradi uporabe različnih kemikalij in nevarnih snovi. Nevarne snovi: eksplozivne, vnetljive, oksidativne, strupene, radioaktivne, jedke in okolju nevarne kemikalije ter plini. Prevoz in skladiščenje nevarnih kemikalij. Nov evropski sistem obvladovanja tveganja pri ravnanju s kemikalijami - REACH. Varnost pri delu v laboratoriju, kemijskih in drugih procesnih industrijah. Kompleksnost delovanja industrijskega procesa, tehnološki režim in standardni proizvodni postopki, ustreznega vzdrževanja posameznih naprav in celotnega sistema. Verjetnost za nastanek izrednih situacij ter preprečevanje in ukrepanje v takih primerih. Analiza	Identifying, understanding and managing risk due to the use of various chemicals and hazardous substances. Hazardous substances: explosive, flammable, oxidizing, toxic, radioactive, corrosive and environmentally hazardous chemicals and gases. Transportation and storage of hazardous chemicals. A new European system of risk management in handling the chemicals - REACH. Safety at work in a laboratory, chemical and other process industries. The complexity of the operation of industrial processes, technological regime and the standard manufacturing procedures, proper maintenance of individual devices and the entire system. Probability of stress and prevent or take action in such cases. Analysis of industrial processes

industrijskih procesov in priprava ocen tveganja. Zajemanje pomembnih in kritičnih parametrov ter pogojev procesa, ki vplivajo na njegovo varnost, možni scenariji izrednih dogodkov. Verjetnost dogodka in analiza odpovedi. Kvalitativna in kvantitativna ocena tveganja. Določevanje ukrepov za zmanjšanje tveganja. Vaje: iskanje varnostnega lista, priprava navodil za delo z nevarno kemikalijo; vnetljive tekočine, določitev plamenišča; vnetljive trdne snovi, razvrščanje; plini, označevanje, določevanje trenutnih koncentracij; prašne eksplozije, določevanje minimalne eksplozijske energije; jedke snovi, razredčevanje, nevtralizacija.	and the preparation of risk assessments. Capture important and critical process parameters and conditions that affect the security of the possible scenarios of emergencies. Probability of the event and failure analysis. Determination of risk reduction measures. Tutorial: Student must find the safety data sheet, and createsafety card; flammable liquids, flash point determination; flammable solids, clasification; labeling, measuring of current concentrations of gases; dust explosions, minimum ignition energy determination; corrosive substances, dilution, neutralization

Temeljna literatura in viri / Readings:

- Burke R.: Hazardous materials chemistry for emergency responders , 3rd Ed., CRC Press, Boka Raton, 2013., 527 str., (30%)
- Brauer, R. L.: Safety and health for engineers, 3rd Ed., Wiley, cop. Hoboken (New Jersey), 2016, 765 str. (30 %)
- Crowl D.A., Louvar J.F., Chemical Process Safety, 2nd Ed., Prentice Hall PTR, New Jersey 2002, (str.625) (10 %) OSTANE??

Cilji in kompetence:	**Objectives and Competences:**
Pri predmetu se študenti seznanijo z zahtevnostjo in kompleksnostjo zagotavljanja varnosti pri delu z različnimi kemikalijami v laboratoriju in v kemijskih ter procesnih industrijah. Spoznajo potrebo po natančnem poznavanju vseh lastnosti kemikalij, ki jih pri svojem delu uporabljajo. Pridobljeno znanje usposobi študenta za razumevanje in presojanje nevarnosti oziroma stopnje tveganja ter za določitev ukrepov, ki zagotavljajo varno delo z nevarnimi kemikalijami. Študentje spoznajo, da je za varno delo v industriji osnovni pogoj natančno poznavanje vseh faz procesa in podrobna analiza njegovega delovanja na osnovi katere se izvede ocene tveganja. Spoznajo, da je varnost procesa pogojena z mnogo dejavniki in da je za njegovo varno obratovanje potrebno tako optimalno delovanje posameznih procesnih operacij kot tudi usklajeno delovanje sistema kot celote. Neustrezno načrtovanje, vodenje ali, vzdrževanje procesa lahko vodi do odstopanj od tehnološkega režima in ogrožanja	At this subject students get acquainted with pretentiousness and the complexity of ensuring safety at work with various chemicals in the laboratory and in the chemical and process industries. Learn about the need of precise knowledge of the characteristics of chemicals they use at work. The course enables understanding and assessment of hazards and level of risk, and the measures for safe and healthy work. Students learn that basic conditions for safe work in industry are exact knowledge of all phases of the process and detailed analysis of its performance on the basis a risk assessment. Students learn that process safety depends on many factors and for safe operation is necessary so optimize the performance of individual part of the process operation as well as the coordinated operation of the system as a whole. Inadequate planning, management or maintenance process can lead to deviations

varnosti. Napake se lahko širijo po celotnem sistemu, potencirajo in lahko vodijo do nastanka izrednih razmer, ogrožanja delovnega in širšega okolja. Študentje se pri predmetu usposobijo za sistematičen pregled kemijskih in drugih sorodnih procesov, zaznavanje potencialnih kritičnih mest, priprave ocene tveganja in ukrepov za zmanjšanje tveganja.	from the technological regime and security threats. Errors may spread throughout the system, potentiate, and may lead to the formation of an emergency, endangering the work and the wider environment. Students are trained in the course of a systematic review of chemical and other related processes, identify potential critical points, preparation of risk assessment and risk reduction measures.

Predvideni študijski rezultati:	**Intended Learning Outcomes:**
Znanje in razumevanje Študentje se pri predmetu usposobijo za sistematičen pregled nevarnosti pri uporabi nevarnih kemikalij ter pri delu v kemijskih in sorodnih procesih, za zaznavanje potencialnih kritičnih mest, pripravo ocene tveganja in ukrepov za zmanjšanje tveganja.	Knowledge and Comprehension The subject makes students capable of a systematic review of the risks of using dangerous chemicals and work in the chemical and related processes for detecting potential critical points, risk assessment and risk reduction measures.
Uporaba Delo z nevarnimi kemikalijami. Vodenje in nadzor kemijskih procesov. Ocenjevanje tveganja kemijskih procesov. Analiza nezgod in določevanje ukrepov za preprečitev nezgod.	Application Work with hazardous chemicals. Management and control of chemical processes. Risk assessment of chemical processes. Analysis of accident and determination of measures to prevent accidents.
Refleksija Študenta se usmeri v podrobnejši pregled lastnosti posamezne kemikalije z namenom, da ugotovi nevarnosti snovi za človeka in okolje. Na osnovi spoznanj mora določiti varnostne ukrepe za zmanjšanje ali celo eliminacijo tveganja pri rabi kemikalije. Glede na veljavno SI zakonodajo so podana znanja osnova za opravljanje izpita za svetovalce za kemikalije v različnih podjetjih, kakor tudi temelji za delo v carinski, komercialni ali inšpektorski službi.	Analysis A student will be directed to a more detailed examination of the properties of each chemical in order to identify the hazards of the substance for humans and the environment. Based on the findings should establish the security measures for the reduction or even elimination of risk in the use of chemicals. According to the current SI legislation are given the knowledge base for the exam for counselors of chemicals in different companies, as well as based on the work of customs, commercial or inspector service.
Prenosljive spretnosti Sistematičen, analitičen pristop do reševanja problema, več razumevanja in upoštevanja varnostne kulture v širšem kontekstu.	Skill-transference Ability Systematic, analytical approach to problem solving, more understanding and observance of safety culture in a broader context.

Metode poučevanja in učenja:	**Learning and Teaching Methods:**
Predavanja, seminarji, praktične vaje.	Lectures, seminars, practical exercises.

Delež (v %) /

Načini ocenjevanja:	Weight (in %)	**Assessment:**
Seminar (pisni in predstavitev), pisni izpit (računske naloge), ustni izpit (15 min), ocenjevalna lestvica skladna s Statutom UL, pri pisnih izpitih min 50 % možnih točk		Submitted reports on practical exercises.
Seminar	**20 %**	Presentation of the seminar.
pisni izpit	**50 %**	Written exam
ustni izpit	**30 %**	Oral examination.

Reference nosilca / Lecturer's references:

- SLABAJNA, Dominika, **NOVOSEL, Barbara**. Smernica za zagotavljanje varnosti in zdravja v kemijskih laboratorijih : projekt Kemijska varnost 3. Ljubljana: Urad RS za kemikalije: Univ. v Ljubljani, Fak. za kemijo in kemijsko tehnologijo, 2010. 48 str., ilustr. http://www.fkkt.uni-lj.si/si/?2416. [COBISS.SI-ID 34765317]

- **NOVOSEL, Barbara**, MARINŠEK, Marjan. Računska obravnava kemijskih procesov : zbirka nalog. V Ljubljani: Fakulteta za kemijo in kemijsko tehnologijo, 2003. 132 str., ilustr. ISBN 961-6286-56-0. [COBISS.SI-ID 125977600]
NOVOSEL, Barbara. Ugotavljanje kritičnih mest v kemijski industriji in zmanjševanje tveganja nezgod. V: BRVAR, Miran (ur.). Kemijske nesreče na delovnem mestu : zbornik prispevkov. Ljubljana: Slovensko zdravniško društvo, Sekcija za klinično toksikologijo, 2013, str. 78-83. [COBISS.SI-ID 1654319]

- MAČEK, Jadran, **NOVOSEL, Barbara**, MARINŠEK, Marjan. Anorganska kemijska tehnologija, Navodila za vaje za 3. letnik UN ŠP Kemijsko inženirstvo. Ljubljana: Fakulteta za kemijo in kemijsko tehnologijo, Katedra za anorg. kem. tehnologijo in materiale, 2001/2002. III, 61 str., tabele. [COBISS.SI-ID 24156165]

- MISLEJ, Vesna, **NOVOSEL, Barbara**, VUK, Tomaž, GRILC, Viktor, MLAKAR, Ernest. Combustion behaviour and products of dried sewage sludge - prediction by thermogravimetric analysis and monitoring the co-incineration process in a cement factory. V: 20th International Congress of Chemical and Process Engineering [and] 15th Conference PRES, 25 - 29 August 2012, Prague, Czech Republic. CD-ROM of full texts. Prague: [s. n.], cop. 2012, str. [1-11]. [COBISS.SI-ID 5083674]

UČNI NAČRT PREDMETA / COURSE SYLLABUS	
Predmet:	MATEMATIKA IN STATISTIKA
Course Title:	MATHEMATICS AND STATISTICS

Študijski program in stopnja Study Programme and Level	Študijska smer Study Field	Letnik Academic Year	Semester Semester
VŠP Kemijska tehnologija, 1. stopnja	**/**	**1.**	**1. in 2.**
HSP Chemical Technology, 1st Cycle	**/**	**1.**	**1st and 2nd**

Vrsta predmeta / Course Type: Obvezni / Mandatory

Univerzitetna koda predmeta / University Course Code:

Predavanja Lectures	Seminar Seminar	Vaje Tutorial	Klinične vaje Work	Druge oblike študija	Samost. delo Individual Work	ECTS
90	**/**	**60 SV**	**/**	**/**	**150**	**10**

Nosilec predmeta / Lecturer: izr. prof. dr. Karin Cvetko Vah / Dr. Karin Cvetko Vah, 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):
Limite funkcij: računske operacije s funkcijami (vsota, produkt, kompozitum, inverzna funkcija), zveznost, asimptote, lastnosti zveznih funkcij. **Odvod in njegova uporaba:** geometrijski pomen, pravila za odvajanje, odvodi elementarnih funkcij, diferencial in njegova uporaba, višji odvodi, L' Hospitalovo pravilo, ekstremi, konveksnost, konkavnost in prevoji, uporaba odvoda. **Funkcije več spremenljivk:** funkcija dveh spremenljivk in njen graf, zveznost, parcialni odvodi, posredno odvajanje, implicitne funkcije, totalni diferencial, gradient, ekstremi, vezani ekstremi. **Nedoločeni integral**: osnovne lastnosti, integriranje po delih, vpeljava nove	**Limits of functions:** computation with functions (sum, product, composition, inverse), continuity, asimptotes, properties of continuous functions. **The derivative and its application:** the geometric meaning, rules for differentiation, the derivatives of elementary functions, the differential and its applications, higher derivatives, L'Hospitale rule, minima and maxima, convexity and concavity, application of the derivative. **Functions of several variables**: functions of two variables and their graphs, continuity, partial derivatives, the chain rule, implicit functions, extrema, constrained extrema.

spremenljivke, integrali osnovnih elementarnih funkcij (racionalnih in nekaterih trigonometrijskih). **Določeni integral**: geometrijski pomen in osnovne lastnosti, zveza z nedoločenim integralom, izlimitirani integrali. **Uporaba integrala:** ploščina, ločna dolžina, prostornina in površina vrtenine, težišče, vztrajnostni moment. **Diferencialne enačbe:** enačbe prvega reda z ločljivima spremenljivkama, homogene, linearne, linearne diferencialne enačbe drugega reda s konstantnimi koeficienti, sistemi linearnih diferencialnih enačb prvega reda s konstantnimi koeficienti, uporaba v kemiji in drugod. **Osnove statistike**: predstavitev podatkov, populacija, vzorec, cenilke. Hipoteze, korelacija in linearna regresija, metoda najmanjših kvadratov. Intervali zaupanja za srednjo vrednost in disperzijo ter testiranje hipotez.	**The indefinite integral**: basic properties, integration per partes, change of variables, integration of elementary functions (rational and certain trigonometric ones). **The definite integral**: the geometric meaning and basic properties, the fundamental theorem of calculus, improper integrals. **Application of integration:** calculations of areas, arc lenghts, volumes and surfaces of revolution, centers of mass, moments of inertia. **Differential equations**: equations of order 1, separation of variables, homogeneous and linear equations, second-order linear differential equations with constant coefficients, systems of linear differential equations, applications to chemistry and elsewhere. **The basics of statistics:** data presentation, population, samples, estimators. Hypothesis, correlation and linear regression, the least square method. Interval estimation and hypothesis testing.

Temeljna literatura in viri / Readings:

R. Jamnik, Matematika, DMFA Slovenije, Ljubljana, 1994.
P. Šemrl, Osnove višje matematike, DMFA Slovenije, Ljubljana, 2009.
Dopolnilna literatura:
- A. Turnšek, Tehniška matematika, FS, Ljubljana, 2007, 306 str.
- P. Mizori – Oblak, Matematika za študente tehnike in naravoslovja, FS, UL Ljubljana, 2001.
- P. Mizori – Oblak, Matematika za študente tehnike in naravoslovja, 2. del, FS UL, Ljubljana, 1997.
- I. Vidav, Višja matematika I, DMFA Slovenije, Ljubljana, 1994, 477 str.
- G. Doggett, B. T. Sutcliffe, Mathematics for Chemistry, Longman, 1995, 286 str.

Cilji in kompetence:	**Objectives and Competences:**
Cilj predmeta: Seznaniti študente z osnovnimi metodami matematične analize in linearne algebre, potrebnimi pri nadaljnem študiju, ki spadajo v temeljno izobrazbo naravoslovca ali tehnika. **Predmetno specifične kompetence:** Pridobljeno znanje bo študentu omogočilo boljše razumevanje drugih strokovnih predmetov. Imel bo možnost pridobiti nekaj temeljnih matematičnih pojmov in spretnosti, ki so potrebne za razumevanje strokovne literature in tudi za uspešno opravljanje dela.	To familiarize students with calculus and basic linear algebra necessary for further study. This is a usual part of curriculum for students of science and technology. This enables students to better understnad some other areas of their study. It gives them an oportunity to acquire basic mathematical skills needed to follow the literature in their own speciality.

Predvideni študijski rezultati:	**Intended Learning Outcomes:**
Znanje in razumevanje Razumevanje pojmov funkcijske odvisnosti, limite, odvoda in integrala, poznavanje metod reševanja nekaterih elementarnih tipov diferencialnih enačb in njihove uporabe v kemiji (in drugod), osnovna analiza funkcij več spremenljivk.	Knowledge and Comprehension Students should understand the concepts of functional dependence, limits, differentiation and integration, and acquire the skill of solving certain types of differential equations and their application to chemistry (and elsewhere), basic analysis of functions of several variables.
Uporaba Uporaba zgoraj omenjenih pojmov pri reševanju konkretnih nalog iz matematike, fizike in kemije.	Application Students should be able to apply calculus and linear algebra to problems from physics and chemistry.
Refleksija Gre za poglobitev in bistveno razširitev v srednji šoli pridobljenega znanja matematike, ki je nujno za razumevanje naravoslovnih znanosti.	Analysis The course gives a considerable extension of the mathematical knowledge that the students acquired in high school, which is essential for the understanding of any natural science and chemistry in particular.
Prenosljive spretnosti Predmet daje tudi osnovo za razumevanje nekaterih računalniških postopkov in metod, ki jih bodo spoznali kasneje pri drugih predmetih in ob delu.	Skill-transference Ability The knowledge of calculus is necessary for effective use of computer modeling in science, which the students will meet later in the course of their study.

Metode poučevanja in učenja:	**Learning and Teaching Methods:**
Predavanja, vaje, sodelovalno učenje / poučevanje.	Lectures, exercises, homework, consultations.

Načini ocenjevanja:	Delež (v %) / Weight (in %)	**Assessment:**
Pisni izpit iz praktičnega dela (ali štirje kolokviji).	**50%**	Written practical exam (or four midterm tests).
Teoretični izpit. Od 6-10 (pozitivno), 1-5 (negativno).	**50%**	Oral exam.

Reference nosilca / Lecturer's references:

- **Cvetko-Vah, Karin**; Leech, Jonathan; Spinks, Matthew. Skew lattices and binary operations on functions, J. Appl. Log. 11 (2013), no. 3, 253--265.
- Bauer, Andrej; **Cvetko-Vah, Karin**. Stone duality for skew Boolean algebras with intersections, Houston J. Math. 39 (2013), no. 1, 73--109.
- **Cvetko-Vah, Karin**; Leech, Jonathan. Rings whose idempotents form a multiplicative set, Comm. Algebra 40 (2012), no. 9, 3288--3307.
- **Cvetko Vah, Karin**; Pisanski, Tomaž. A census of edge-transitive planar tilings, J. Combin. Math. Combin. Comput. 80 (2012), 243--265.
- Carfi, David; **Cvetko-Vah, Karin**. Skew lattice structures on the financial events plane, Appl. Sci. 13 (2011), 9--20.

UČNI NAČRT PREDMETA / COURSE SYLLABUS	
Predmet:	MEHANSKE OPERACIJE
Course Title:	MECHANICAL OPERATIONS

Študijski program in stopnja Study Programme and Level	Študijska smer Study Field	Letnik Academic Year	Semester Semester
VSŠP Kemijska tehnologija, 1. stopnja	**/**	**3.**	**5.**
PSP Chemical Technology, 1st Cycle	**/**	**3rd**	**5th**

Vrsta predmeta / Course Type: obvezni / Mandatory

Univerzitetna koda predmeta / University Course Code: KTSI3

Predavanja Lectures	Seminar Seminar	Vaje Tutorial	Klinične vaje Work	Druge oblike študija	Samost. delo Individual Work	ECTS
45	**15**	**15 LV**	**/**	**/**	**75**	**5**

Nosilec predmeta / Lecturer: izr. prof. dr. Marjan Marinšek / Dr. Marjan Marinšek, 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):**
1. **Priprava zrnatih kolektivov** (fizikalno kemijske metode priprave, mehanske metode priprave) 2. Naprave in tehnologije priprave ter procesov **večanja površin** 3. **Velikost in porazdelitev velikosti**, fizikalni principi merjenja velikosti delcev 4. **Oblika delcev** (faktor oblike) 5. **Specifična površina** (določevanje specifične površine iz granulacijske sestave, določevanje specifične površine z adsorpcijo plinov) 6. **Poroznost** in porazdelitev por 7. **Gostota** sipkih snovi 8. **Vzorčenje** sipkih snovi 9. Procesi **manjšanja površin** 10. **Transport** sipkih snovi	1. **Preparation of dispersed systems**: physical-chemical methods, mechanical methods 2. Principles of **grinding and milling** 3. **Particle size and size distribution**: particle size definition and measurements principles. 4. **Particle shape**: (shape factor) 5. **Specific surface of dispersed systems**: basic principles and surface measurement 6. **Porosity and pore distribution in disperse systems**: 7. **Density of dispersed systems**: 8. **System sampling**: 9. **Agglomeration in dispersed systems**: 10. **Transport of dispersed systems**: **Seminar work**: Mechanical operations through

Seminar: Slušatelji v okviru seminarja rešujejo računske primere, ki ilustrirajo principe priprave in karakterizacije zrnatih kolektivov. **Vaje:** Pri vajah se slušatelji praktično seznanijo z bistvenimi metodami priprave (mletje) in karakterizacije delcev (vzorčenje, merjenje velikosti, določevanje specifične površine)	mathematical problems **Tutorial work**: Laboratory work to demonstrate basic principles of mechanical operations.

Temeljna literatura in viri / Readings:

- J. Stražišar, Mehanska procesna tehnika, Univerza v Ljubljani, FNT, Ljubljana 1996, 138 strani
- T. Allen, Particle Size Measurement, Vol.1, 5th ed., Chaopman & Hall, London 1997, 774 strani
- M. Rhodes, Introduction to Particle technology, John Wiley & Sons, 1998, 320 strani
- R.H. Perry, Perry's Chemical Engineers Handbook, 7th. ed., McGraw-Hill, New York, 1997, 2581 strani

Cilji in kompetence:	**Objectives and Competences:**
Namen predmeta je priprava in karakterizacija zrnatih kolektivov. V okviru predmeta študent osvoji osnovna znanja o karakterizaciji delcev, ki vključujejo definicije velikosti delcev, njihove oblike, specifične površine, vzorčenja ter določevanja gostote sipkih snovi. V okviru predmeta bo študent pridobil tudi osnovna znanja o procesih večanja površin ter potrebni tehnološki opremi.	Definition and characterization of dispersed systems. Students acquire basic knowledge about dispersed system preparation and characterization including particle size and shape, system specific surface and density, as well as basic knowledge of dispersed system grinding and milling or system agglomeration.

Predvideni študijski rezultati:	**Intended Learning Outcomes:**
Znanje in razumevanje Študentje spoznajo osnovne principe ter naprave za pripravo zrnatih kolektivov. Osvojijo tudi osnovne metode njihove karakterizacije.	Knowledge and Comprehension Basic knowledge about principles and equipment for dispersed systems preparation and characterization.
Uporaba S pridobljenim znanjem je študent sposoben v laboratorijske kakor tudi v industrijskem merilu, glede na predpisane zahteve, izbrati primeren postopek priprave delcev ter njihove karakterizacije.	Application Students are capable of choosing equipment for particle tailoring in laboratory or industrial scale.
Refleksija Na osnovi pridobljenega znanja študent pridobi občutek za smotrno izbiro najprimernejšega tehnološkega postopka priprave zrnatega kolektiva.	Analysis Students are capable of choosing appropriate equipment for dispersed system preparation in laboratory or industrial scale.
Prenosljive spretnosti Laboratorijske spretnosti na področju zrnatih kolektivov, seznanitev in učenje iz domače in tuje literature, pisna in ustna predstavitev izbrane tematike, delov skupina	Skill-transference Ability Developed laboratory skills in the field of dispersed systems, literature research; literature data collecting, data analysis and interpretation, team work.

Metode poučevanja in učenja:	**Learning and Teaching Methods:**
Predavanja, seminar, laboratorijsko delo	Lectures, seminars, tutorial work

Načini ocenjevanja:	Delež (v %) / Weight (in %)	**Assessment:**
Preverjanja znanja – izpit - (2/3 skupne ocene) od tega pisni izpit (40% ocene) in ustni izpit (60% ocene). Izpit se v celoti lahko opravi z vmesnimi kolokviji in opravljeno seminarsko nalogo (seminarska naloga 20% ocene). Vaje: Opravljene vaje. Ocena vaj predstavlja 1/3 skupne ocene predmeta. Pozitivna ocena 6-10, negativna ocena 1-5		Written (40%) and oral (60%) exam. The exam can be accomplished also by achieving positive grades at written colloquiums during the semester (80%) and prepared individual seminar work (20%). Pass grades from 6 to 10, fail grades from 1 to 5. Tutorial work must be done before taking an exam.

Reference nosilca / Lecturer's references:

- **MARINŠEK, Marjan**, ZUPAN, Klementina. Influence of the granulation and grain shape of quartz sands on the quality of foundry cores = Vpliv granulacije in oblike zrn kremenovega peska na kakovost livarskih jeder. Materiali in tehnologije, ISSN 1580-2949, 2011, letn. 45, št. 5, str. 451-455
- BITENC, Marko, **MARINŠEK, Marjan**, CRNJAK OREL, Zorica. Preparation and characterization of zinc hydroxide carbonate and porous zinc oxide particles. Journal of the European Ceramic Society, ISSN 0955-2219. [Print ed.], 2008, vol. 28, no. 15, str. 2915-2921
- MAČEK, Jadran, KAPUN, Gregor, **MARINŠEK, Marjan**. Priprava sub- in mikrometrskih srebrovih prahov = Preparation of sub- and micrometer silver powders. Materiali in tehnologije, ISSN 1580-2949, 2005, letn. 39, št. 4, str. 113-118

UČNI NAČRT PREDMETA / COURSE SYLLABUS	
Predmet:	MERITVE IN OSNOVE REGULACIJE PROCESOV
Course Title:	MEASUREMENTS AND FUNDAMENTALS OF PROCESS CONTROL

Študijski program in stopnja Study Programme and Level	Študijska smer Study Field	Letnik Academic Year	Semester Semester
VSŠP Kemijska tehnologija, 1. stopnja	**/**	**3.**	**5.**
PSP Chemical Technology, 1st Cycle	**/**	**3rd**	**5th**

Vrsta predmeta / Course Type: obvezni / Mandatory

Univerzitetna koda predmeta / University Course Code:

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: prof. dr. Andrej Jamnik / Dr. Andrej Jamnik, Full 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):**
Merjenje procesnih spremenljivk Metrologija. Merski sistem. Enote in standardi. Hierarhija standardov. Sledljivost kalibracijske opreme do nacionalnih in mednarodnih standardov. Statične karakteristike merilnih instrumentov. Merjenje tlaka, nivoja, pretoka, temperature. Merjenje nekaterih ostalih količin. **Avtomatska regulacija procesov** Namen in pomen avtomatske regulacije kemijskih procesov. Osnovni pojmi in terminologija. Instrumentacijski in blokovni diagram, značilni elementi regulacijskega kroga. Odprti in zaprti regulacijski krog. Negativna povratna zanka. Standardni signali za prenos informacije v regulacijski zanki. Analogno-digitalna in digitalno analogna pretvorba signalov.	**Measurements of process variables** Metrology. Measurement system. Units and standards. Hierarchy of standards. Traceability of measurements. Static characteristics of measuring instruments. Pressure, level, flow, temperature measurements. Measurements of some other process variables. **Process control** Incentives for chemical process control. Basic concepts and terminology. Feedback loop. Open and closed control loop. Instrumentation and block diagrams. Standard signals for transmission of information in the control loop. Analog-to-digital and digital-to-analog signal conversion. **Dynamic characteristics of systems**

Dinamične karakteristike sistemov Časovni odzivi sistemov prvega in drugega reda na različne vhodne spremenljivke. **Izvršilni členi:** Avtomatski regulirni ventil. Regulirne črpalke. **Vrste povratnozančnih (feedback) regulatorjev** Dvopoložajna in tripoložajna regulacija. Proporcionalni, integrirni in diferencirni ter kombinirani načini regulacije. Avtomatska regulacija enostavnih procesov: regulacija temperature, nivoja in pH. **Laboratorijske vaje** Merjenje tlaka, pretoka, temperature in nekaterih drugih procesnih količin. Umerjanje instrumentov. Dinamične karakteristike sistemov 1., 2. in višjih redov. Laplaceova transformacija. Prenosne funkcije in njihova uporaba v regulacijski tehniki. Regulacija temperature, nivoja in pH. Karakteristike regulirnih ventilov. Dvopoložajna, P, PI in PID regulacija. Avtomatsko zajemanje podatkov.	Dynamic response of first and second-order measuring devices and processes on different input variables. **Final control elements**: pneumatic control valve and control pumps. **Types of feedback controllers** Two and three position controllers. Proportional, integral, derivative and other types of feedback controllers. Examples of simple control systems: control of temperature, level, and pH. **Laboratory practice** Measurement of pressure, flow, temperature and some other process variables. Calibration of some process measuring instruments. Dynamic characteristics of first, second and higher order systems. Laplace transforms. Transfer functions and the input-output models. Temperature, liquid level and pH control. Characteristics of control valves. Characteristics of the ON/OFF, P, PI and PID controllers. Automatic data acquisition.

Temeljna literatura in viri / Readings:

- P.W. Murrill, *Fundamentals of process control theory* (2. izdaja), Instrument Society of America (1993), 265 str., 40%.
- C.D. Johnson, *Process Control Instrumentation Technology* (5. izdaja), Prentice-Hall Inc. (1997), 638 str., 25%
- C. Pohar in sodelavci, *Praktikum iz meritev, regulacije in avtomatizacije*, interna skripta Katedre za fizikalno kemijo, Ljubljana (1994).

Dopolnilna literatura:
- R. Karba, *Gradniki sistemov vodenja* (1. izdaja), Ljubljana: Založba FER (1994). 326 str.
- G. Platt, *Process Control – A Primer for the Nonspecialist and the Newcomer* (2. izdaja), Instrument Society of America (1993), 207 str., 40%.

Cilji in kompetence:	**Objectives and Competences:**
Študenti spoznajo osnovne principe regulacijskega kroga s poudarkom na merjenju procesnih spremenljivk. Pridobijo temeljno znanje, ki je potrebno za nadaljnji samostojni študij na tem hitro razvijajočem se področju in za dialog s specialisti iz drugih strok.	The course informs the student with the basic principles of control loop with special emphasis on the measurement of process variables. It offers them the basic knowledge needed for further independent study in this rapidly developing field and make possible to dialogue with specialists from other disciplines.

Predvideni študijski rezultati:	**Intended Learning Outcomes:**

Znanje in razumevanje Poznavanje različnih načinov merjenja procesnih spremnljivk. Razumevanje delovanja regulacijske zanke, osnov avtomatske regulacije, dinamičnih karakteristik regulacijskih sistemov in merilnih inštrumentov.	Knowledge and Comprehension Knowledge of different ways for measurements of various process variables. Understanding the operation of control loop, the basics of automatic control and dynamic characteristics of control systems and measuring instruments.
Uporaba Pridobljeno znanje je širše uporabno in ni omejeno zgolj na področje kemijske tehnologije.	Application Acquired knowledge is widely applicable and not limited only to the field of chemical technology.
Refleksija Na podlagi pridobljenega znanja o meritvah in regulaciji se bo študent sposoben bolje in hitreje vključiti v tehnološko-procesno delovno okolje.	Analysis On the basis of the knowledge about the measurements and process control, the student will be able to better and more quickly incorporate into the technological process working environment.
Prenosljive spretnosti Študent je sposoben povezati znanje iz več predmetov v celoto ter ga uporabiti pri svojem delu tako v teku študija kot tudi kasneje pri opravljanju svojega poklica.	Skill-transference Ability The students are able to complement knowledge from this course with those obtained in other subjects and use it in their work both in the course of the study as well as later in the professional career.

Metode poučevanja in učenja:	**Learning and Teaching Methods:**
Predavanja, seminarji, laboratorijske vaje.	Lectures, seminars, laboratory practice.

Načini ocenjevanja:	Delež (v %) / Weight (in %)	**Assessment:**
Pisni izpit po uspešno opravljenih laboratorijskih vajah. Ocenjevanje: 6-10 (pozitivno); 1-5 (negativno).	**100 %**	Written examination after successful completion of practical work. Marks: 6-10 (positive); 1-5 (negative).

Reference nosilca / Lecturer's references:

- J. Orehek, I. Dogša, M. Tomšič, **A. Jamnik**, D. Kočar, D. Stopar, Structural investigation of carboxymethyl cellulose biodeterioration by Bacillus subtilis subsp. subtilis NCIB 3610, Int. Biodeterioration & Biodegradation 77, 2013, 10-17.
- A. Lajovic, M. Tomšič, G. Fritz-Popovski, L. Vlček, **A. Jamnik**, Exploring the structural properties of simple aldehydes: A Monte Carlo and small-angle x-ray scattering study, J. Phys. Chem. B 113, 2009, 9429-9435.
- M. Tomšič, **A. Jamnik**, G. Fritz, O. Glatter, L. Vlček, Structural properties of pure simple alcohols from ethanol, propanol, butanol, pentanol, to hexanol: Comparing Monte Carlo simulations with experimental SAXS data, J. Phys. Chem. B 111, 2007, 1738-1751.

UČNI NAČRT PREDMETA / COURSE SYLLABUS	
Predmet:	ORGANSKA ANALITIKA IN SPEKTROSKOPIJA
Course Title:	ORGANIC ANALYSIS AND SPECTROSCOPY

Študijski program in stopnja Study Programme and Level	Študijska smer Study Field	Letnik Academic Year	Semester Semester
VSŠP Kemijska tehnologija, 1. stopnja	/	3.	6.
PSP Chemical Technology, 1st Cycle	/	3rd	6th

Vrsta predmeta / Course Type: izbirni strokovni / Elective Professional

Univerzitetna koda predmeta / University Course Code: KTSI33

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

Nosilec predmeta / Lecturer: prof. dr. Janez Košmrlj / Dr. Janez Košmrlj, Full 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):
Separacijske metode. Ločba zmesi na osnovi razlik v fizikalnih lastnostih (topnost v vodnih raztopinah, raztopinah kislin in baz, organskih topilih; vrelišče). Kromatografske metode (teoretske osnove, vrste kromatografskih metod) in uporaba v analizi organskih spojin (uporaba v preparativne namene, ločba zmesi, ločba enantiomerov). **Identifikacija organskih spojin**. Kvalitativna in kvantitativna organska analiza. Testi na funkcionalne skupine in priprava derivatov. **Spektroskopske metode**. Ultravijolična in vidna spektroskopija. Infrardeča spektroskopija (karakteristični absorbcijski trakovi za funkcionalne skupine, interpretacija infrardečih spektrov, aplikacija IR na organske strukturne probleme). Jedrska magnetna resonanca (kemijski premik,	Separation techniques. Separation of organic compounds from the mixtures based on different physical properties (distillation, and solubility in water, organic solvents, acid-base extraction). Chromatographic techniques: Theoretical background, types of chromatographic methods (thin-layer-, column-, gas-chromatography). Qualitative and quantitative organic analyses, separation of mixtures, chiral separation. Identification of organic compounds based on chemical methods: Qualitative and quantitative analysis, analysis of functional groups and preparation of their derivatives. Molecular spectroscopy: NMR (chemical shift, integral, coupling patterns), IR (characteristic absorption bands of functional

integral, sklopitveni vzorci, aplikacija NMR na organske strukturne probleme) s povdarkom na 1H NMR spektrih. Masna spektrometrija. Fragmentacije in premestitve nekaterih tipov organskih spojin. Določanje molske mase. **Vaje** Individualni pristop k analizi sestave in strukture kompleksnega vzorca (separacija, čiščenje in identifikacija na osnovi kemijskih metod in spektroskopskih tehnik).	groups, interpretation of IR spectra). Mass spectrometry (basic ionization techniques, fragmentations). Organic analysis laboratory course is based on students individual analysis of an organic sample; separation, purification, and identification (based on chemical and spectroscopic methods).

Temeljna literatura in viri / Readings:

- Shiner, R. L., C. K. F.; Morrill, T. C.; Curtin, D. Y.; Fuson, R. C. The Systematic Identification of Organic Compounds, 8th Edition, J. Wiley & Sons, 2003.
- Laboratory course - Dolenc, D. Vaje iz organske analize : praktikum. Ljubljana: Fakulteta za kemijo in kemijsko tehnologijo, 2007.

Dodatna literatura / Additional literature:

- Pavia, L. D; Lampman, G. M.; Kriz, G. S. Introduction to Spectroscopy. A Guide for Students of Organic Chemistry, 3th Edition, Hartcourt, Inc. 2001.
- Harwood, L. M.; Moody, C. J. Experimental Organic Chemistry. Principles and Practice. Blackwell Scientific Publications, 1994.

Cilji in kompetence:	**Objectives and Competences:**
Študent pridobi sposobnost analitičnega razmišljanja ter povezovanja podatkov dobljenih s posameznimi analiznimi metodami pri reševanju kvalitativnih in kvantitativnih analiznih problemov. Poudarek je na analizi funkcionalnih skupin s kemijskimi in spektroskopskimi metodami.	Understanding the principles of qualitative and quantitative organic analysis using different basic analytical methods and techniques. Ability to design and perform standard experimental techniques for separation, isolation and purification of organic compounds. Analysis and characterization of organic compounds based on typical reactions at functional groups and by using basic spectroscopic methods.

Predvideni študijski rezultati:	**Intended Learning Outcomes:**
Znanje in razumevanje Pozna osnovne kriterije za ločevanje zmesi organskih spojin. Zna povezati spektroskopske lastnosti spojin s strukturo spojin.	Knowledge and Comprehension Student learns basics of separation, identification and characterization as well as spectroscopic methods and their application in characterization of organic compounds.
Uporaba Zna uporabiti teoretično znanje za kvalitativno in kvantitativno analizo vzorcev organskih spojin.	Application Student learns to use theoretical knowledge for qualitative and quantitative analysis of organic compounds in research work.
Refleksija Kritično vrednotenje rezultatov pri vajah na osnovi teoretičnega znanja.	Analysis Student learns to critically evaluate results acquired at practical course and connect it to

	the theoretical knowledge.
Prenosljive spretnosti Študent pridobi laboratorijske spretnosti in zna eksperimentalne podatke ustrezno obdelati in primerno interpretirati. Uporaba že pridobljenega znanja iz organske kemije in analizne kemije.	Skill-transference Ability Student gains skills for laboratory work and learns how to assess and interpret the experimental results. Student combines the knowledge from courses in organic and analytical chemistry. Learning and teaching methods: Lectures and laboratory practical courses.

Metode poučevanja in učenja:	**Learning and Teaching Methods:**
Predavanja in laboratorijske vaje	Lectures and laboratory practical courses.

Načini ocenjevanja:	Delež (v %) / Weight (in %)	**Assessment:**
a) Pri vajah se ocenjuje motivacija, samostojnost in sposobnost študenta pri reševanju praktičnih problemov in pripravi laboratorijskih poročil. b) Pisni izpit. 10 (odlično), 9 in 8 (prav dobro), 7 (dobro), 6 (zadostno), 5-1 (nezadostno)		Written examination (60–100%: student passes the exam, 0–59%: student fails the exam).

Reference nosilca / Lecturer's references:

- A. Demšar, **J. Košmrlj**, S. Petriček: Variable-temperature nuclear magnetic resonance spectroscopy allows direct observation of carboxylate shift in zinc carboxylate complexes. J. Am. Chem. Soc. 2002, 124, 3951–3958.
- **J. Košmrlj**, S. Kafka, I. Leban, M. Grad: Formation and Structure Elucidation of Two Novel Spiro[2H-indol]-3(1H)-ones, Magn. Reson. Chem. 2007, 45, 700–704.
- D. Urankar, A. Pevec, I. Turel, **J. Košmrlj**: Pyridyl Conjugated 1,2,3-Triazole is a Versatile Coordination Ability Ligand Enabling Supramolecular Associations. Cryst. Growth Des. 2010, 10, 4920–4927.
- D. Urankar, B. Pinter, A. Pevec, F. De Proft, I. Turel, **J. Košmrlj**: Click-Triazole N2 Coordination to Transition Metal Ions is Assisted by a Pendant Pyridine Substituent. Inorg. Chem. 2010, 49, 4820–4829.
- B. Pinter, A. Demšar, D. Urankar, F. De Proft, **J. Košmrlj**: Conformational Fluxionality in a Palladium(II) Complex of Flexible Click Chelator 4-phenyl-1-(2-picolyl)-1,2,3-triazole. A dynamic NMR and DFT study. Polyhedron 2011, 30, 2368–2373.
- B. Pinter, D. Urankar, A. Pevec, F. De Proft, **J. Košmrlj**: Platinum mediated dinitrogen liberation from 2-picolylazide through a putative Pt=N double bond containing intermediate. Inorg. Chem. 2013, 4528–4533.

UČNI NAČRT PREDMETA / COURSE SYLLABUS	
Predmet:	ORGANSKA KEMIJA 1
Course Title:	ORGANIC CHEMISTRY 1

Študijski program in stopnja Study Programme and Level	Študijska smer Study Field	Letnik Academic Year	Semester Semester
VSŠP Kemijska tehnologija, 1. stopnja	/	1.	2.
PSP Chemical Technology, 1st Cycle	/	1st	2nd

Vrsta predmeta / Course Type: obvezni / Mandatory

Univerzitetna koda predmeta / University Course Code: KT108

Predavanja Lectures	Seminar Seminar	Vaje Tutorial	Klinične vaje Work	Druge oblike študija	Samost. delo Individual Work	ECTS
60	15	/	/	/	75	5

Nosilec predmeta / Lecturer: doc. dr. Franc Požgan / Dr. Franc Požgan, Assistant 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):
Nomenklatura (poimenovanje) organskih spojin. Struktura in vezi v organskih spojinah, kislost in bazičnost. Narava kemijske vezi, vezna entalpija, hibridizacija, ionske in kovalentne vezi; struktura etana, etena in etina; polarnost vezi in elektronegativnost; toksičnost kemikalij in varno delo z njimi. **Narava organskih spojin.** **Alkani in cikloalkani**: nomenklatura, izomerija, konformacije; *cis-trans* izomerija pri cikloalkanih, ekvatorialni in aksialni substituenti pri cikloheksanu; fizikalne lastnosti alkanov, nafta. **Alkeni in alkini:** nomenklatura, elektronska struktura, *cis-trans* izomerija, pravila sekvence in *Z*,*E*-konfiguracija; tipi organskih reakcij, mehanizmi in reakcijski intermediati ter prehodna stanja;	Nomenclature of organic compounds. Structure and bonding of organic compounds; acids and bases. The nature of chemical bonds, bond (dissociation) enthalpy, hybridization, ionic and covalent bonds; structure of ethane, ethene and ethyne; bond polarity and electronegativity; toxicity of chemicals and risks. The nature of organic compounds. Alkanes and cycloalkanes: nomenclature, isomerism, conformations; cis-trans isomerism of cycloalkanes, equatorial and axial substituents in cyclohexane; physical properties of alkanes; naphtha. Alkenes and alkynes: nomenclature, electronic structure, cis-trans isomerism, sequence rules and Z,E-configuration; kinds of organic reactions; mechanisms, reaction intermediates and

reakcijska hitrost, kinetika in termodinamika; sinteza alkenov in alkinov ter njihove pretvorbe; adicijske reakcije, mehanizmi, polimerizacija, naravni kavčuk. **Osnove stereokemije**: tetraedrski ogljikov atom in stereokemija; kiralnost, optična aktivnost, absolutna konfiguracija; enantiomeri, diastereoizomeri, mezo spojine; projekcijske formule, stereokemija reakcij; kiralnost v naravi, kiralna zdravila. **Alkil halogenidi:** nomenklatura, sinteza in pretvorbe alkil halogenidov; S_N1 in S_N2 reakciji, E1 in E2 reakciji, E1cb; PCB in drugi naravni polutanti. **Alkoholi, etri in fenoli:** nomenklatura, lastnosti, sinteza in pretvorbe; vodikova vez, kislost alkoholov in fenolov, ciklični etri (epoksidi); etanol kot kemikalija, zdravilo in strup.	transition states; rate of the reaction, kineticsand thermodynamics; synthesis and transformations of alkenes and alkynes; addition reactions, mechanisms, polymerization; natural rubber. Stereochemistry: tetrahedral carbon atom; chirality, optical activity, absolute configuration; enantiomers, diastereo(iso)mers, meso compounds; presentation of the structure, stereochemistry of reactions; chirality in Nature, chiral drugs. Alkyl halides:nomenclature, synthesis and transformations; SN1 and SN2 reactions, E1 and E2 reactions, E1cb; PCB and other pollutants in Nature. Alcohols, ethers andphenols:nomenclature, properties, synthesisand transformations; hydrogen bonding, acidity; cyclic ethers (epoxides); ethanol as chemical, drug and poison.

Temeljna literatura in viri / Readings:

- J. McMurry: Fundamentals of Organic Chemistry, Brooks/Cole Publishing Company, 4th Edition, Pacific Grove 1998, 566 pages (50%).
Supplementary reading:
(a) P. W. Atkins, M. J. Frazer, M. J. Clugston, R. A. Y. Jones: Kemija, zakonitosti in uporaba (translated by A. Kornhauser, S. A. Glažar), Tehniška založba Slovenije d. d., Ljubljana, 1997.
(b) M. Tišler: Organska kemija, 3. popravljena in dopolnjena izdaja, Državna založba Slovenije, Ljubljana, 2005.

Cilji in kompetence:	**Objectives and Competences:**
Cilj predmeta je, da študent pridobi: temeljno znanje iz organske kemije tj. poznavanje nomenklature organskih spojin, poznavanje posameznih vrst organskih spojin (po funkcionalnih skupinah) in njihovih strukturnih značilnosti ter reaktivnosti, poznavanje osnov organske stereokemije, reakcijskih mehanizmov in intermediatov, poznavanje osnovnih principov organske sinteze.	Objectives of the course are mastering basic knowledge of organic chemistry: nomenclature, structural features, functional groups, reactivity, and typical transformations of organic compounds. Basic knowledge of organic stereochemistry, reaction mechanisms and intermediates. Knowledge of the basic principles of organic chemistry and accessing literature sources. Competences: Basic knowledge of organic chemistry: nomenclature, structure, reactivity, toxicity of fundamental organic compounds and basic transformations of organic compounds. Ability to understand structure-reactivity relationship, i.e. to predict chemical properties of a given

	organic compound from its structure and vice versa.

Predvideni študijski rezultati:	**Intended Learning Outcomes:**
Znanje in razumevanje Študent se nauči osnov organske kemije: poimenovanja organskih spojin, posameznih vrst organskih spojin (po funkcionalnih skupinah) in njihovih strukturnih značilnosti ter reaktivnosti, osnov organske stereokemije, reakcijskih mehanizmov in intermediatov ter osnovnih principov organske sinteze.	Knowledge and Comprehension Student understands and is familiar with: – Structure of organic compounds and functional groups – Isomerisation and nomenclature of organic compounds – Basic transformations of organic compounds – Typical reagents used for performing basic organic reactions
Uporaba Študent pridobi temeljno znanje, ki je osnova za nadaljnji študij kemije in se navezuje na večino ostalih predmetov študija kemije. To znanje je nujno potrebno pri kasnejšem delu v praksi.	Application Mastered knowledge of organic chemistry is basic knowledge needed for studding chemical engineering. The knowledge is interconnected with majority of other subjects concerning the program. Course is also fundamental for understanding biochemistry subjects and curses concerning organic materials and ecology.
Refleksija Zavedanje, da je za popolno razjasnitev kemijske reakcije potreben natančen študij vsake reakcijske stopnje.	Analysis Student is capable of recognising different basic types of organic compounds, predict there physical properties, toxicity, reactivity, etc.
Prenosljive spretnosti Pri predmetu se študenti z reševanjem različnih problemov izurijo v uporabi znanja in analitičnega razmišljanja.	Skill-transference Ability The student acquires skills that are required for a basic synthetic laboratory work and for handling with chemicals. The knowledge on organic chemistry enables better understanding of the basic principles of other subjects and courses within the study.

Metode poučevanja in učenja:	**Learning and Teaching Methods:**
Predavanja; seminarji	Lectures, seminar work, training by analytical solving of the theoretical problems.

Načini ocenjevanja:	Delež (v %) / Weight (in %)	**Assessment:**
Pisni izpit (nadomestita ga lahko dva pozitivno ocenjena kolokvija).		Written exam. Written exam can be passed by two positive partial exams.

Reference nosilca / Lecturer's references:

1. ŠTEFANE, Bogdan, PERDIH, Franc, VIŠNJEVAC, Aleksander, POŽGAN, Franc. Novel triazole-based ligands and their zinc(II) and nickel(II) complexes with a nitrogen donor environment as potential structural models for mononuclear active sites. *New journal of chemistry*, ISSN 1144-0546, no. 1, 2015, str. 566-575, ilustr. http://pubs.rsc.org/en/content/articlepdf/2014/nj/c4nj01642d?page=search,

doi: 10.1039/c4nj01642d. [COBISS.SI-ID 1536036291]
2. WAGGER, Jernej, POŽES, Aljaž, POŽGAN, Franc. Synthesis of European pharmacopoeial impurities A, B,C, and D of cabergoline. *RSC advances*, ISSN 2046-2069, 2013, vol. 3, no. 45, str. 23146-23156, ilustr. http://pubs.rsc.org/en/content/articlepdf/2013/ra/c3ra43417f, doi: 10.1039/c3ra43417f. [COBISS.SI-ID 1646639]
3. POŽGAN, Franc, DIXNEUF, Pierre H. Ruthenium(II) acetate catalyst for direct functionalisation of sp[sup]2-C-H bonds with aryl chlorides and access to tris- heterocyclic molecules. *Advanced Synthesis & Catalysis*, ISSN 1615-4150. [Print ed.], 2009, vol. 351, no. 11/12, str. 1737-1743, doi: 10.1002/adsc.200900350. [COBISS.SI-ID 30712837]

UČNI NAČRT PREDMETA / COURSE SYLLABUS	
Predmet:	ORGANSKA KEMIJA 2
Course Title:	ORGANIC CHEMISTRY 2

Študijski program in stopnja Study Programme and Level	Študijska smer Study Field	Letnik Academic Year	Semester Semester
VSŠP Kemijska tehnologija, 1. stopnja	/	2.	3.
PSP Chemical Technology, 1st Cycle	/	2nd	3rd

Vrsta predmeta / Course Type: obvezni / Mandatory

Univerzitetna koda predmeta / University Course Code: KT113

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

Nosilec predmeta / Lecturer: doc. dr. Franc Požgan / Dr. Franc Požgan, Assistant Professor

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

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):
Aromatske spojine: nomenklatura, struktura benzena in njegova stabilnost, aromatičnost; elektrofilne aromatske substitucije; policiklične aromatski ogljikovodiki. **Aldehidi in ketoni:** tipi karbonilnih spojin, nomenklatura, sinteza, pretvorbe in lastnosti aldehidov in ketonov; nukleofilne adicije na aldehide in ketone; kislost alfa vodikovih atomov, keto-enolna tavtomerija, kondenzacijske reakcije. **Karboksilne kisline in derivati:** nomenklatura, struktura, lastnosti in pretvorbe karboksilnih kislin in njihovih derivatov; najlon in poliestri. **Amini:** nomenklatura, struktura in lastnosti aminov; bazičnost aminov, sinteza in pretvorbe. **Biomolekule.**	Aromatic compounds: nomenclature, structure of benzene and its stability; electrophilic aromatic substitution reactions; polycyclic aromatic compounds. Aldehydes and ketones: kinds of carbonyls, nomenclature, synthesis, transformations and properties of aldehydes and ketones;nucleophilic additions; acidity of alpha hydrogen atoms, keto-enol tautomerism, condensationreactions. Carboxylic acids and derivatives: nomenclature, structure, properties and conversions of carboxylic acids and their derivatives; nylon and polyesters. Amines: nomenclature, structure and properties of amines; synthesis and

Ogljikovi hidrati: razdelitev, struktura, Fisherjeva projekcija, D- in L-monosaharidi; pretvorbe monosaharidov; disaharidi in polisaharidi. **Aminokisline, peptidi in beljakovine:** nomenklatura, struktura in lastnosti aminokislin; peptidi in beljakovine, razdelitev beljakovin in njihova struktura. **Lipidi:** razdelitev, nomenklatura; trigliceridi, masti in olja, mila in umetni detergenti; steroidi, holesterol. **Nukleinske kisline:** uvod in sestavine. **Nukleinske kisline:** uvod in sestavine.	conversions. Biomolecules. Carbohydrates: classification, structure, Fischer projection, D- and L-monosaccharides; conversions of monosaccharides; disaccharides and polysaccharides. Amino acids, peptides and proteins: nomenclature, structure and properties of amino acids; peptides and proteins, classification of proteins and their structure. Lipids: classification, nomenclature; triglycerides, fats and oils, soaps and synthetic detergents; steroids, cholesterol. Nucleic acids: introduction and components.

Temeljna literatura in viri / Readings:

- J. McMurry: Fundamentals of Organic Chemistry, Brooks/Cole Publishing Company, 4th Edition, Pacific Grove 1998, 566 pages (50%).
Supplementary reading:
(a) P. W. Atkins, M. J. Frazer, M. J. Clugston, R. A. Y. Jones: Kemija, zakonitosti in uporaba (translated by A. Kornhauser, S. A. Glažar), Tehniška založba Slovenije d. d., Ljubljana, 1997.
(b) M. Tišler: Organska kemija, 3. popravljena in dopolnjena izdaja, Državna založba Slovenije, Ljubljana, 2005.

Cilji in kompetence:	**Objectives and Competences:**
Cilj predmeta je, da študent pridobi oz. poglobi: temeljno znanje iz organske kemije tj. poznavanje nomenklature organskih spojin, poznavanje posameznih vrst organskih spojin (po funkcionalnih skupinah) in njihovih strukturnih značilnosti ter reaktivnosti, poznavanje osnov organske stereokemije, reakcijskih mehanizmov in intermediatov, poznavanje osnovnih principov organske sinteze, poznavanje literaturnih virov in njihove uporabe.	Understanding of the basic principles of organic chemistry, i.e. knowledge of individual classes of organic compounds (by functional groups), their nomenclature, structural characteristics and reactivity. Knowledge of basis of organic stereochemistry, reaction mechanisms and intermediates, knowledge of basic principles of organic synthesis, knowledge of sources of chemical literature and their use. Competences: Ability to interpret structural characteristics of individual classes of organic compounds and to predict their reactivity on the basis of their structures. Ability to explain the fundamental organic reactions.

Predvideni študijski rezultati:	**Intended Learning Outcomes:**
<u>Znanje in razumevanje</u> Študent se nauči osnov organske kemije iz področja: karboksilnih spojin, aminov in biomolekul (ogljikovih hidratov, aminokislin, peptidov in beljakovin, lipidov in nukleinskih kislin) ter spozna literaturne vire in njihovo uporabo. V obliki	<u>Knowledge and Comprehension</u> Student understands and is familiar with organic chemistry subjects: Carboxylic compounds Amines and biomolecules (carbohydrates, amino acids, peptides, lipids, and nucleic acids)

seminarjev pa utrjuje tudi področja iz Organske kemije I.	Is familiar with literature sources and its use. By solving the theoretical problems they review the knowledge of Organic chemistry I
Uporaba Študent pridobi oz. utrdi temeljno znanje, ki je osnova za nadaljnji študij kemije in se navezuje na večino ostalih predmetov študija kemije. To znanje je nujno potrebno pri kasnejšem delu v praksi.	Application Mastered knowledge of organic chemistry is basic knowledge needed for studding Chemical technology. The knowledge is interconnected with majority of other subjects concerning the program. Course is also fundamental for understanding analytical chemistry subjects and curses concerning organic materials and ecology.
Refleksija Zavedanje, da je za popolno razjasnitev kemijske reakcije potreben natančen študij vsake reakcijske stopnje.	Analysis Student is capable of recognising different types of organic compounds, predict there physical properties, toxicity, reactivity, etc.
Prenosljive spretnosti Pri predmetu se študenti z reševanjem različnih problemov izurijo v uporabi znanja, analitičnega razmišljanja in uporabe literaturnih virov.	Skill-transference Ability The student acquires skills that are required for a basic synthetic laboratory work and for handling with chemicals. The knowledge on organic chemistry enables better understanding of the basic principles of other subjects and courses within the study.

Metode poučevanja in učenja:	**Learning and Teaching Methods:**
Predavanja; seminarji, individualni in skupinski projekti.	Lectures, seminar work, training by analytical solving of the theoretical problems.

Načini ocenjevanja:	Delež (v %) / Weight (in %)	**Assessment:**
Pisni izpit (nadomestita ga lahko dva pozitivno ocenjena kolokvija).		Written exam. Written exam can be passed by two positive partial exams

Reference nosilca / Lecturer's references:

1. ŠTEFANE, Bogdan, PERDIH, Franc, VIŠNJEVAC, Aleksander, POŽGAN, Franc. Novel triazole-based ligands and their zinc(II) and nickel(II) complexes with a nitrogen donor environment as potential structural models for mononuclear active sites. *New journal of chemistry*, ISSN 1144-0546, no. 1, 2015, str. 566-575, ilustr. http://pubs.rsc.org/en/content/articlepdf/2014/nj/c4nj01642d?page=search, doi: 10.1039/c4nj01642d. [COBISS.SI-ID 1536036291]
2. WAGGER, Jernej, POŽES, Aljaž, POŽGAN, Franc. Synthesis of European pharmacopoeial impurities A, B,C, and D of cabergoline. *RSC advances*, ISSN 2046-2069, 2013, vol. 3, no. 45, str. 23146-23156, ilustr. http://pubs.rsc.org/en/content/articlepdf/2013/ra/c3ra43417f, doi: 10.1039/c3ra43417f. [COBISS.SI-ID 1646639]
3. POŽGAN, Franc, DIXNEUF, Pierre H. Ruthenium(II) acetate catalyst for direct functionalisation of sp[sup]2-C-H bonds with aryl chlorides and access to tris- heterocyclic molecules. *Advanced Synthesis & Catalysis*, ISSN 1615-4150. [Print ed.], 2009, vol. 351, no. 11/12, str. 1737-1743, doi: 10.1002/adsc.200900350. [COBISS.SI-ID 30712837]

UČNI NAČRT PREDMETA / COURSE SYLLABUS	
Predmet:	OSNOVE BIOKEMIJE Z BIOTEHNOLOGIJO
Course Title:	FUNDAMENTALS OF BIOCHEMISTRY WITH BIOTECHNOLOGY

Študijski program in stopnja Study Programme and Level	**Študijska smer Study Field**	**Letnik Academic Year**	**Semester Semester**
VSŠP Kemijska tehnologija, 1. stopnja	**/**	**1.**	**2.**
PSP Chemical Technology, 1st Cycle	**/**	**1st**	**2nd**

Vrsta predmeta / Course Type: obvezni / Mandatory

Univerzitetna koda predmeta / University Course Code: KT109

Predavanja Lectures	**Seminar Seminar**	**Vaje Tutorial**	**Klinične vaje Work**	**Druge oblike študija**	**Samost. delo Individual Work**	**ECTS**
50	**10**	**15 LV**	**/**	**/**	**75**	**5**

Nosilec predmeta / Lecturer: izr. prof. dr. Polona Žnidaršič Plazl / Dr. Polona Žnidaršič Plazl, 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):**
Temeljna vsebinska področja predmeta so: **1. Molekule in življenje** - Lastnosti bioloških sistemov. Prokariontske in evkariontske celice. Raznolikost živega sveta. Mikrobiološke zbirke. - Biološke makromolekule. Aminokisline, peptidi, proteini. Encimi. Ogljikovi hidrati. Lipidi. DNA in RNA. - Osnove celičnih procesov. Ohranjanje in prenos biološke informacije. Osnove celičnega metabolizma in bioenergetike. **2. Biotehnologija** - Vloga biotehnologije v družbi. Uporaba v industriji (kemijska, farmacevtska, živilska), v medicini, kmetijstvu in okoljevarstvu. Biološka varnost in	The primary subject areas of the course are: 1. Molecules and living systems - Characteristics of biological systems. Prokaryotic and eukaryotic cells. The diversity of the living world. Microbial collections. - Biological macromolecules. Amino acids, peptides, proteins. Enzymes. Carbohydrates. Lipids. DNA and RNA. - Principles of cellular processes. Conservation and transfer of biological information. Basics of cell metabolism and bioenergetics. 2. Biotechnology - The role of biotechnology in society. Use in industry (chemical, pharmaceutical, food), in medicine, agriculture and environmental

etična vprašanja sodobne biotehnologije. - Interdisciplinarnost načrtovanja, vodenja in analize bioprocesov. Stopnje razvoja bioprocesa. Vloga bioprocesnega inženirja. Kvantitativni pristop. - Industrijska biotehnologija. Biotransformacije. Integrirani procesi. Izbrani primeri industrijskih procesov. - Smernice razvoja sodobne biotehnologije. Zarodne celice. Nanobiotehnologija. Mikroreaktorji in »lab on a chip« sistemi.	engineering. Biological safety and ethical issues of modern biotechnology. - Interdisciplinary planning, management and analysis of bioprocesses. The development of bioprocesses. The role of bioprocess engineer. Quantitative approach. - Industrial biotechnology. Biotransformations. Integrated processes. Selected examples of industrial processes. - Guidelines in the development of modern biotechnology. Stem cells. Nanobiotechnology. Microreactors and "lab on a chip" systems.

Temeljna literatura in viri / Readings:

- Boyer, R. Temelji biokemije. Študentska založba, Ljubljana. 2005. 634 p. (30%)
- Raspor, P. (ur.) Biotehnologija. Bia, d.o.o., Ljubljana. 1996. 815 p. (20%)
- Žnidaršič Plazl, P., Podgornik, H. Vaje iz biotehnologije, 2. Izd. Fakulteta za kemijo in kemijsko tehnologijo, Ljubljana. 2011. 96 p.

Cilji in kompetence:	**Objectives and Competences:**
Cilj predmeta je seznaniti študente z nekaterimi osnovami o molekularni zgradbi in delovanju celic ter o njihovi uporabi v biotehnologiji, razvijati zavest o pomenu biotehnologije v sodobni družbi in razvijati sposobnosti za sodelovanje pri razvijanju in analizi bioprocesov. Študent si pri predmetu pridobi naslednje specifične kompetence: - poznavanje nekaterih temeljnih pojmov iz biokemije in biologije celice - poznavanje uporabe sodobne biotehnologije v industrijskih procesih, kmetijstvu in okoljevarstvu - razumevanje specifičnosti bioprocesov z inženirskega vidika - poznavanje nekaterih etičnih vprašanj sodobne biotehnologije - osvajanje nekaterih izbranih laboratorijskih tehnik: aseptično delo z mikroorganizmi, določevanje parametrov encimske kinetike, vodenje in analiza bioprocesa v laboratorijskem bioreaktorju	Students obtain the following specific competencies: - Knowledge of some fundamental concepts in biochemistry and cell biology - Knowledge of the use of modern biotechnology in industrial processes, agriculture and environmental engineering - Understanding of the specificity of bioprocesses from the engineering point of view - Knowledge of some of the ethical issues of modern biotechnology - Knowledge of some selected laboratory techniques: sterilization, aseptic work with microorganisms, the determination of enzyme kinetics parameters, management and analysis of bioprocesses in a laboratory bioreactor

Predvideni študijski rezultati:	**Intended Learning Outcomes:**
<u>Znanje in razumevanje</u> Študent pridobi osnovna znanja o sestavi celic, bioloških makromolekulah in specifičnosti vodenja in analize bioprocesov. Razume zakonitosti	<u>Knowledge and Comprehension</u> Understanding of the basics of molecular structure and functioning of cells and their application in biotechnology, to develop

delovanja encimov, nekatere osnovne metabolne poti in principe ohranjanja in prenosa genetske informacije, ki omogočajo razumevanje njihove uporabe v biotehnologiji.	awareness of the importance of biotechnology in modern society.
Uporaba Pridobljena znanja je študent sposoben uporabljati pri razvijanju in analizi bioprocesov.	Application Student will develop the ability to participate in the development and analysis of bioprocesses.
Refleksija Študent bo interpretiral ter pred kolegi analiziral lastno razumevanje izbranih bioprocesov. Pri tem bo uporabil pridobljena teoretična znanja ter jih vrednotil s praktičnimi izkušnjami.	Analysis Student will interpret and analyse the knowledge on selected bioprocesses.
Prenosljive spretnosti Računalniška obdelava eksperimentalnih podatkov, uporabljanje spletnih virov, pisanje poročil, priprava računalniške predstavitve seminarja, timsko delo.	Skill-transference Ability Analysis of experimental data, the use of internet as a data source, writing of reports, a seminar preparation and oral presentation, team work.

Metode poučevanja in učenja:	**Learning and Teaching Methods:**
Predavanja, laboratorijske vaje, individualno in skupinsko delo pri pripravi seminarjev. Spletna gradiva za določena poglavja.	Lectures, seminars, practical training.

Načini ocenjevanja:	Delež (v %) / Weight (in %)	**Assessment:**
pisni izpit	**70%**	
laboratorijske vaje	**15%**	
seminarska naloga	**15%**	

Reference nosilca / Lecturer's references:

- TIŠMA, Marina, **ŽNIDARŠIČ PLAZL, Polona**, VASIĆ-RAČKI, Đurđa, ZELIĆ, Bruno. Optimization of laccase production by Trametes versicolor cultivated on industrial waste. Appl. Biochem. Biotechnol., 2012, 166, 36-46.
- **ŽNIDARŠIČ PLAZL, Polona**, PLAZL, Igor. Development of a continuous steroid biotransformation process and product extraction within microchannel system. Catalysis Today, 2010, 157, 315-320.
- **ŽNIDARŠIČ PLAZL, Polona**, RUTAR, Vera, RAVNJAK, David. The effect of enzymatic treatments of pulps on fiber and paper properties. Chemical and biochemical engineering quarterly, 2009, 23, 497-506.

UČNI NAČRT PREDMETA / COURSE SYLLABUS	
Predmet:	OSNOVE INDUSTRIJSKE KEMIJE
Course Title:	FUNDAMENTALS OF INDUSTRIAL CHEMISTRY

Študijski program in stopnja Study Programme and Level	Študijska smer Study Field	Letnik Academic Year	Semester Semester
VSŠP Kemijska tehnologija, 1. stopnja	**/**	**1.**	**1.**
PSP Chemical Technology, 1st Cycle	**/**	**1st**	**1st**

Vrsta predmeta / Course Type: obvezni / Mandatory

Univerzitetna koda predmeta / University Course Code: KT104

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

Nosilec predmeta / Lecturer: doc. dr. Boštjan Genorio / dr. Boštjan Genorio, Assistant Professor

Jeziki / Languages:

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

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):
Osnove industrijske kemije: Kemija in industrijska kemija, razdelitev in organiziranost kemijske industrije, slovenska kemijska industrija, Malotonažna in malolitražna industrijska proizvodnja, velikotonažna idnustrijska proizvodnja, predelovanlna industrija, visokotehnološka proizvodnja Surovinska osnova procesov, primarne, sekundarne surovine, racionalna uporaba surovinskih virov, reproverige, predpriprava surovin pred predelavo, bogatenje surovin Energija v kemijski industriji, smotrna uporaba različnih surovinskih virov in odpadne toplote Kemijski tehnološki procesi, tehnološki režim, tehnološke sheme, šaržni in kontinuirni procesi	Fundamentals of Industrial Chemistry: Chemistry and industrial chemistry, distribution and structure of the chemical industry, Slovenian chemical industry, Small scale industrial production, large scale industrial production, high-tech manufacturing. The raw material base processes, primary, secondary raw materials, rational use of raw materials resources, reproductions chains, pretreatment of raw materials before processing, beneficiation of raw materials Energy in the chemical industry, rational use of different sources of raw materials and waste heat Chemical technological processes, technological regime, technological schemes, batch and

Infrastrukturni pogoji industrijske proizvodnje, oprema, proces Tehnološki procesi, masne bilance procesov, karakteristike in kvaliteta produktov, izkoristek procesov.	continuous processes Infrastructure conditions in industrial production, equipment, process Technological processes, mass balance processes, characteristics and quality of products, efficiency of processes.

Temeljna literatura in viri / Readings:

- Ignatowitz, Eckhard, Kemijska tehnika, Jutro, 1996, ISBN 961-6006-30-4 (60%)
- Heaton, C.A., Introduction to Industrial Chemistry, Springer 1996, ISBN 978-0-7514-0272-8 (10 %);
- Brockel, U.; Meier, W.; Wagner, G., Product Design and Engineering, Vol 1 & Vol 2, Wieley-vch Verlag GmbH & Co. KgaA 2007, ISBN 978-3-527-31529-1 (30%)

Cilji in kompetence:	**Objectives and Competences:**
Slušatelji se v okviru predavanj in seminarja seznanijo z različnimi nivoji in osnovnimi značilnostmi kemijske industrijske proizvodnje, z osnovami kemijskih industrijskih procesov ter njihovimi infrastrukturnimi pogoji, možnostmi za uspešno in varno vodenje procesov.	Students in the context of lectures and seminars familiar with the different levels and the basic characteristics of industrial chemical production, with the fundamentals of chemical industrial processes and their infrastructure requirements, the possibilities for successful and safe management processes.

Predvideni študijski rezultati:	**Intended Learning Outcomes:**
Znanje in razumevanje Študent se nauči razlikovati med pogoji in zahtevami laboratorijskega dela in industrijskim nivojem. Spozna osnovne značilnosti, robne pogoje in zahteve za uspešno in sodobno industrijsko proizvodnjo.	Knowledge and Comprehension Students learn how to distinguish between the terms and conditions of the laboratory work and industrial level. Learn about the basic features, boundary conditions and requirements for a successful and modern industrial production.
Uporaba Analizira probleme, ki se pojavijo pri prenosu v večje merilo pri prenosu procesov v industrijsko prakso.	Application The student analyzes the problems that occur in the transmission of higher criterion in the transfer processes in industrial practice.
Refleksija Analiza racionalne izvedbe industrijskih kemijskih reakcijskih sistemov in procesov omogoča študentu boljši vpogled in razumevanje osnovnih konceptov kemije in industrijske kemije.	Analysis Analysis of the rational performance of industrial chemical reaction systems and processes allows students a better understanding of the basic concepts of chemistry and industrial chemistry.
Prenosljive spretnosti Teoretične principe dodatno spoznava pri njihovi implementaciji v industrijsko merilo in prakso ter kritično vrednoti skladnost med teoretičnimi načeli in možnostjo za njihovo praktičnim uveljavljanje.	Skill-transference Ability A student gets additionally acquainted with theoretical principles at implementation into industrial scale and practice and to critically evaluate the consistency between theoretical principles and practical option for their

	enforcement.

Metode poučevanja in učenja:	**Learning and Teaching Methods:**
Predavanja in seminar.	Lectures and seminars.

Načini ocenjevanja:	Delež (v %) / Weight (in %)	**Assessment:**
kolokviji, pisni/ustni izpit od 6-10 (pozitivno) oz. 1-5 (negativno) oz. opravil/ ni opravil; ob upoštevanju Statuta UL in fakultetnih pravil		

Reference nosilca / Lecturer's references:

- Genorio B, Strmcnik D, Subbaraman R, Tripkovic D, Karapetrov G, Stamenkovic V R, Pejovnik S and Marković N M 2010 Selective catalysts for the hydrogen oxidation and oxygen reduction reactions by patterning of platinum with calix [4] arene molecules Nat. Mater. 9 998–1003
- Genorio B, Lu W, Dimiev A M, Zhu Y, Raji A-R O, Novosel B, Alemany L B and Tour J M 2012 In Situ Intercalation Replacement and Selective Functionalization of Graphene Nanoribbon Stacks ACS Nano 6 4231–40
- Xiang C, Behabtu N, Liu Y, Chae H G, Young C C, Genorio B, Tsentalovich D E, Zhang C, Kosynkin D V, Lomeda J R, Hwang C-C, Kumar S, Pasquali M and Tour J M 2013 Graphene Nanoribbons as an Advanced Precursor for Making Carbon Fiber ACS Nano 7 1628–37
- Xiang C, Cox P J, Kukovecz A, Genorio B, Hashim D P, Yan Z, Peng Z, Hwang C-C, Ruan G, Samuel E L G, Sudeep P M, Konya Z, Vajtai R, Ajayan P M and Tour J M 2013 Functionalized Low Defect Graphene Nanoribbons and Polyurethane Composite Film for Improved Gas Barrier and Mechanical Performances. ACS Nano 7 10380–6
- Raji A-R O, Varadhachary T, Nan K, Wang T, Lin J, Ji Y, Genorio B, Zhu Y, Kittrell C and Tour J M 2016 Composites of Graphene Nanoribbon Stacks and Epoxy for Joule Heating and Deicing of Surfaces ACS Appl. Mater. Interfaces 8 3551–6

UČNI NAČRT PREDMETA / COURSE SYLLABUS	
Predmet:	OSNOVE KEMIJSKEGA INŽENIRSTVA
Course Title:	FUNDAMENTALS OF CHEMICAL ENGINEERING

Študijski program in stopnja Study Programme and Level	Študijska smer Study Field	Letnik Academic Year	Semester Semester
VSŠP Kemijska tehnologija, 1. stopnja	**/**	**2.**	**3.**
PSP Chemical Technology, 1st Cycle	**/**	**2nd**	**3rd**

Vrsta predmeta / Course Type: obvezni / Mandatory

Univerzitetna koda predmeta / University Course Code: KT117

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. Igor Plazl / Dr. Igor Plazl, Full 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:

Osnovni koncepti termodinamike (zaprt-odprt sistem, vrste energij, lastnosti sistema, stanje sistema in ravnotežje, proces in cikel). Lahnosti čistih komponent (fazne spremembe čistih komponent, diagrami procesov faznih sprememb , enačbe stanja. Prvi zakon termodinamike (a) zaprt sistem (toplota, delo; notranja energija, entalpija in specifična toplota idealnih plinov, tekočin in trdnih substanc) (b) kontrolni volumen (pretočni stacionarni in nestacionarni sistem, zakon o ohranitvi mase, zakon o ohranitvi energije). Drugi zakon termodinamike. Entropija (definicija entropije, sprememba entropije čistih substanc: idealnih plinov, tekočin in trdnih substanc; izentropski procesi).

Content (Syllabus outline):

Basic concepts of thermodynamics (closed-opened system, types of energies, system characteristics, state of the system and equilibrium and process cycle). Properties of pure components (phase transition of pure components, diagrams of phase transitions, equations of state. First law of thermodynamics (a) closed system (heat, work, internal energy of a thermodynamic system, enthalpy, specific heat of ideal gasses, liquids and solids) (b) control volume (stationary and unsteady flow systems, law of mass conservation, law of energy conservation). Second law of thermodynamics. Entropy (definition of entropy, entropy changes of pure components:

Mešanica plinov in hlapov ter lastnosti zraka (osnove psihrometrije: definicije vlažnosti zraka, definicije temperature adiabatnega nasičenja, temperatura rosišča in temperature mokrega termometra, Mollierov diagram.)
Inženirske osnove tehnoloških operacij: opredelitev pretočnega sistema, makroskopska snovna in energijska bilanca pretočnega sistema, bilanca energije za diferencialni element in posebne oblike le-te, Bernoullijeva enačba). Tok tekočin (definicija viskoznosti, newtonijske in nenewtonijske tekočine, tokovne oblike, mejni sloji, turbulenten tok tekočin v cevi, frikcijski faktor, računanje izgub v sestavljenih cevnih sistemih).
Prenos toplote: mehanizmi prenosa toplote: (prevajanje, konvekcija, medfazni prenos, radiacija). Stacionarno prevajanje toplote (za različne geometrije in kombiniran prenos toplote), Nestacionarno prevajanje. Konvekcija toplote (toplotna prestopnost, podobnost med prenosom toplote in gibalne količine, kriterijske enačbe za oceno toplotnih prestopnosti, toplotna prehodnost). Načrtovanje toplotnih menjalnikov. Prenos toplote s sevanjem.
Prenos snovi: mehanizmi prenosa snovi (difuzija, konvekcija, (definicije, difuzija v dvokomponentnih sistemih). Snovna bilanca za diferencialni element v sistemu in posebne oblike le-te. Stacionarna difuzija (difuzija skozi mirujočo komponento, pseudostacionarna difuzija, ekvimolarna protidifuzija). Nestacionarna difuzija. Konvekcijski prenos snovi (snovna prestopnost. podobnost med prenosom snovi in gibalne količine, kriterijske enačbe za oceno snovnih prestopnosti, snovna prehodnost). Načrtovanje naprav za snovni prenos.
Izbrane tehnološke operacije (destilacija, sušenje, mešanje, uparjanje) s poudarkom na varnostnem vidiku. Izbrane mehanske operacije (mletje).
Osnove inženirske kinetike (hitrostna enačba, enostavne reakcije, kompleksne reakcije). Eksperimentalno določevanje hitrostne enačbe (integralna metoda, diferencialna metoda). Dimenzioniranje reaktorjev (obratovalna enačba šaržnega reaktorja in mešalnega ter cevnega pretočnega reaktorja na osnovi snovnih in energijskih bilanc). Primerjava mešalnega in cevnega reaktorja.

gasses, liquids and solids, isentropic processes).
Mixtures of gases and vapors, properties of air (fundamentals of psychrometry, definitions of: air humidity, temperature of adiabatic saturation, dry-bulb temperature, wet-bulb temperature, dew point temperature, Mollier diagram.)
Engineering fundamentals of technological operations: definition of flow system, macroscopic mass and energy balances of flow system, energy balance of differential element and its special cases, Bernoulli equation). Fluid flow (viscosity definition, Newtonian and non-Newtonian liquids, types of flows, boundary layer, turbulent pipe flow, friction factor, calculation of head losses due to friction in assembled pipe systems.
Heat transfer: mechanisms of heat transfer (conduction, convection, interfacial exchange, radiation). Stationary heat conduction (for different geometries, combined heat transfer). Unsteady heat conduction. Convective heat transfer, transport coefficient, similarity between heat and momentum transfers, criterion equations for prediction of heat transport coefficient, overall heat transfer coefficient). Design of heat exchangers. Heat transfer by radiation.
Mass transfer: mechanisms of mass transfer (diffusivity, convection, diffusivity of two-components systems). Mass balance for differential element of the system and its special cases. Stationary diffusivity, (diffusivity through stagnant component, pseudo-stationary diffusivity, equi- molar opposite diffusivity). Unsteady diffusion. Convective mass transfer (transport coefficient, similarity between mass and momentum transfers, criterion equations for prediction of mass transport coefficient, overall mass transfer coefficient. Design of mass transfer devices.
Selected technological operations (distillation, drying, mixing, evaporation) with a focus on security aspects. Selected mechanical operation (crushing, milling).
Basic of engineering kinetics (rate equation, simple and complex chemical reaction).

	Experimentally determination of rate equation (integral method, differential method). Reactor design (operational equations based on energy balances for batch, mixing and plug flow reactors. Comparison of mixing and plug flow reactors

Temeljna literatura in viri / Readings:

- Z. Rant, Termodinamika: knjiga za uk in prakso, Ljubljana, Fakulteta za strojništvo, 2001, 607 str., (30%)
- Koloini, Prenos toplote in snovi, FKKT, Ljubljana, 1999, 273 str., (30%)

Cilji in kompetence:	**Objectives and Competences:**
Cilj predmeta je omogočiti globlje spoznavanje in razumevanje baznih znanj termodinamike, transportnih pojavov in kemijske tehnike, skupaj s poznavanjem osnovnih inženirskih konceptov.	Objective of the course is deeper knowledge and understanding fundamentals of thermodynamics, transport phenomena and chemical technology, on basis of chemical engineering concepts.

Predvideni študijski rezultati:	**Intended Learning Outcomes:**
Znanje in razumevanje: Varnostni inženir je pri svojem delu soočen s potrebo po osnovnem razumevanju tehnoloških postopkov in raznovrstnih specifičnih procesov, ki ga usposabljajo za kvalitetno in inovativno delo na svojem področju.	Knowledge and Comprehensions: Safety Engineer is faced at his/her work with the need to understand the basic techniques and understanding of specific processes, which qualify him/her for excellence and innovative work in his/her field
Uporaba Tako izobražen profil je sposoben ustrezne strokovne komunikacije z ostalimi tehnično podkovanimi kadri, kar privede do uspešnih rešitev konkretnih problemov. Pomemben vidik predmeta je študenta naučiti kritičnega pogleda na problem in na osnovi sintetiziranih znanj podati hitre in efektivne rešitve v praksi.	Application Such educated profile student is skilled for professional communication with other technically knowledgeable staffs which leads to successful solutions to concrete problems. Student learns to have critical view on the problem and on the basis of synthesized knowledge to provide quick and effective solutions in practice.
Refleksija Kritična primerjava teoretskega znanja s praktično uporabo na področju pojava in širjenja požarov.	Analysis Critical comparison of theoretical knowledge with practical application in candidate's working field.
Prenosljive spretnosti Pri predmetu se študent nauči sintetizirati vsebine znanj, pridobljene z različnih področij tehničnih in naravoslovnih segmentov, ter tako pridobi vzorec za inovativno delo na drugih področjih.	Skill-transference Ability By matter of this course student learns to connect knowledge of different technical and natural science segments and acquires mode for innovative work on different fields.

Metode poučevanja in učenja:	**Learning and Teaching Methods:**

Predavanja, seminarji in vaje.	Lectures, seminars and laboratory work.

Načini ocenjevanja:	Delež (v %) / Weight (in %)	**Assessment:**
- Pisni in ustni izpit - pisna seminarska naloga. Ocene: negativno: 1-5 ; pozitivno: 6-10	**60 %** **20 %** **20 %**	- written and oral exam; - Written seminar Grading scale: 1-5 (negative) 6-10 (positive)

Reference nosilca / Lecturer's references:

1. G.N. Jovanovic, J. E. Atwater, P. Žnidaršič Plazl, I. Plazl. Dechlorination of Polychlorinated Phenols on Bimetallic Pd/Fe Catalyst in a Magnetically Stabilized Fluidized Bed. Chem. Eng.J., 2015, 274:50-60
2. SKUBIC, Blaž, LAKNER, Mitja, PLAZL, Igor. Microwave drying of expanded perlite insulation board. Ind. eng. chem. res.. [Print ed.], 2012, vol. 51, no. 8, str. 3314-3321.
3. BEESTON, Michael Philip, POHAR, Andrej, ELTEREN, Johannes Teun van, PLAZL, Igor, ŠLEJKOVEC, Zdenka, VEBER, Marjan, GLASS, Hylke J. Assessment of physical leaching processes of some elements in soil upon ingestion by continuous leaching and modeling. Environ. sci. technol.. [Print ed.], 2010, vol. 44, issue 16, str. 6242-6248.

UČNI NAČRT PREDMETA / COURSE SYLLABUS	
Predmet:	OSNOVE POLIMERNEGA INŽENIRSTVA
Course Title:	PRINCIPLES OF POLYMER ENGINEERING

Študijski program in stopnja Study Programme and Level	Študijska smer Study Field	Letnik Academic Year	Semester Semester
VSŠP Kemijska tehnologija, 1. stopnja	/	2.	4.
PSP Chemical Technology, 1st Cycle	/	2nd	4th

Vrsta predmeta / Course Type: izbirni strokovni / Elective Professional

Univerzitetna koda predmeta / University Course Code: KTSI4

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

Nosilec predmeta / Lecturer: prof. dr. Urška Šebenik / Dr. Urška Šebenik, Full 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):
- Uvod v polimere; - Polimerizacijski procesi: stopenjska polimerizacija in verižna polimerizacija; - Kinetika in rezultat reverzibilne in ireverzibilne stopenjske polimerizacije; - Vpliv funkcionalnosti monomerov in razmerja funkcionalnih skupin na rezultat stopenjske polimerizacije; - Kinetika verižne polimerizacije; - Vpliv reakcij prenosa na rezultat verižne polimerizacije; - Verižna kopolimerizacija in njena kinetika; - Kvantitativna analiza polimerizacijskih procesov glede na medij in njihove karakteristike: polimerizacija v raztopini, polimerizacija v masi,	- Introduction to polymers; - Polymerization processes: step-reaction and chain-reaction polymerization; - Kinetics and result of reversible and non-reversible step polymerization; - Effect of monomer functionality and functional group ratio on the result of step polymerization; - Kinetics of chain polymerization; - Effect of chain transfer reactions on the result of chain polymerization; - Chain copolymerization and its kinetics; - Quantitative analysis and characteristics of: Solution polymerization; Bulk polymerization; Emulsion polymerization; Suspension polymerization.

emulzijska polimerizacija, suspenzijska polimerizacija. - Osnove emulzijske polimerizacije v šaržnem sistemu, Harkinsov mehanizem in kinetika; - Računski primeri; - Laboratorijske vaje (kvalitativna in kvantitativna obravnava procesov): Šaržna polimerizacija v raztopini; Kontinuirna polimerizacija v masi; Šaržna polimerizacija v suspenziji; Šaržna polimerizacija v emulziji.	- Principles of batch emulsion polymerization, Harkins mechanism, kinetics; - Problems; - Laboratory practice (qualitative and quantitative process description): Batch polymerization in solution, Continuous polymerization in bulk; Batch suspension polymerization; Batch emulsion polymerization.

Temeljna literatura in viri / Readings:

- A. Kumar in R. K. Gupta, Fundamentals of Polymers, The McGraw-Hill Companies, Inc., New York, 1998, 543 str., (50 %).
- R. O. Ebewele, Polymer Science and Technology, CRC Press, Boca Raton, 2000, 463 str., (25 %).
- U. Šebenik, Osnove polimernega inženirstva: Zbirka nalog, UL FKKT, Ljubljana, 2012, 41 str., (100 %).

Dopolnilna literatura:

- Rudin, The Elements of Polymer Science and Engineering, 2nd Ed., Academic Press, London, 1999, 483 str.
- P. Rempp, E. W. Merrill, Polymer synthesis, 2nd Ed., Huthig & Wepf Verlag, Basel, 1991, 336 str.

Cilji in kompetence:	**Objectives and Competences:**
Cilj predmeta je, da študentje osvojijo osnovna znanja iz področja polimernega inženirstva. Študentje pri predmetu pridobijo naslednje specifične kompetence: - poznavanje načinov napovedovanja distribucije molekulskih mas; - poznavanje toplotnih prehodov, specifičnih za polimerne molekule; - poznavanje fizikalnih stanj polimerov in vpliva procesnih parametrov na fizikalna stanja; - poznavanje in kvantitativno ovrednotenje polimerizacijskih procesov; - razumevanje vpliva načina polimerizacije na lastnosti polimernega produkta.	Acquisition of basic knowledge from polymer engineering; Acquisition of knowledge about molecular weight and molecular weight distribution and methods for molecular weight distribution prediction; knowledge about thermal transitions in polymers and the ability to distinguish between different polymer physical states; Acquisition of knowledge about polymerization processes and their quantitative description; Understanding the effect of the type of polymerization and of polymerization process parameters on product properties.

Predvideni študijski rezultati:	**Intended Learning Outcomes:**
Znanje in razumevanje Študent zna kvantitativno obravnavati osnovne polimerizacijske procese in napovedovati ključne lastnosti produkta glede na vrsto in način polimerizacijskega procesa. Razume zvezo med procesnimi parametri in sintetiziranim	Knowledge and Comprehension Understanding basic principles of polymer engineering science; Ability of quantitative description of basic polymerization processes and resulting polymers; Understanding relationship between process parameters and polymer properties; Ability to employ chemical

polimerizacijskim produktom. Zna uporabiti znanja kemijske kinetike in termodinamike na področju sinteze polimerov.	kinetics and thermodynamics to describe polymerizations.
Uporaba Pridobljena znanja je sposoben uporabiti pri študiju kemijsko inženirskih predmetov, kot tudi pri samostojnem razvojnem in raziskovalnem delu. Sposoben je kvantitativne analize enostavnejših industrijskih polimerizacijskih procesov.	Application At other courses from chemical engineering and at individual research work; Quantitative analysis of relatively simple polymerization processes on industrial level.
Refleksija Študent je sposoben samostojno sklepati, postavljati zaključke ter uporabiti svoje znanje pri sorodnih predmetih. Znanja s področja polimernega inženirstva mu omogočajo razumevanje sorodnih reakcijskih sistemov.	Analysis Ability to apply the acquired knowledge at familiar courses by critical thinking and deduction; Fundamental knowledge enables understanding similar reactive processes.
Prenosljive spretnosti Razvita sposobnost kritičnega razmišljanja in sklepanja. Sposobnost povezovanja osnovnih znanj ter študija domače in tuje literature.	Skill-transference Ability Development of the ability of critical thinking and deduction; Ability of knowledge integration and studying relevant literature from the field of polymer engineering.

Metode poučevanja in učenja:	**Learning and Teaching Methods:**
Predavanja, seminarji, laboratorijske vaje	Lectures, seminars, laboratory practice

Načini ocenjevanja:	Delež (v %) / Weight (in %)	**Assessment:**
Opravljene vaje so pogoj za pristop k izpitu.		Laboratory practice is a prerequisite to exam attendance
Poročila in zagovor laboratorijskih vaj.	**30**	Written reports and oral laboratory practice defence.
Pisni izpit.	**70**	Written exam.

Reference nosilca / Lecturer's references:

1. RUČIGAJ, Aleš, ALIČ, Branko, KRAJNC, Matjaž, **ŠEBENIK, Urška**. Curing of bisphenol A-aniline based benzoxazine using phenolic, amino and mercapto accelerators. Express polymer letters, ISSN 1788-618X, 2015, vol. 9, no. 7, str. 647-657, ilustr. http://www.expresspolymlett.com/, doi: 10.3144/expresspolymlett.2015.60. [COBISS.SI-ID 1536286915]
2. RUČIGAJ, Aleš, KRAJNC, Matjaž, **ŠEBENIK, Urška**. Polymerization of octamethylcyclotetrasiloxane between montmorillonite nanoplatelets initiated by surface anions. Polymer bulletin, ISSN 0170-0839, str. 1-16, ilustr. http://link.springer.com/article/10.1007/s00289-015-1377-5, doi: 10.1007/s00289-015-1377-5. [COBISS.SI-ID 1536273859]
3. RUČIGAJ, Aleš, ALIČ, Branko, KRAJNC, Matjaž, **ŠEBENIK, Urška**. Investigation of cure kinetics in a system with reactant evaporation : epoxidized soybean oil and maleic anhydride case study. European Polymer Journal, ISSN 0014-3057. [Print ed.], 2014, vol. 52, no. 1, str. 105-116, ilustr. http://dx.doi.org/10.1016/j.eurpolymj.2014.01.009, doi: 10.1016/j.eurpolymj.2014.01.009. [COBISS.SI-ID 1667887]
4. KAJTNA, Jernej, **ŠEBENIK, Urška**, KRAJNC, Matjaž. Synthesis and dynamic mechanical analysis of

nanocomposite UV crosslinkable 100% solid acrylic pressure sensitive adhesives. International journal of adhesion and adhesives, ISSN 0143-7496. [Print ed.], 2014, vol. 49, no. 1, str. 18-25, ilustr. http://ac.els-cdn.com/S0143749613002212/1-s2.0-S0143749613002212-main. pdf?_tid=0be1f984-6c7a-11e3-b240-00000aab0f6c&acdnat=1387875899_0bee10364d8f1fce86b5ce0adea1f8d5, doi: 10.1016/j.ijadhadh.2013.12.010. [COBISS.SI-ID 1663791]

5. KAJTNA, Jernej, ALIČ, Branko, KRAJNC, Matjaž, **ŠEBENIK, Urška**. Influence of hydrogen bond on rheological properties of solventless UV crosslinkable pressure sensitive acrylic adhesive prepolymers. International journal of adhesion and adhesives, ISSN 0143-7496. [Print ed.], 2014, vol. 49, no. 1, str. 103-108, ilustr. http://ac.els-cdn.com/S0143749613002273/1-s2.0-S0143749613002273-main. pdf?_tid=1f9b954e-7921-11e3-9740-00000aacb35e&acdnat=1389267072_2b2c514569d4f86a66d77b0b12a891ad, doi: 10.1016/j.ijadhadh.2013.12.016. [COBISS.SI-ID 1664047]

UČNI NAČRT PREDMETA / COURSE SYLLABUS	
Predmet:	OSNOVE VEDE O MATERIALIH
Course Title:	BASICS IN MATERIAL SCIENCE AND ENGINEERING

Študijski program in stopnja Study Programme and Level	Študijska smer Study Field	Letnik Academic Year	Semester Semester
VSŠP Kemijska tehnologija, 1. stopnja	/	3.	5.
PSP Chemical Technology, 1st Cycle	/	3rd	5th

Vrsta predmeta / Course Type: obvezni / Mandatory

Univerzitetna koda predmeta / University Course Code: KT135

Predavanja Lectures	Seminar Seminar	Vaje Tutorial	Klinične vaje Work	Druge oblike študija	Samost. delo Individual Work	ECTS
45	15	15 LV	/	/	75	5

Nosilec predmeta / Lecturer: izr. prof. dr. Marjan Marinšek / Dr. Marjan Marinšek, 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):
1. **Uvod**: Osnovne skupine materialov ter njihove značilnosti (mehanske, temične, optične, električne, magnetne). Kriterij za izbiro materialov. Smeri razvoja materilov. 2. **Zgradba snovi**: Zgradba atoma in medatomske vezi. Vpliv tipov vezi, jakost vezi in kristalne zgradbe na lastnosti materialov. 3. **Kristalna struktura**. Molekularne strukture. Osnove za razumevanje katere lastnosti materialov niso odvisne od njihove mikrostrukture, ter na katere lastnosti ima mikrostruktura odločilen vpliv. 4. **Fazna ravnotežja**: Fazno pravilo. Fazni diagrami. Kinetika fazne transformacije. Poseben povdarek na faznih ravnotežjih sistemov Fe-C, Al-Cu- Al2O3-SiO2. 5. **Osnove difuzije v trdnem** 6. **Mehanske lastnosti materialov** (natezna trdnost,	1. **Introduction:** Classification of materials and their basic properties, Choice of a material. Trends in materials' development. 2. **Materials structure:** The atom, Bonding in solids, Primary bonds, Secondary bonds. 3. **Crystal structures:** Amorphous and crystalline structure of solids, Bravais lattices and unit cells, Miller indices, Densities and packing factors, Interstitial positions and sizes 4. **Phase equilibria and phase diagrams:** The one-component phase diagram, phase equilibria in two-component system, Fe-C, Al-Cu- Al_2O_3-SiO_2 phase diagrams, Kinetics and microstructure of structural transformations. 5. **Defects in solids and diffusion:** Point defects, Linear, planar and volume defects, solid state

zlomna trdnost, žilavost, krhkost) 7. **Kovine**: Lastnosti kovin ter vpliv sestave in tehnologije izdelave kovinskih materialov na njihove lastnosti. Zlitine. Mehanizmi utrjevanja kovin. Kaljenje in popuščanje jekla. 8. **Polimeri**: Lastnosti polimerov ter vpliv sestave in tehnologije izdelave polimerov na njihove lastnosti. Termoplasti, duroplasti in elastomeri. Deformacija in utrjevanje polimernih materialov. Lezenje in zlom. 9. **Keramika**: Značilne lastnosti keramičnih materialov. Struktura silikatne keramike. Klasična in sodobna tehnična keramika. Krhki lom in utrjevanje keramike. Funkcijska in inženirska keramika. 10. **Propad materialov**: Osnove korozije. Visokotemperaturni propad. Osnove zaščite materialov. 11. **Kriteriji za izbor materialov** (možnost za njegovo obdelavo, ekonomska upravičenost izbire, stabilnost) **Seminar**: Slušatelji v okviru seminarja rešujejo računske primere, ki ilustrirajo principe vpliva zgradbe snovi na lastnosti in propad materialov. **Vaje**: Pri vajah se slušatelji praktično seznanijo z bistvenimi fazami izdelave keramičnega izdelka, ter določijo njegove mikrostrukturne, termične, mehanske in električne lastnosti. **Samostojna seminarska naloga**: V okviru seminarske naloge študentje bolj poglobljeno obdelajo eno izmed tematik nauka o materialih.	diffusion 6. **Mechanical properties:** Deformation and fracture of engineering materials, brittle fracture, Fracture mechanism 7. **Metals:** Metalic materials, Properties, Application, Hardening 8. **Polymers:** Polymer materials, Properties, Application, Deformation mechanism, Creep 9. **Ceramics:** Properties, Glass-ceramics, Silicates, Engineering ceramics 10. **Materials degradation:** Basics in corrosion, High-temperature degradation 11. **Choice of material:** **Seminar work:** Material science through mathematical problems **Tutorial work:** Laboratory preparation of ceramic component. Microstructure description, thermal and electrical properties determination

Temeljna literatura in viri / Readings:

- D.R. Askeland, P.P. Phule, The Science and Engineering of Materials, 5th.ed. Thomson Learning, Brooks Cole, 2006, 748 strani (50%)
- P. Glavič, Gradiva, Tehniška fakulteta Maribor, 1990, 424 strani (20%)
- W,D.Jr. Callister, Materials Science and Engineering – An Itroductin, 7th. ed. John Wiley & Sons, Inc., New York, 2007, 720 strani (20%)

Cilji in kompetence:	**Objectives and Competences:**
Namen predmeta je spoznavanje materialov kot sestavnih delov različnih struktur s katerimi imamo opravka v vsakdanjem življenju. Ob tem bo študent pridobil znanja o lastnosti materialov s poudarkom na kemijskih, fizikalnih in mehanskih lastnostih. Hkrati bo študent spoznal konkretne materiale	Students get related with various types of materials and their basic properties (chemical, physical, mechanical). Ability to investigate the relationship between the structure of materials at atomic or molecular scales and their macroscopic

(kovine, polimerne materile, keramiko in kompozitne materiale), ki se uporabljajo v industrijskih in drugih aplikacijah. Poudarek predmeta je na razumevanju soodvisnosti načina povezovanja osnovnih gradnikov materialov ter njihovih lastnosti oziroma mikro- in makro-strukture materialov. V okviru predmeta bo študent pridobil tudi znanja potrebna za kvalitetno napoved možnosti odpovedi gradiv na katere delujejo normalne obremenitve, ali pa so izpostavljeni zaostrenim, izrednim razmeram oziroma korozijskemu okolju. Skupaj z znanji za napoved uporabnosti gradiv bo študent pridobil tudi osnovna znanja zaščite materialov.	properties. Ability to predict failure of chosen material under load or in aggressive environment. Choice of a material in a certain application on a basis of the desired properties and relative performance.

Predvideni študijski rezultati:	**Intended Learning Outcomes:**
<u>Znanje in razumevanje</u> Študentje spoznajo soodvisnost med zgradbo in lastnostmi materialov. V kurzu bomo podali osnovna znanja o različnih tipih materialov, njihovi pripravi ter njihovih lastnostih. Študente bomo uvajali k samostojnemu, logičnemu in kritičnemu razmišljanju o lastnostih in uporabi različnih materialov.	<u>Knowledge and Comprehension</u> Understanding the relationship between the structure of materials at various scales and their macroscopic properties. Students get to know various types of materials – their properties and preparation. Students are encouraged to logical and critical thinking about various materials.
<u>Uporaba</u> Študentje analizirajo znane materiale iz prakse in s tem ilustrirajo principe pridobljene pri predavanjih.	<u>Application</u> Students analyse known various materials with respect to material science.
<u>Refleksija</u> Študent pridobi znanje za smotrno analizo uporabe izbranega materiala ter možnosti, da pri njegovi uporabi zaradi izrednih pogojev pride do neželenih sprememb.	<u>Analysis</u> Ability to understand materials so that right materials with the desired properties are chosen for specific application without unnecessary risk for its failure.
<u>Prenosljive spretnosti</u> Splošno razumevanje področja materialov, pridobitev laboratorijskih spretnosti, seznanitev z modernimi analiznimi tehnikami, uporaba domače in tuje literature, pisna in ustna predstavitev problema, delo v skupinah.	<u>Skill-transference Ability</u> General understanding of materials, developed laboratory skills, modern analytical techniques, literature data collecting, data analysis and interpretation, team work.

Metode poučevanja in učenja:	**Learning and Teaching Methods:**
Predavanja, seminar, laboratorijsko delo.	Lectures, seminars, tutorial work

Načini ocenjevanja:	Delež (v %) / Weight (in %)	**Assessment:**
Pisni in ustni izpit. Pisni izpit se v celoti lahko opravi z vmesnimi kolokviji in opravljeno seminarsko nalogo.	PI 40% UI 60%	Written and oral exam. Written exam can be accomplished also by achieving positive grades at written colloquiums

Pozitivna ocena 6-10, negativna ocena 1-5. Opravljene laboratorijske vaje so pogoj za opravljanje izpita.		during the semester and prepared individual seminar work. Pass grades from 6 to 10, fail grades from 1 to 5. Tutorial work must be done before taking an exam.

Reference nosilca / Lecturer's references:

- SKALAR, Tina, ZUPAN, Klementina, **MARINŠEK, Marjan**, NOVOSEL, Barbara, MAČEK, Jadran. Microstructure evaluation of Ni-SDC synthesized with an innovative method and Ni-SDC/SDC bi-layer construction. Journal of the European Ceramic Society, ISSN 0955-2219. [Print ed.], 2014, vol. 34, no. 2, str. 347-354
- **MARINŠEK, Marjan**, PADEŽNIK GOMILŠEK, Jana, ARČON, Iztok, ČEH, Miran, KODRE, Alojz, MAČEK, Jadran. Structure development of NiO-YSZ oxide mixtures in simulated citrate-nitrate combustion synthesis. Journal of the American Ceramic Society, ISSN 0002-7820, 2007, vol. 90, no. 10, str. 3274-3281
- **MARINŠEK, Marjan**, PEJOVNIK, Stane, MAČEK, Jadran. Modelling of electrical properties of Ni-YSZ composites. V: MAČEK, Marjeta (ur.), SUVOROV, Danilo (ur.). Refereed reports of IX Conference & Exhibition of the European Ceramic Society : 19-23 June 2005, Portorož, Slovenia, (Journal of the European ceramic society, ISSN 0955-2219, vol. 27, no. 2-3, 2007). Amsterdam: Elsevier, 2007, vol. 27, no. 2/3, str. 959-964

UČNI NAČRT PREDMETA / COURSE SYLLABUS	
Predmet:	OSNOVNE OPERACIJE V KEMIJSKEM INŽENIRSTVU
Course Title:	UNIT OPERATIONS IN CHEMICAL ENGINEERING

Študijski program in stopnja Study Programme and Level	Študijska smer Study Field	Letnik Academic Year	Semester Semester
VSŠP Kemijska tehnologija, 1. stopnja	/	2.	4.
PSP Chemical Technology, 1st Cycle	/	2nd	4th

Vrsta predmeta / Course Type: obvezni / Mandatory

Univerzitetna koda predmeta / University Course Code: KT119

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. Aleksander Pavko / Dr. Aleksander Pavko, Full Professor

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

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):
Uvod: Pomen kemijskega inženirstva v svetu tehnike, znanosti in gospodarstva. Domena in smeri razvoja kemijskega inženirstva. Področja aktivnosti kemijskega inženirja. **Proces in procesna shema**. Osnovne procesne spremenljivke. Osnovne faze kemijskega procesa: priprava, kemijska pretvorba, izolacija in čiščenje produkta. **Osnovne operacije**. Koncept in temeljni principi osnovnih operacij. **Mehanske in hidrodinamske operacije**: drobljenje in mletje, sejanje, mešanje, posedanje, centrufugiranje, filtracija. Osnovni principi in naprave. **Termodifuzijske operacije**: destilacija, ekstrakcija, absorpcija, adsorpcija, uparjanje, kristalizacija, sušenje. Osnovni principi in naprave. Primeri sinteze posameznih osnovnih operacij v tehnološki proces.	**Introduction.** The role of chemical engineering in the field of science and technology as well as economy. Directions of development of chemical engineering. Activity fields of a chemical engineer. **Process diagram.** Basic process variables. Phases in a chemical process: upstream, reaction and downstream. **Unit operations.** Concept and basic principles. **Mechanical and hydrodynamical unit operations:** grinding, screening, mixing, settling, centrifugation, filtration. Basic principles and equipment. **Thermodiffusional unit operations.** Distillation, extraction, absorption, adsorption, crystallization, evaporation, drying. Basic principles and equipment. Selected examples of integration

	of unit operations into whole technological process.

Temeljna literatura in viri / Readings:

- E.Ignatowitz, Kemijska tehnika (prevedel Leon Čelik), Jutro, Ljubljana, 1996, 456 str. (50%)
- J.H.Harker, J.R.Backhurst, J.F.Richardson, Chemical Engineering, Volume 2, Elsevier, 2002.

Cilji in kompetence:	**Objectives and Competences:**
Cilj predmeta je študente seznaniti z značilnostmi in koncepti kemijsko inženirske stroke. Predmetno specifične kompetence: - študent spozna osnovno in splošno vlogo ter pomen osnovnih operacij v kemijsko tehnološkem procesu, razume in zna pripraviti procesno shemo iz osnovnih operacij oziroma aparatov za določen tehnološki proces.	The objective is to acquaint the student with characteristics and concepts of chemical engineering profession. Specific competences are: - student recognizes basic and general role and significance of unit operations in a chemical process technology, student understands and is able to prepare a process scheme containing unit operations and equipment for a particular process technology.

Predvideni študijski rezultati:	**Intended Learning Outcomes:**
Znanje in razumevanje Študent je po osvojitvi pojmov, zakonitosti, teorij in pojavov, ki jih podaja ta predmet, sposoben razumeti specifičnosti kemijsko inženirske stroke ter pomena osnovnih operacij v tehnološkem procesu.	Knowledge and Comprehension After mastering notions, laws, theories and phenomenon presented by those course, student is able to understand the specifics of chemical engineering profession and the role of unit operations in the chemical process technology.
Uporaba Pridobljena znanja je sposoben uporabiti pri reševanju posameznih praktičnih primerov in problemov v industrijskih kemijsko tehnoloških procesih .	Application Student is able to use the acquired knowledge in solving particular practical cases and problems from chemical process technology on industrial scale.
Refleksija Uporaba splošnih znanj in osnovnih principov kemijskega inženirstva, analiza in kritično ovrednotenje tehnološkega procesa oziroma posameznega postopka in naprave.	Analysis Use of general knowledge and basic principles of chemical engineering as well as analysis and critical evaluation of chemical process technology and particular operation and equipment.
Prenosljive spretnosti Razvita sposobnost identifikacije in reševanja problemov, kritičnega razmišljanja in logičnega sklepanja. Sposobnost uporabe literature, zbiranja in interpretacije podatkov in njihove kritične evalvacije.	Skill-transference Ability Developed skill to identify and solve problem, critical thinking and making logical conclusions. Ability of literature data using, data collection and interpretation as well as their critical evaluation.

Metode poučevanja in učenja:	**Learning and Teaching Methods:**

Predavanja in seminarji, laboratorijske vaje.	Lectures, seminars, laboratory exercises.

Načini ocenjevanja:	Delež (v %) / Weight (in %)	**Assessment:**
Pisni in ustni izpit	**40 %**	Written and oral exam
Pisna seminarska naloga (pogoj za pristop k izpitu)	**20 %**	Written seminar (mandatory before exam)
Ocene: 6-10 (pozitivno), 1-5 (negativno).	**40 %**	Marks: 6-10 (positive), 1-5 (negative).

Reference nosilca / Lecturer's references:

- LEVEC, Janez, **PAVKO, Aleksander**. Mass transfer in square gas-liquid contractors. *Chemical Engineering Science*, 1979, vol. 34, str. 1159-1160.
- **PAVKO, Aleksander**, LEVEC, Janez. Kinetics in three-phase reactors. *Chemical engineering journal*, 1981, vol. 21, str. 149-154.
- PAVKO, Aleksander. Gas/liquid oxygen mass transfer in bubble columns and modified bubble columns. *Chemical and biochemical engineering quarterly*, 1989, vol. 3, str. 33-37.
- LIKOZAR, Blaž, SENICA, David, **PAVKO, Aleksander**. Equilibrium and kinetics of vancomycin adsorption on polymeric adsorbent. *AIChE journal*, 2012, vol. 58, no. 1, str. 99-106.

UČNI NAČRT PREDMETA / COURSE SYLLABUS	
Predmet:	POLIMERNI MATERIALI
Course Title:	POLYMER MATERIALS

Študijski program in stopnja Study Programme and Level	Študijska smer Study Field	Letnik Academic Year	Semester Semester
VSŠP Kemijska tehnologija, 1. stopnja	/	2.	3.
PSP Chemical Technology, 1st Cycle	/	2nd	3rd

Vrsta predmeta / Course Type: izbirni strokovni / Elective Professional

Univerzitetna koda predmeta / University Course Code: KTSI1

Predavanja Lectures	Seminar Seminar	Vaje Tutorial	Klinične vaje Work	Druge oblike študija	Samost. delo Individual Work	ECTS
60	/	15 LV	/	/	75	5

Nosilec predmeta / Lecturer: prof. dr. Urška Šebenik / Dr. Urška Šebenik, Full 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):
- Definicije pojmov monomer, oligomer, polimer, polimerizacija, stopnja polimerizacije, ponavljajoča se enota, zamreženje, kopolimer, kopolimerizacija; - Osnovne vrste polimernih materialov; - Fizikalno stanje in urejenost polimernih verig: amorfno in kristalinično stanje, deformacije stanja; - Toplotni prehodi in mehanske lastnosti; - Osnovne vrste polimerizacij, stopenjski in verižni polimeri; - Sintetični polimeri: plastomeri, duromeri, elastomeri; - Polimeri za široko proizvodnjo in inženirski polimeri; - Polimerni kompoziti, nanokompoziti, zmesi; - Recikliranje in degradacija polimernih materialov;	- Definition of terms monomer, oligomer, polymer, polymerization, degree of polymerization, repeating unit, crosslinking, copolymerization, copolymer; - Basic types of polymer materials; - Molecular interactions, polymer crystals, amorphous bulk state; - Heat transitions and mechanical properties; - Basic types of polymerizations, step and chain polymers; - Synthetic polymers: plastomers, thermosets, elastomers; - Common polymers, polymer materials for general use and engineering polymer materials; Polymer composites, nanocomposites and

- Polimeri s posebnimi lastnostmi, biopolimeri, polimeri iz obnovljivih virov; - Instrumentalne tehnike za karakterizacijo polimernih materialov; - Laboratorijske vaje: Sinteza nasičenega poliestra; zamreženje nenasičenega poliestra; Izdelava plastisola; Ekstrudiranje plastomerov..	blends; - Recycling and degradation of polymer materials; - Polymers designed for specific use, biopolymers, polymers from renewable resources; - Instrumental techniques for polymer materials characterization; - Laboratory practice: Synthesis of saturated polyester; Crosslinking of unsaturated polyester; Making plastisol; Extrusion of plastomers.

Temeljna literatura in viri / Readings:

- C. E. Carraher, Jr., Polymer Chemistry: An Introduction, 4th Ed., Marcel Dekker, Inc., New York, 1996, 541 str., (60 %),
- R. O. Ebewele, Polymer Science and Technology, CRC Press, Boca Raton, 2000, 471 str., (20 %).

Dopolnilna literatura:

- C. A. Harper, Handbook of Plastics Technologies, McGraw-Hill, New York, 2006, (loč. pag.).

Cilji in kompetence:	**Objectives and Competences:**
Cilj predmeta je, da študentje osvojijo osnovna znanja o polimernih materialih in njihovih ključnih lastnostih. Študentje pri predmetu pridobijo naslednje specifične kompetence: - poznavanje fizikalnih stanj in načina urejanja polimernih verig v polimernih materialih ter razumevanje vpliva na lastnosti polimernih materialov; - poznavanje osnovnih vrst polimernih materialov, njihovih specifičnosti in uporabe; - razlikovanje med osnovnimi sintetičnimi polimernimi materiali; - razlikovanje med polimernimi materiali za široko potrošnjo in inženirskimi polimernimi materiali; - poznavanje polimernih materialov s specifičnimi lastnostmi; - razumevanje pomena in prednosti polimernih zmesi, polimernih kompozitov in polimernih nanokompozitov; - poznavanje osnovnih biopolimerov; - poznavanje možnosti ter načinov recikliranja in	Acquisition of basic knowledge about polymer materials and their properties; Acquisition of knowledge on polymer morphology and polymer structure-property relationships, knowledge about basic polymer materials, key properties and use of basic polymer materials, distinction between basic synthetic polymer materials for common use and engineering polymer materials, polymer materials with specific properties, polymer blends and composites, polymer nanocomposites, biopolymers, polymer recycling and degradation.

razgradnje polimerov.	

Predvideni študijski rezultati:	**Intended Learning Outcomes:**
Znanje in razumevanje Študent pozna osnovne in specifične, znane polimerne materiale in njihove lastnosti ter uporabnost. Lastnosti polimernih materialov zna povezati z njihovo strukturo in fizikalnim stanjem. Razume pomen in prednosti polimernih zmesi, polimernih kompozitov in polimernih nanokompozitov. Pozna osnovne načine recikliranja polimernih materialov.	Knowledge and Comprehension Knowledge and Comprehension: Understanding the basic principles of composition and structure of polymer materials and polymer composites, and understanding the basic principles of the relationship between polymer material properties and their composition and structure.
Uporaba Znanja iz predmeta zna uporabiti pri študiju predmetov s področja polimernega inženirstva in materialov. Študent je sposoben izbirati med različnimi polimernimi materiali za izbrano aplikacijo.	Application Acquired knowledge is necessary for appropriate polymer material selection for a specific application, and for work, research and development in the field of polymer materials and polymer engineering.
Refleksija Študent je sposoben pridobljeno znanje uporabiti pri sorodnih predmetih in na področjih, kjer se polimerni materiali uporabljajo.	Analysis Ability to apply knowledge about material properties at familiar courses and/or when a polymer material selection is needed.
Prenosljive spretnosti Razvita sposobnost kritičnega razmišljanja in logičnega sklepanja. Sposobnost študija domače in tuje literature.	Skill-transference Ability Ability of critical thinking and deduction; Ability of studying relevant literature from the field of polymer materials.

Metode poučevanja in učenja:	**Learning and Teaching Methods:**
Predavanja, seminarji, laboratorijske vaje	Lectures, seminars, laboratory practice.

Načini ocenjevanja:	Delež (v %) / Weight (in %)	**Assessment:**
Opravljene vaje so pogoj za pristop k izpitu.		Laboratory practice is a prerequisite to exam attendance
Poročila in zagovor laboratorijskih vaj.	**30**	Written reports and oral laboratory practice defence.
Pisni izpit.	**70**	Written exam.

Reference nosilca / Lecturer's references:

- KAJTNA, Jernej, **ŠEBENIK, Urška**, KRAJNC, Matjaž. Synthesis and dynamic mechanical analysis of nanocomposite UV crosslinkable 100% solid acrylic pressure sensitive adhesives. International journal of adhesion and adhesives, ISSN 0143-7496. [Print ed.], 2014, vol. 49, no. 1, str. 18-25. [COBISS.SI-ID 1663791]
- KRAJNC, Matjaž, KARGER-KOCSIS, József, **ŠEBENIK, Urška**. Grafting of maleic anhydride onto an ethylene-propylene-diene terpolymer and concurrent organoclay nanocomposite preparation in solution and melt. Journal of applied polymer science, ISSN 0021-8995, 2013, vol. 127, no. 2, str. 950-958. [COBISS.SI-ID 35973125]

- MOHORIČ, Ines, **ŠEBENIK, Urška**. Anionic ring-opening polymerization of octamethylcyclotetrasiloxane in emulsion above critical micelle concentration. Polymer, ISSN 0032-3861. [Print ed.], 2011, vol. 52, no. 5, str. 1234-1240. [COBISS.SI-ID 34739717]

UČNI NAČRT PREDMETA / COURSE SYLLABUS	
Predmet:	PRAKTIČNO USPOSABLJANJE
Course Title:	PRACTICAL TRAINING

Študijski program in stopnja Study Programme and Level	Študijska smer Study Field	Letnik Academic Year	Semester Semester
VSŠP Kemijska tehnologija, 1. stopnja	/	3.	6.
PSP Chemical Technology, 1st Cycle	/	3rd	6th

Vrsta predmeta / Course Type: obvezni / Mandatory

Univerzitetna koda predmeta / University Course Code: PRUSP

Predavanja Lectures	Seminar Seminar	Vaje Tutorial	Klinične vaje Work	Druge oblike študija	Samost. delo Individual Work	ECTS
/	/	/	/	150	/	5

Nosilec predmeta / Lecturer: Prof. dr. Igor Plazl /
Prof. dr. Igor Plazl, Full Professor

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

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):
Pri praksi se študenti seznanijo z zahtevnostjo in kompleksnostjo vodenja industrijskih procesov. Spoznajo, da je za uspešno in varno delo v industriji osnovni pogoj natančno poznavanje vseh faz procesa in podrobna kemijska analiza in druga karakterizacija surovin, intermediatov, procesnih tokov in končnih produktov, kot tudi celovita analiza njegovega delovanja. Uspešnost procesa je pogojena z mnogo dejavniki in za njegovo varno obratovanje je potrebno tako optimalno delovanje posameznih procesnih operacij kot tudi usklajeno delovanje sistema kot celote. Vsebina prakse se prilagaja konkretnemu mestu kjer se opravlja. Področja na katerih študent lahko	During practical training student meets with complexity of management of industrial processes. Student recognizes that: accurate knowledge of all stages of technological process, detailed chemical analysis and other characterization method of row materials, intermediates and final products, process flows and entire analysis of process operation is essential for successful and safety industrial work. Success of technological process depends on many factors, among them optimal operation of separate process stages and adjustment of overall technological system are most important. Content of practical training depends on

opravlja prakso so: - uvajanje v delo inženirja kemijske tehnologije, - spoznavanje s tehnološkim procesom in industrijsko proizvodnjo, - sodelovanje pri raziskovalno razvojnih nalogah in planiranju ter načrtovanju izdelkov, - nadzor proizvodnega procesa, - vhodna in izhodna kontrola kvalitete surovin in produktov, - instrumentalna analitika v raziskovalnem in kontrolnem laboratoriju, - aktivnosti v zvezi z varovanjem okolja in zagotavljanjem varnosti, - vzdrževanje aparatov, merilnih in regulacijskih sistemov.	specific working environment. Fields where student can perform practical training are: - Introducing to work of chemical engineer - Collaboration in technological process and industrial production - Collaboration in research projects, planning and design of final products - Supervision of technological process - Instrumental analysis in research and control labs - Activities for environment protections and to ensure working safety - Apparatus, measuring and system maintenance

Temeljna literatura in viri / Readings:

Nabor literature bo študent dobil na mestu opravljanja prakse oziroma jo lahko dobi tudi v knjižnici UL FKKT.

Cilji in kompetence:	**Objectives and Competences:**
Namen prakse je omogočiti študentom preverjanje posredovanih teoretičnih znanj v okolju v katerem bodo delovali po zaključku študija ter jih nadgradili z znanji, ki so značilna za industrijsko tehnološko okolje in jih ni možno dobiti na šoli. Praksa poteka v povezavi študent – mentor v podjetju ali inštituciji – mentor na fakulteti. Praktično usposabljanje uvajanja študente v praktično delo in s tem spoznavanje strokovne narave dela ter aktualnih problematik v laboratoriju, industrijski proizvodnji in drugod.	Goal of practical training is to give opportunity that student verifies his/her theoretical knowledge, which was gained during study, under working conditions where student may operate after finishing study. Furthermore, to upgrade his/her theoretical knowledge with proficiency, specific for industrial technological practice, which he/her cannot learn during education. Practical training is supervised by industrial mentor (from establishment) and mentor at University. Practical training introduces student to practical work, technical work profession and actual problems in industrial productions and in laboratory.

Predvideni študijski rezultati:	**Intended Learning Outcomes:**
<u>Znanje in razumevanje</u> Študent se pri opravljanju praktičnega dela usposobi za povezovanje teoretičnih in praktičnih znanj, ki jih je pridobil pri različnih predmetih med študijem z dejanskimi pogoji v praksi, tj. analiznih laboratorijih in laboratorijih za kontrolo kvalitete, industrijskih obratih. Študent spozna način reševanja posameznega problema, se seznani s tehnološko-tehničnimi parametri, se nauči	<u>Knowledge and Comprehension</u> Knowledge and Comprehension By realization of practical training student knows how to connect theoretical knowledge, which was gained during education at University and practical experience present in various industrial fields (laboratories for analysis, research and quality control, industrial plants). Student finds a way to solve specific

strokovne komunikacije z drugim člani tima.	problems, learns about technological process parameters, and understands professional communication in team.
Uporaba Praktično usposabljane razvija pri študentu: sposobnost prenosa teoretičnih znanj na reševanje konkretnih problemov, predstavi sodoben pristop k reševanju inženirskih problemov, razvija sposobnost za vključevanje v skupinsko delo, sposobnost komuniciranja s sodelavci in strokovnjaki drugih disciplin, kar mu omogoča sodelovanje pri multidisciplinarnih projektih in mu razvija profesionalno etično in okoljsko odgovornost.	Application Practical training develops student's skill: capability to transfer theoretical knowledge on solving concrete problems, student gains contemporary approach to solving engineering problems, student develops the ability to integrate in working team, student gains ability to communicate with fellow workers and experts from other disciplines, which enables to collaborate on multidisciplinary projects and develops ethical and environmental responsibility.
Refleksija Študent je sposoben kritično analizirati in primerjati različne pristope pri reševanju problemov tako na laboratorijskem kot tudi industrijskem nivoju.	Analysis Student is able to compare and critical examines different approaches for solving problems on level of laboratory as well as those at industrial plant.
Prenosljive spretnosti Usposabljanje v konkretnem delovnem okolju mu razvija sposobnost za analitično naravoslovno tehnično vrednotenje dogajanj v praksi.	Skill-transference Ability Practical training in a certain working environment develops student's capability of science and technical evaluation of developments in practice.

Metode poučevanja in učenja:	**Learning and Teaching Methods:**
Praksa poteka v izbranem podjetju oziroma drugi inštituciji s katerim je vnaprej podpisana tripartitna pogodba, ki določa pogoje usposabljanja. V podjetju vodi delo študenta, ki mora imeti najmanj 7. stopnjo izobrazbe kemijske ali sorodne smeri.	Practical training takes place in a selected company or institution with which it is signed a tripartite treaty which determines the conditions of training. The company manages the work of a student by mentor, who must have at least 7. education level of the chemical or similar direction.

Načini ocenjevanja:	Delež (v %) / Weight (in %)	**Assessment:**
Študent odda dnevnik in sumarno poročilo o praksi. Potrdilo o opravljenem praktičnem usposabljanju z oceno delovnega mentorja v podjetju in fakultetnega mentorja je osnova za oblikovanje ocene. Ocenjevalna lestvica: opravljeno - neopravljeno		Student submits diary and summary report on practical training. The student obtains a certificate of completion practical training with an assessment of the work of the mentor in the company and assessment of the mentor at Faculty. Grading scale: Done – Failure

Reference nosilca / Lecturer's references:

- ŠUŠTERŠIČ, Ema, TUŠAR, Marjan, **ZUPANČIČ-VALANT, Andreja.** Rheological and mechanical characterization of waste PMMA/ATH modified bitumen. V: 25th Anniversary Session for ACI 228.

BOYD, Andrew J. (ur.). Building on the past for the future of NDT of concrete, (Construction & building materials, ISSN 0950-0618, Vol. 38 (Jan. 2013)). Guildford: Butterworth Scientific, 2013, vol. 38, str. 119-125

- **ZUPANČIČ-VALANT, Andreja**, ŽIBERNA, Lovro, PAPAHARILAOU, Yannis, ANAYIOTOS, Andreas, GEORGIOU, Georgios C. The influence of temperature on rheological properties of blood mixtures with different volume expanders : implications in numerical arterial hemodynamics simulations. Rheologica acta, ISSN 0035-4511, 2011, vol. 50, no. 4, str. 389-402
- ŠEBENIK, Urška, **ZUPANČIČ-VALANT, Andreja**, KRAJNC, Matjaž. Investigation of rubber-rubber blends miscibility. Polymer engineering and science, ISSN 0032-3888, 2006, vol. 46, no. 11, str. 1649-165

UČNI NAČRT PREDMETA / COURSE SYLLABUS	
Predmet:	PRAKTIKUM IZ ANORGANSKE KEMIJE
Course Title:	PRACTICAL COURSE IN INORGANIC CHEMISTRY

Študijski program in stopnja Study Programme and Level	Študijska smer Study Field	Letnik Academic Year	Semester Semester
VSŠP Kemijska tehnologija, 1. stopnja	**/**	**2.**	**2.**
PSP Chemical Technology, 1st Cycle	**/**	**2nd**	**2nd**

Vrsta predmeta / Course Type: obvezni / Mandatory

Univerzitetna koda predmeta / University Course Code: KT112

Predavanja Lectures	Seminar Seminar	Vaje Tutorial	Klinične vaje Work	Druge oblike študija	Samost. delo Individual Work	ECTS
/	**15**	**60 LV**	**/**	**/**	**75**	**5**

Nosilec predmeta / Lecturer: doc. dr. Franc Perdih / Dr. Franc Perdih, Assistant Professor

Jeziki / Languages: **Predavanja / Lectures:** **/**; **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):
Vsebina seminarjev in vaj: Študenti bodo pri predmetu sintetizirali anorganske snovi z različnimi sinteznimi tehnikami in dobljene snovi preiskali. Spoznali bodo metode karakterizacije v anorganski kemiji, prirejene predznanju študentov: uporaba rentgenske praškovne analize, termične analize in infrardeče in UV-vidne spektroskopije ter magnetne meritve. Študenti bodo sintetizirali bazični bakrov(II) sulfat, zemeljskoalkalijske oksalate hidrate, pentafluoridomanganate(III), izomere bakrovih glicinato kompleksov in do dve snovi, ki se uporabljata pri tekočem raziskovalnem delu nosilca predmeta ali njegovih sodelavcev. Pri seminarju bodo študenti dobili potrebno teoretsko osnovo in navodila za sintezo.	Syntheses and characterization of inorganic compounds. Different characterization methods used in inorganic chemistry will be studied, adapted to the knowledge level of these students: X-ray powder diffraction analysis, thermal analysis, infrared spectroscopy, UV-vis spectroscopy and measurements of magnetic susceptibility. Basic copper(II) sulphate, alkaline earth oxalates hydrates, pentafluoridomanganates(III), isomers of copper glycinato complexes and some new complexes which are subject of current research at the department of Inorganic chemistry are prepared and characterized. Theoretical background is explained at seminars.

Temeljna literatura in viri / Readings:

- S. Petriček, F. Perdih, A. Demšar: Vaje iz anorganske kemije, FKKT UL, Ljubljana, 2012, pp. 1–74.

Cilji in kompetence:	**Objectives and Competences:**
Cilj predmeta je poglobitev znanja iz anorganske kemije in pridobitev posebnih laboratorijskih veščin. Specifično, študenti z laboratorijskimi vajami nadgradijo teoretično znanje iz predmeta Anorganska kemija I s praktičnimi izkušnjami s področja sinteze in karakterizacije anorganskih snovi.	**Learning outcomes**: Expanding of basic knowledge of syntheses and characterization of inorganic compounds obtained in courses of General chemistry and Inorganic Chemistry I. **Competences**: Practical skills in comprehensive inorganic syntheses and characterization of inorganic compounds.

Predvideni študijski rezultati:	**Intended Learning Outcomes:**
Znanje in razumevanje Predmet predstavlja dopolnitev predmeta Anorganska kemija I s praktičnim delom in izkušnjami iz laboratorija. Tehnike, ki jih obvladajo študenti, bodo uporabili pri nadaljnjem študiju in pri delu.	Knowledge and Comprehension Subject is a supplement of a course Chemistry I with practical work and experience in the laboratory. Techniques learned in this course will be used for further studies and work.
Uporaba Študent spozna metode sinteze spojin in določitve njihovih lastnosti. V laboratoriju dobi občutek za varno laboratorijsko delo. Nauči se uporabljati laboratorijsko opremo in instrumente. Izkušnje pri delu in občutek za snovi skupaj s teoretskim znanjem omogočajo kemiku potrebno strokovno širino.	Application Different synthetic methods are performed and properties of the prepared materials are determined. Laboratory skills are developed also in the field of laboratory safety. Students learn how to use laboratory equipment and instruments. Experiences and sense of materials together with theoretical knowledge enables to a chemist the necessary expertise insight.
Refleksija Kemija je eksperimentalna veda in za diplomante tega študijskega programa je poznavanje dela v laboratoriju in kemijskem obratu posebej pomembno in hkrati motivacija pri osvajanju teoretskega znanja drugih predmetov.	Analysis Chemistry is an experimental science and for graduates of this study program is the chemical and laboratory knowledge particularly important and is at the same time a motivation in acquiring theoretical knowledge of other subjects.
Prenosljive spretnosti Laboratorijske veščine, izkušnje in prijemi pri načrtovanje sintez so pomembni pri drugih kemijskih predmetih in pri osebnemu strokovnemu razvoju.	Skill-transference Ability Laboratory skills, experiences and the knowledge on different synthetic approaches are important in other chemistry courses and in their personal professional development.

Metode poučevanja in učenja:	**Learning and Teaching Methods:**
Predmet se izvaja v obliki seminarjev in samostojnih laboratorijskih vaj. Na seminarju se tematiko vsake vaje umesti v širši kontekst anorganske kemije.	Seminars and individual laboratory practice. At the seminar, the topic of each practical assignment is presented within the broader

	context of inorganic chemistry.

Načini ocenjevanja:	Delež (v %) / Weight (in %)	**Assessment:**
Pisni izpit po uspešno opravljenem praktičnem delu.	**100%**	Written examination after successfully passed all laboratory work.

Reference nosilca / Lecturer's references:

- **F. Perdih**: Diversity of supramolecular aggregation in copper(II) pentane-2,4-dionato compounds with methyl substituted 2-aminopyridines. J. Coord. Chem. 2012, 65, 1850–1591.
- **F. Perdih**: Different coordination modes and supramolecular aggregations in copper(II) pentane-2,4-dionato compounds with 2-pyridone and 3-hydroxypyridine. Monatshefte für Chemie 2012, 143, 1011–1017.
- **F. Perdih**, A. Perdih: Lignin selective dyes : quantum-mechanical study of their characteristics. Cellulose 2011, 18, 1139–1150.

UČNI NAČRT PREDMETA / COURSE SYLLABUS	
Predmet:	PRAKTIKUM IZ OSNOV KEMIJSKEGA INŽENIRSTVA
Course Title:	PRACTICAL COURSE IN CHEMICAL ENGINEERING FUNDAMENTALS

Študijski program in stopnja Study Programme and Level	Študijska smer Study Field	Letnik Academic Year	Semester Semester
VSŠ Kemijska tehnologija, 1. stopnja	**/**	**3.**	**5.**
USP Chemical Egineering, 1st Cycle	**/**	**3rd**	**5th**

Vrsta predmeta / Course Type: obvezni / Mandatory

Univerzitetna koda predmeta / University Course Code:

Predavanja Lectures	Seminar Seminar	Vaje Tutorial	Klinične vaje Work	Druge oblike študija	Samost. delo Individual Work	ECTS
/	**/**	**15 SV + 60 LV**	**/**	**/**	**75**	**5**

Nosilec predmeta / Lecturer: prof. dr. Aleksander Pavko /
Dr. Aleksander Pavko, Full Professor

Jeziki / Languages: **Predavanja / Lectures:** **/**
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:

Praktikum vključuje eksperimentalno in seminarsko delo, katerega teoretične osnove sodijo na naslednja temeljna področja kemijskega inženirstva:

- fluidna mehanika (mešanje);
- prenos toplote in snovi;
- kemijsko reakcijsko inženirstvo (vzbujevalno odzivna tehnika),
- izbrane osnovne operacije (filtracija, destilacija, sušenje)

Content (Syllabus outline):

Practical course consists of experimental work and seminars with a theoretical background of the following basic fields of chemical engineering:

- fluid mechanics (mixing),
- heat and mass transfer,
- chemical reaction engineering (stimulus response technique),
- selected unit operations (filtration. distillation, drying).

Temeljna literatura in viri / Readings:

- A.Bižal and A.Pavko, Kemijsko inženirski praktikum, FKKT, Ljubljana, 1987; (80%)

Dopolnilna literatura / Additional literature:
Literatura, ki je navedena pri predmetih Osnove kemijskega inženirstva in Osnovne operacije v kemijskem inženirstvu.
Literature cited for the courses Chemical engineering fundamentals and Unit operations in chemical engineering

***Cilji* in kompetence:**

Cilj predmeta je, da študentje s pomočjo laboratorijskega praktičnega dela dopolnijo predstavo in znanje o fazah proizvodnega procesa ter o vlogi kemijskega inženirstva pri tem. Tako spoznajo osnovne principe te temeljne tehniške discipline.

Študentje pri predmetu pridobijo naslednje specifične kompetence:

- vodenje kemijsko inženirskih procesov v laboratorijskem merilu;
- uporaba laboratorijskih naprav, instrumentalnih metod in programskih paketov;
- uporaba znanj fluidne mehanike;
- uporaba znanj prenosa toplote in snovi;
- uporaba osnovnih znanj kemijskega reakcijskega inženirstva;
- uporaba osnovnih znanj separacijskih procesov.

Objectives and Competences:

The aim of the course is that students implement the view and theoretical knowledge about the stages of a production process and the role of chemical engineering through the laboratory experimental work. This way they become familiar with the basic principles of this fundamental technical science.

Students gain the following specific competences:

- to control chemical engineering processes at laboratory scale,
- to use laboratory equipment, instrumentation methods and computer software;
- to use the knowledge of fluid mechanics;
- to use the knowledge of heat and mass transfer;
- to use the basic knowledge chemical reaction engineering;
- to use the knowledge separation processes.

Predvideni študijski rezultati:

Znanje in razumevanje
Študent je sposoben prepoznati vlogo in razumeti pomen poznavanja osnovnih kemijsko inženirskih znanj za načrtovanje in vodenje specifičnih kemijsko tehnoloških procesov. Študent zna identificirati ključne dejavnike pri razvoju kemijsko inženirskih procesov, produktov in opreme. Spozna osnove izvedbe in kontrole procesov v laboratorijskem merilu. Zna uporabljati instrumentalne metode in ostale analitske tehnike za nadzor procesa in karakterizacijo produkta. Zna eksperimentalne rezultate kvantitativno obravnavati v skladu z literaturo in s pomočjo sodobne programske opreme.

Intended Learning Outcomes:

Knowledge and Comprehension
Student is able to recognize the role and to understand the significance of chemical engineering knowledge for specific chemical process design and control. Student knows to identify essential factors for the development of processes, products and equipment in chemical engineering. Student learns basics of process realization and control in a laboratory scale. He can use instrumental methods and other analytical techniques for the process control and product characterization. Student can qualitatively treat the results in accordance with the literature and by using contemporary

	computer software.
Uporaba Pridobljena praktična znanja in znanje interpretiranja ter obdelovanja eksperimentalnih podatkov je sposoben uporabiti pri delu na različnih področjih kemijskega inženirstva.	Application Student is able to use gained practical skills and knowledge of interpreting and handling the experimental data in the various fields of chemical engineering.
Refleksija Laboratorijske vaje se neposredno navezujejo na vsebine predmetov Osnove kemijskega inženirstva in Osnovne operacije v kemijskem inženirstvu. Študent je sposoben uporabiti pridobljeno znanje pri reševanju praktičnih problemov iz različnih področij kemijskega inženirstva. Sposoben je povezovanja praktičnih rezultatov s teoretičnimi osnovami.	Analysis Laboratory exercises are in direct connection with the courses Chemical engineering fundamentals and Unit operations in chemical engineering. Student is capable to use the acquired knowledge during solving of practical problems from the various fields of chemical engineering. Student is capable to link practical results with theoretical background.
Prenosljive spretnosti Razvita sposobnost uporabe teoretičnega znanja pri izvedbi laboratorijskih eksperimentov. Razvita sposobnost opravljanja laboratorijskih poskusov, vrednotenja in interpretiranja eksperimentalnih rezultatov z uporabo sodobne programske opreme na osnovi osvojenih teoretičnih znanj. Razvita sposobnost razmišljanja in logičnega sklepanja. Sposobnost zbiranja podatkov in predstavitve rezultatov. Spozna vrednosti skupinskega dela.	Skill-transference Ability Developed capability of using theoretical knowledge at laboratory experiments. Developed capability of performing laboratory experiments, evaluation and interpretation of experimental results by using the contemporary computer software on the basis of accomplished theoretical knowledge. Developed capability of thinking and logical concluding. Capability of data collection and result presentation. Student learns the value of a team work.

Metode poučevanja in učenja:	**Learning and Teaching Methods:**
Eksperimentalno delo ki vključuje laboratorijske vaje in seminarske vaje.	Experimental work including laboratory exercises and seminars.

Načini ocenjevanja:	Delež (v %) / Weight (in %)	**Assessment:**
Pisni in ustni izpit. Seminarska naloga (pogoj za pristop h kolokviju).	**80%** **20%**	Written and oral exam. Written seminar (mandatory before exam).

Reference nosilca / Lecturer's references:

- LIKOZAR, Blaž, SENICA, David, **PAVKO, Aleksander**. Equilibrium and kinetics of vancomycin adsorption on polymeric adsorbent. *AIChE journal*, 2012, vol. 58, no. 1, str. 99-106.
- TISU, Matjaž, **PAVKO, Aleksander**. Oxygen transfer in a laboratory stirred tank bioreactor during mammalian cell culture cultivation. Acta chimica slovenica, 2010, vol. 57, no. 1, str. 123-128.

- FOJKAR, Andrej, **PAVKO, Aleksander**. Wetting of immobilising plaster bandages by immersion before application. Acta chimica slovenica, 2004, vol. 51, str. 325-332.

UČNI NAČRT PREDMETA / COURSE SYLLABUS	
Predmet:	PRAKTIKUM IZ SPLOŠNE KEMIJE
Course Title:	PRACTICAL COURSE IN GENERAL CHEMISTRY

Študijski program in stopnja Study Programme and Level	Študijska smer Study Field	Letnik Academic Year	Semester Semester
VSŠP Kemijska tehnologija, 1. stopnja	/	1.	1.
PSP Chemical Technology, 1st Cycle	/	1st	1st

Vrsta predmeta / Course Type: obvezni / Mandatory

Univerzitetna koda predmeta / University Course Code: KT106

Predavanja Lectures	Seminar Seminar	Vaje Tutorial	Klinične vaje Work	Druge oblike študija	Samost. delo Individual Work	ECTS
/	/	15 SV + 60 LV	/	/	75	5

Nosilec predmeta / Lecturer: doc. dr. Nives Kitanovski / Dr. Nives Kitanovski, Assistant 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):
Pri računskih vajah študenti utrjujejo poznavanje kvantitativnega obravnavanja snovi in snovnih sprememb z reševanjem računskih nalog in kvantitativnih kemijskih problemov s poudarkom na stehiometriji. Obseg in nivo pričakovanih veščin in znanja sta določena s predpisanim učbenikom (skripta) Program laboratorijskih vaj se izvede v obliki eksperimentalnih vaj z vsebinami: - osnove varnega dela v laboratoriju - osnovna laboratorijska steklovina in oprema - odmerjanje trdnih in tekočih reagentov (tehtanje, pipetiranje, itd.) - dodajanje trdnih in tekočih reagentov - delo pri sobni temperaturi (npr. mešanje) - delo pri povišani temperaturi (segrevanje)	In numerical exercises students strengthen knowing of the quantitative approach of the substance and material changes with solving numerical tasks and quantitative chemistry problems, with focus on the stoichiometry. The scope and level of expected skills and knowledge are determined by the prescribed textbook (script). Program of laboratory work is conducted in the form of laboratory work content: - The basics of safe work in the laboratory - Basic laboratory glassware and equipment - Dosing of solid and liquid reagents (mass measurements, pipetting, etc.). - Adding solid and liquid reagents - Working at room temperature (eg, mixing)

- delo pri znižani temperaturi (hlajenje) - kristalizacija - navadna destilacija (izbor vaj se lahko spreminja) S seminarskimi vajami se poudari povezanost praktičnega eksperimentalnega dela s teorijo.	- Work at elevated temperature (heating) - Work at reduced temperature (cooling) - crystallization - basic distillation (selection of exercises may vary) The seminar exercises emphasize the integration of practical experimental work with theory.

Temeljna literatura in viri / Readings:

- P. Šegedin, Osnove kemijskega računanja z zbirko nalog, UL Biotehniška fakulteta - Oddelek za lesarstvo, Ljubljana 1996, 149 strani.
- B. Kozlevčar, N. Kitanovski, P. Šegedin, Navodila za vaje iz splošne kemije, študijsko gradivo, UL FKKT, 2013, 27 strani.

Dodatna literatura / additional readings:

- N. Bukovec, J. Brenčič, Kemija za gimnazije 1, srednješolski učbenik, DZS, Ljubljana, 2006, 160 strani.
- J. Brenčič, F. Lazarini, Splošna in anorganska kemija, UL FKKT, Ljubljana 2004, strani 1-239.
- P. Šegedin, Zbirka izpitnih nalog iz kemije, UL Biotehniška fakulteta - Oddelek za lesarstvo, Ljubljana 1995, 65 strani.

Cilji in kompetence:	**Objectives and Competences:**
Študenti spoznajo osnove kvantitativnega obravnavanja snovi in snovnih sprememb (osnove kemijskega računanja s poudarkom na stehiometriji). Pri laboratorijskih vajah je osnovni cilj seznaniti študente z osnovnimi prijemi za delo v laboratoriju. Ob tem je poseben poudarek na osebni varnosti ter varnosti delovnega prostora in okolja.	Students learn about the basics of quantitative treatment of materials and material changes (basic chemical calculation with focus on stoichiometry). The basic aim of laboratory exercises is to pair students with the basic approaches to laboratory work. It has a special emphasis on personal safety, safety of the working space and the environment.

Predvideni študijski rezultati:	**Intended Learning Outcomes:**
Znanje in razumevanje Študenti pri računskih vajah predvsem spoznajo pomen poznavanja in razumevanja osnovnih kemijskih pojmov in zakonitosti pri reševanju nalog in kvantitativnih izzivov s področja kemijskega računanja. Pri laboratorijskih vajah pridobijo osnovno praktično znanje varnega dela v kemijskem laboratoriju in spoznajo osnovna navodila o varnosti in prvi pomoči pri laboratorijskem delu.	Knowledge and Comprehension At numerical exercises students learn especially about the importance of knowing and understanding of basic chemical concepts and principles in problem solving and quantitative challenges in the field of chemical calculations. During laboratory exercises they acquire the basic practical knowledge of safe work in a chemistry lab and learn the basic instructions on safety and first aid at laboratory work.
Uporaba Študenti se seznanijo s postopki in pristopi pri reševanju računskih nalog in problemov in jih znajo uporabiti pri njihovem reševanju. Pri izvedbi osnovnih eksperimentalnih (laboratorijskih) vaj	Application Students meet with the procedures and approach for solving numerical tasks and problems, and are able to use to tackle them. Students are able to choose the appropriate

znajo izbrati ustrezen postopek in ga na pravilen način uporabiti (izvesti).	experimental procedure and use (performed) it in correct way.
Refleksija Študenti so sposobni kritično ovrednotiti izvedene meritve in oceniti dobljene rezultate. Teoretične naloge in kvantitativne probleme so sposobni povezati z eksperimentalnimi nalogami in problemi, s katerimi se srečajo pri laboratorijskih vajah in se tako naučiti povezovanja in razumevanja teorije in prakse.	Analysis Students are able to critically evaluate the performed measurements and assess the obtained results. They are able to connect theoretical challenges and quantitative problems with the experimental tasks and problems that may arise at laboratory work, thus also learn the integration and understanding of theory and practice.
Prenosljive spretnosti Pri predmetu bodo študenti pridobili laboratorijske spretnosti in se urili v reševanju kvantitativnih teoretičnih in eksperimentalnih nalog in problemov ter lahko pridobljene izkušnje in znanje koristno uporabil tudi pri vseh drugih kemijskih predmetih. Varnost pri delu je pomembna vrlina ne le v laboratoriju, temveč pri kakršnikoli dejavnosti.	Skill-transference Ability In this course, students gain laboratory skills and are trained in solving quantitative theoretical and experimental tasks and problems, and may learn experience and knowledge usefully applied in all other chemistry subjects. Safety at work is an important virtue not only in the laboratory but also in any activities.

Metode poučevanja in učenja:	**Learning and Teaching Methods:**
Seminarske vaje in praktične vaje v laboratoriju. Pri seminarskih vajah poteka reševanje računskih stehiometričnih nalog in kvantitativnih kemijskih izzivov s poudarkom na skupinskem delu (sodelovalno učenje). Laboratorijske vaje so zasnovane na delu posameznika (izkustveno učenje), skupinska analiza meritev in kvalitativnih eksperimentov ter njihova razlaga s primerno teorijo.	Seminars and practical exercises in the laboratory. At seminars, the stoichiometric calculation problems are solving along with the quantitative chemical challenges, emphasising teamwork (collaborative learning). Laboratory exercises are based on the work of the individual (experiential learning), group analysis of measurements and qualitative experiments with their interpretation by the relevant theory.

Načini ocenjevanja:	Delež (v %) / Weight (in %)	**Assessment:**
Kolokvij iz vaj – 5 nalog oz. problemov. Najmanj tri točke za pozitivno oceno. Pri oceni vaj se upošteva tudi nivo laboratorijskega dela. Ocene 6-10 pozitivno		Lab exercise's colloquium - 5 tasks or problems. At least three points for a positive assessment. The level of laboratory work is also taking into account for assessing. Positive grades 6-10

Reference nosilca / Lecturer's references:

- **KITANOVSKI, Nives**, BORSAN, Nataša, KASUNIČ, Marta, FRANCETIČ, Vojmir, POPOVIĆ, Jasminka, DJERDJ, Igor, ROCQUEFELTE, Xavier, REEDIJK, Jan, KOZLEVČAR, Bojan. Chromium coordination compounds with bis(3,5-dimethylpyrazol-1-yl)acetic acid or its anion. Polyhedron, 2014,70, 119-124, [COBISS.SI-ID 1666351]

- **KITANOVSKI, Nives**, GOLOBIČ, Amalija, ČEH, Boris. Synthesis and structural characterization of mono- and dinuclear Mo(V)-oxo-complexes containing bis(3,5-dimethylpyrazol-1-yl)acetate anion as ligand. Inorg. Chem. Commun., 2011, 14, 276-280. [COBISS.SI-ID 34680069]
- **KITANOVSKI, Nives**, PEVEC, Andrej, KOZLEVČAR, Bojan. Copper(II) coordination compounds with ferulic acid. Polyhedron, 2009, 28, 3642-3646, [COBISS.SI-ID 33287429]

UČNI NAČRT PREDMETA / COURSE SYLLABUS	
Predmet:	PRAKTIKUM IZ MATERIALOV
Course Title:	PRACTICAL COURSE IN MATERIALS CHARACTERISATION

Študijski program in stopnja Study Programme and Level	Študijska smer Study Field	Letnik Academic Year	Semester Semester
VSŠP Kemijska tehnologija, 1. stopnja	/	3.	6.
PSP Chemical Technology, 1st Cycle	/	3rd	6th

Vrsta predmeta / Course Type: izbirni strokovni / Elective Professional

Univerzitetna koda predmeta / University Course Code: KTSI34

Predavanja Lectures	Seminar Seminar	Vaje Tutorial	Klinične vaje Work	Druge oblike študija	Samost. delo Individual Work	ECTS
/	/	25 SV + 50 LV	/	/	75	5

Nosilec predmeta / Lecturer: doc. dr. Klementina Zupan / Dr. Klementina Zupan, Assistant Professor

Jeziki / Languages: **Predavanja / Lectures:** /; **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):
I.del: primeri računskih problemov s področja materialov Mehanske lastnosti, električne lastnosti, termične lastnosti, magnetne lastnosti Gostota in poroznost Kemijske vezi, koordinacija Geometrija kristalov, smeri, ravnine, prostor, nekatere osnovne strukture, polimorfizem Točkasti defekti, difuzija v trdnem, teoretična zlomna trdnost, Schmidov zakon, Griffithova teorija Fazni diagrami (binarni, ternarni) fazni diagrami v povezavi z mikrostrukturo, Trdne raztopine, nestehiometrične spojine Korozija, kinetika korozije	Part I: Computational problems solving in the field of materials Mechanical, electrical, thermal, magnetic properties Density and porosity. Chemical bonding, coordination crystal geometry, crystallographic directions, planes and some basic structures, polymorphism - Point defects, diffusion in the solid, theoretical strength, Schmid's Law, Griffi th theory Phase diagrams (binary, ternary) phase diagrams in relation with the microstructure. Solid solution, a non-stoichiometric compound Corrosion, corrosion kinetics.

II.del: praktične vaje iz karakterizacije materialov Mikrostruktura materialov z optično, elektronsko mikroskopijo, mikroskopija na atomsko silo (AFM). Kvantitativna analiza mikrostrukture. Rentgenska praškovna analiza: tehnika z Guinierjevo kamero ter identifikacija vzorca po Hanawaltovi metodi in metoda rentgenske praškovne difrakcije ter identifikacija z uporabo ustreznih identifikacijskih programov. Določanje velikosti kristalitov. Mehanske lastnosti: Mehanski preizkus, določitev deformacije in sile potrebne za zlom preizkušanega materiala, izračun σ_{nat}, $\sigma_{zlomna\ tehnična}$, $\sigma_{zlomna\ realna}$, kontrakcija in E-modul. Določanje trdote materialov. Električne lastnosti: Merjenje odvisnosti upornosti od temperature. Merjenje kapacitivnosti in dielektričnih izgub ploščatega kondenzatorja. Določanje varistorskih lastnosti koeficient nelinearnosti in prebojno napetost. Impedančna spektroskopija: karakterizacija električnih lastnosti materialov (dielektrične konstante in specifične upornosti). Termična analiza: TG in DSC analiza različnih materialov. Vrednotenje rezultatov, določanje vsebnosti posameznih komponent v vzorcu. Določanje parametrov sintranja s segrevalno mikroskopijo. Gostota, poroznost in specifična površina: Piknometrična določitev gostote in poroznosti materialov,, določanje specifične površine z adsorbcijo plinov (BET). Metode klasične kemijske in instrumentalne analize materialov (IR, UV, NMR, MS)	Part II: practical course in materials characterization Optical, electron and atomic force microscopy (AFM) analysis of microstructure, quantitative microstructures analysis. X-ray powder diffraction: technique using Guinier camera and identification of the sample by Hanawalt and by identification programs. Determination of crystallite size. Mechanical properties: Mechanical testing, determination force versus deformation, calculation of tensile strength, rupture strength, contraction and elastic moduli. Materials hardness determination. Electrical properties: electrical resistance versus temperature. Measuring capacitance and dielectric losses of the flat capacitor. Varistor characteristics, nonlinearity coefficient and breakdown voltage. Impedance spectroscopy: characterization of materials (dielectric constant and resistivity). Thermal analysis: DSC and TG analysis of different materials, determination of components contents. Defining parameters of sintering by a heating microscopy. Density, porosity and specific surface area. Picnometric determination of density and porosity of materials. D3etermination of the specific surface area by gas adsorption (BET). Classical methods of chemical and instrumental analysis of materials (IR, UV, NMR, MS).

Temeljna literatura in viri / Readings:

- Zhang s., Li L., Kumar A, Materials Characterization Cechniques, CRC Press, London, 2009
- D. Brandon, W.D. Kaplan, Microstructural Characterization of Materials, 2nd.ed., John Wiley& Sons, 2008
- Kaufman E. N., Characterization of Materials 1&2, A John Wiley and Sons Publication, New Jersey, 2003, 1392 strani. (10 %)
- Sibilia J. P., A Guide to Materials Characterisation and Chemical Analysis, Wiley-VCH, New York, 1996, 388 strani. (30 %)
- Pejovnik, S., Zupan, K., Kolar, D-, Čeh, M., Malič, B., Zbirka nalog iz predmeta Gradiva v kemijski tehniki. [Ljubljana: Fakulteta za kemijo in kemijsko tehnologijo], 1999/2000, 28 strani.

Cilji in kompetence:	**Objectives and Competences:**
Namen predmeta je, da v prvem delu študentje	The purpose of this course is that in the first

pridobijo znanja za računsko obravnavo problemov s področja materialov, v smislu razumevanja njihove zgradbe v povezavi z lastnostmi (mehanskimi, termičnimi električnimi..) na mikro in makro nivoju. V drugem delu pa z laboratorijskim praktičnim delom pridobijo znanja o metodah karakterizacije materialov. Rezultate praktičnih meritev obdelajo in obrazložijo v skladu s teoretičnimi napovedmi. Znanje naj omogoči razumevanje in dialog inženirja s strokovnjaki drugih profilov v praksi in sodobni interdisciplinarni pristop k reševanju nalog.	part, students acquire skills for computational problem solving in the field of materials. in terms of understanding their structure in relation with properties (mechanical, thermal, electrical ...) at the micro and macro level. The goal of the second part of the laboratory practical work is to gain knowledge about the methods of characterization of materials. The students learn to process and explain results of practical measurement in accordance with theoretical predictions. They learn to communicate with experts from other fields in practice and contemporary interdisciplinary approach to problem solving.

Predvideni študijski rezultati:	**Intended Learning Outcomes:**
Znanje in razumevanje Študentje spoznajo soodvisnost med zgradbo in lastnostmi materialov. V tečaju bomo podali znanja o metodah karakterizacije materialov ter jih praktično izvedli. Študent pridobi praktično zanje o računski obravnavi primerov s področja razumevanja strukture in sprememb na mikro in makro nivoju.	Knowledge and Comprehension Students learn relationships between structure and material properties. The course will cover knowledge of characterization methods and practical application. Students acquire knowledge of computational problem solving of cases regarding structure and changes at the macro and micro level.
Uporaba Pridobljena znanja je sposoben uporabljati za samostojno, logično in kritično razmišljanje o lastnostih, načrtovanju, izbiri in uporabi različnih materialov.	Application Knowledge is applied independently using logical and critical thinking about characteristics, planning, choice and use of different materials.
Refleksija Laboratorijske vaje in računanje primerov so vezane na vsebine premeta, ki obravnava materiale, njihovo načrtovanje, uporabo in njihov propad. Zaradi svoji interdisciplinarnosti so vezane tudi na osnovna znanja Fizike, Kemije (anorganske, organske, fizikalne)	Analysis Practical course and computation depends on course curriculum addressing the development of materials, use, decomposition. Due to interdisciplinary properties of the course, knowledge of Physics, Chemistry (inorganic, organic, physical) is required.
Prenosljive spretnosti Sposobnost uporabe principov vede o materialih pri njihovi karakterizaciji in vrednotenju njihovih lastnosti tako pri raziskovalnem kot razvojnem delu.	Skill-transference Ability Ability to use principles of material science. Ability to evaluate material characteristics in research and development

Metode poučevanja in učenja:	**Learning and Teaching Methods:**
Računski seminarji, laboratorijske vaje, individualna seminarska naloga.	-Computational seminars , - practical course , -individual seminar work

Načini ocenjevanja:	Delež (v %) / Weight (in %)	Assessment:
- pisni del iz računskih nalog in praktična izvedba vaj pri katerih študent teoretično obdela temo, ki se nanaša na izbrano metodo ali skupino metod karakterizacije v obliki projektnega dela, ki se zaključi s poročilom - ocenjevalna lestvica v skladu s Statutom UL in fakultetnimi pravili: 60 % dosežek za pozitivno oceno (ocena 6-10), manj kot 50 % negativna ocena (od 1-5).		Final grade is calculated as follows: Written exam: computation problems (50%) (Written part can be accomplished by achieving a positive grade of one written colloquium at the end of semester), individual seminar work (50%).
K končni oceni prispeva pisni del iz računskih nalog (50 %) in	**50 %**	
poročilo o projektnem delu (50%)	**50 %**	

Reference nosilca / Lecturer's references:

- **Zupan, K.**, Marinšek M. , Microstructure development of the Ni-GDC anode material for IT-SOFC = Razvoj mikrostrukture Ni-GDC anodnega materiala za srednjetemperaturne SOFC. Materiali in tehnologije, ISSN 1580-2949, sep.-okt. 2012, letn. 46, št. 5, str. 445-451. http://www.imt.si/Revija/. [COBISS.SI-ID 942762]
- **Zupan, K.**, Marinšek M. , Marjan, Novosel B., Combustible precursor behaviour in the lanthanum chromite formation process = Termične lastnosti reakcijskega gela za pripravo lantanovega kromita. Materiali in tehnologije, ISSN 1580-2949, 2011, vol. 45, no. 5, str. 439-445. [COBISS.SI-ID 35456261]
- Skalar, T., **Zupan, K.**, Marinšek M. , Novosel B., Maček J., Microstructure evaluation of Ni-SDC synthesized with an innovative method and Ni-SDC/SDC bi-layer construction. Journal of the European Ceramic Society, ISSN 0955-2219. [Print ed.], 2014, vol. 34, no. 2, str. 347-354, ilustr. http://www.sciencedirect.com/science/article/pii/S0955221913003786, doi: 10.1016/j.jeurceramsoc.2013.08.020. [COBISS.SI-ID 1615151]

UČNI NAČRT PREDMETA / COURSE SYLLABUS	
Predmet:	PRAKTIKUM IZ ORGANSKE KEMIJE
Course Title:	PRACTICAL COURSE IN ORGANIC CHEMISTRY

Študijski program in stopnja Study Programme and Level	Študijska smer Study Field	Letnik Academic Year	Semester Semester
VSŠP Kemijska tehnologija, 1. stopnja	/	2.	3.
PSP Chemical Technology, 1st Cycle	/	2nd	3rd

Vrsta predmeta / Course Type: obvezni / Mandatory

Univerzitetna koda predmeta / University Course Code: KT114

Predavanja Lectures	Seminar Seminar	Vaje Tutorial	Klinične vaje Work	Druge oblike študija	Samost. delo Individual Work	ECTS
/	/	15SV + 60 LV	/	/	75	5

Nosilec predmeta / Lecturer: izr. prof. dr. Janez Cerkovnik / Dr. Janez Cerkovnik, Associate 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:

Splošno.
-Varnost pri delu. Osebna zaščitna oprema. Varovanje sebe, delovnega prostora in okolja.
-Vodenje laboratorijskega dnevnika in pisanje poročil.
-Iskanje informacij v literaturi in v bazah podatkov.
Metode in tehnike.
Vaje (eksperimenti) bodo izbrane na osnovi karakterističnih sinteznih metod. Vaje bodo zajemale pripravo reagentov in kemikalij, sintezo in izolacijo produktov, ter njihovo analitiko in karakterizacijo. Študentje bodo izvajali:
-merjenje mase in prostornine
-uporaba kemikalij in priprava raztopin,
-topila v laboratoriju (čiščenje, regeneracija,

Content (Syllabus outline):

General.
- Safety at work. Personal protective equipment. Personal, workspace and environmental protection.
- Lab diary and reports writing.
- Literature and databases information search.
Methods and techniques.
Exercise selection (experiments) will be based on the characteristic synthetic methods. Exercises will include a preparation of reagents and chemicals, synthesis and isolation of the products, followed by their analysis and characterization.
Students will implement:
- mass and volume measurements

brezvodna topila) -delo v inertni atmosferi, -delo s plini (jeklenke) -kristalizacija -destilacija, - sublimacija, - ekstrakcija, - kromatografske tehnike za karakterizacijo, izolacijo in separacijo spojin - karakterizacija organskih spojin s testnimi reakcijami in z derivatizacijo - določanje fizikalnih lastnosti snovi (tališče, vrelišče itd.)	- use of chemicals and preparation of solutions - solvents in the laboratory (cleaning , regeneration , anhydrous) - work at inert atmosphere - work with gases (cylinders) -crystallization - distillation - sublimation - extraction - chromatographic techniques, isolation and separation of the compounds - characterization of organic compounds with the test reactions and preparation of corresponding derivate - physical properties determination (melting point, boiling point, etc.).

Temeljna literatura in viri / Readings:

- N. Gros, J. Cerar, F. Kovač, B. Kozlevčar: Praktikum iz kemije, študijsko gradivo, UL FKKT.
- G. J. Shugar, R. A. Shugar, L. Bauman, R. Shugar Bauman: Chemical Technician's Ready Reference Handbook. McGraw-Hill, 1981.
- L. M. Harwood, C. J. Moody: Experimental Organic Chemistry. Blackwell, 1989.

Cilji in kompetence:	**Objectives and Competences:**
Cilji predmeta: Učna enota se navezuje na predmete Splošna kemija, Organska kemija . Študent z eksperimentalnim delom praktično nadgradi osnovno teoretično znanje kemije in pridobi osnovne veščine, ki so potrebne za eksperimentalno delo v kemijskem laboratoriju. **Predmetno specifične kompetence:** -varno delo v laboratoriju -priprava in izvedba preprostih in nekaterih srednje zahtevnih eksperimentov -izvajanje najpogostejših laboratorijskih meritev, temeljnih laboratorijskih operacij in postopkov -izvajanje standardnih laboratorijskih tehnik za izolacijo in čiščenje spojin -poznavanje osnov karakterizacije spojin -dostopanje in uporaba literaturnih virov in baz podatkov	**Objectives of the subject:** The course is related to the subjects of general chemistry, organic chemistry. The basic theoretical knowledge of chemistry is upgraded and the basic skills are acquired by the practical experimental work of a student, needed for the experimental work in the chemistry laboratory. **Subject-specific competencies:** -safe work in laboratory -preparation and implementation of simple and some moderately complex experiments -implementation of the most common laboratory measurements of basic laboratory operations and procedures -the application of standard laboratory techniques for the isolation and purification of compounds -knowledge of basics of compounds characterization -accessing and applying literature and databases

Predvideni študijski rezultati:	**Intended Learning Outcomes:**

Znanje in razumevanje -varno delo v laboratoriju - osnove merjenja in pravilno izvajanje temeljnih laboratorijskih operacij in meritev -priprava in izvedba pretvorb in eksperimentov - ločevanje, izolacija, čiščenje in karakterizacija spojin -pravilno načrtovanje priprave reagentov in raztopin, izbor ustreznih vrst kemikalij in pribora ter izvedba postopka -dostopanje do literaturnih virov in baz podatkov ter njihova uporaba **Razumevanje:** -osnovni in srednje zahtevni eksperimentalni postopki in pretvorbe v kemiji -teoretske osnove postopkov za izolacijo, čiščenje in karakterizacijo spojin. -osnovna pravila varnega dela v laboratoriju	Knowledge and Comprehension - laboratory safety - fundamentals of measurements, measuring techniques and basic laboratory operations in accordance with good laboratory practice - preparatory activities, transformations and experiments - separation, isolation, purification and characterisation of substances - preparation of solutions and reagents: planning, selecting chemicals of appropriate grade, choice of equipment, procedures - accessing to the information sources and data bases and their use **Understanding** - basic experimental procedures and transformations in chemistry - understanding the fundamentals of procedures of isolation, purification and characterisation of substances at the basic and intermediate level - performance in in accordance with safety precautions
Uporaba Osnovno praktično znanje kemije z razumevanjem povezav med kemijskimi področji je temeljno znanje, ki se uporablja v nadaljnjem študiju kemije in kemijske tehnologije hkrati pa je nujno potrebno vsakemu kemiku/tehnologu pri njegovem kasnejšem delu v praksi.	Application Fundamental chemical skills and understanding of the connections and relations between different chemical disciplines support study of prospect chemical and technological modules and are essential in professional practice.
Refleksija Študent bo na osnovi pridobljenega znanja sposoben izvesti preproste in srednje zahtevne meritve, eksperimente in pretvorbe v kemiji. S tem je sposoben preveriti hipoteze v praksi oziroma kritično ovrednotiti rezultate eksperimenta glede na skladnost s teoretičnimi načeli. Študent je seznanjen z dostopom do literaturnih virov in baz podatkov. Študent bo pridobil občutek za optimalno izvedbo osnovnih laboratorijskih postopkov. Študent bo pridobil kritičen odnos do priprave raztopin in se zavedal omejitev pri odmerjanju mase in prostornine ter razlik v razredih kemikalij v laboratoriju.	Analysis Student develops ability of performing measurements, experiments and transformations in chemistry at the basic and intermediate level. Student acquires skills for checking hypotheses experimentally and evaluating the conformity of the outcomes and results of experiments with theoretical expectations. Student is capable of using sources of information. Student develops sensitivity for adequate performance of laboratory operations. Student will be aware of the safety precautions for handling gasses. Student will develop critical attitude towards preparation of solutions and will be aware of the limitations in measuring mass and volume. Student will be

	aware of the distinctions between chemicals of different grades in a laboratory.
Prenosljive spretnosti - Merjenje mase in prostornine, priprava raztopin, -Pravilno izvajanje temeljnih laboratorijskih operacij -Dostopanje do literaturnih virov -Zbiranje, merjenje, analiza, razlaga in kritično vrednotenje podatkov -Identifikacija in reševanje problemov in izzivov. -Poročanje. -Kritična analiza, sinteza.	Skill-transference Ability - Measurement of mass and volume and preparation of solutions. - Performance of laboratory operations in accordance with good laboratory practice. - Ability of using information sources. - Ability of finding information, obtaining data by measurements, analysing, evaluating and interpreting data. - Ability of recognising and defining problems and challenges. - Reporting. - Critical analysis and synthesis of information.

Metode poučevanja in učenja:	**Learning and Teaching Methods:**
Predavanja, laboratorijske vaje.	Lectures, laboratory exercises.

Načini ocenjevanja:	Delež (v %) / Weight (in %)	**Assessment:**
Opravljene vaje so pogoj za pristop k izpitu. Pisni izpit, ki ga lahko nadomestita dva (sprotna) pregledna testa. Ocene: pozitivno 6-10.		Laboratory coursework is a prerequisite for the exam. Final written exam (or two partial written tests). Positive grades 6-10

Reference nosilca / Lecturer's references:

1. STRLE, Gregor, CERKOVNIK, Janez. A simple and efficient preparation of high-purity hydrogen trioxide (HOOOH). Angewandte Chemie, ISSN 1433-7851. [Print ed.], 2015, vol. 54, no. 34, str. 9917-9920, ilustr. http://onlinelibrary.wiley.com/doi/10.1002/anie.201504084/abstract, doi: 10.1002/anie.201504084. [COBISS.SI-ID 1536385475]
2. TUTTLE, Tell, CERKOVNIK, Janez, KOLLER, Jože, PLESNIČAR, Božo. The search for protonated dihydrogen trioxide (HOOOH) : insights from theory and experiment. The journal of physical chemistry. A, Molecules, spectroscopy, kinetics, environment, & general theory, ISSN 1089-5639, 2010, vol. 114, no. 30, str. 8003-8008, doi: 10.1021/jp103882e. [COBISS.SI-ID 34295813]
3. CERKOVNIK, Janez, PLESNIČAR, Božo. Recent advances in the chemistry of hydrogen trioxide (HOOOH). Chemical reviews, ISSN 0009-2665. [Print ed.], 2013, vol. 113, no. 10, str. 7930-7951, ilustr. http://pubs.acs.org/doi/ipdf/10.1021/cr300512s, doi: 10.1021/cr300512s. [COBISS.SI-ID 1615407]

UČNI NAČRT PREDMETA / COURSE SYLLABUS	
Predmet:	PROCESI V INDUSTRIJSKI KEMIJI
Course Title:	PROCESSES IN INDUSTRIAL CHEMISTRY

Študijski program in stopnja Study Programme and Level	Študijska smer Study Field	Letnik Academic Year	Semester Semester
VSŠP Kemijska tehnologija, 1. stopnja	/	2.	3.
PSP Chemical Technology, 1st Cycle	/	2nd	3rd

Vrsta predmeta / Course Type: obvezni / Mandatory

Univerzitetna koda predmeta / University Course Code: KT118

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

Nosilec predmeta / Lecturer: doc. dr. Boštjan Genorio / dr. Boštjan Genorio, Assistant Professor
prof. dr. Urška Šebenik / Dr. Urška Šebenik, Full Professor

Jeziki / Languages:

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

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:

Katalitski postopki: vloga in delovanje katalizatorja v tehnološkem procesu, homogena in heterogena k ataliza, aktivnost in druge lastnosti katalizatorja, kat alizatorski strupi in deaktivacija katalizatorjev.

Razklop mineralnih surovin: Razklop mineralov, pre cipitacija in kristalizacija, prenasičenje, nukleacija in vpliv na lastnosti produktov kristalizacije,
rast in zorenje kristalov.

Industrijski elektrokemijski procesi: Osnove elektro kemijskih procesov, prenapetost, celični separatorji in druge
značilnosti elektrokemijskih reaktorjev, industrijska elektroliza in galvanotehnika.

Content (Syllabus outline):

Catalytic processes: Role
and function of catalyst in technological process ; Homogeneous and heterogeneous catalysis; A ctivity and other properties of the catalyst; Catalyst deactivation and catalyst poisons.

Decompositions of mineral raw materials: Dec ompositions of minerals; Precipitation and cryst allization, supersaturation, nucleation and impacts on crystalline product properties; Grow th and aging of the crystals.

Industrial electrochemical processes: Fundame ntals of electrochemical processes; Over voltage, current, and energy efficiency; Cell sep

Visokotemperaturni procesi: elektrotermični in drugi termični procesi, peči, metalurški procesi.

Tehnični plini: industrijski tehnični plini, osnove krio tehnike, proizvodnja, shranjevanje in distribucija pli nov.

Predelava fosilnih snovi: katalitski in nekatalitski procesi, reakcijski mehanizmi, proizvodi in čiščenje proizvodov; kemikalije iz sinteznega plina; tehnologija reakcij v plinastem stanju.

Polimerizacijski procesi: reakcijski mehanizmi; primeri tehnologij.

Optimizacija proizvodnih procesov: Primer optimizirane proizvodnje sladkorja.

Kvantitativna obravnava enostavnih reakcijskih in separacijskih procesov: totalna in komponentna integralna snovna bilanca za kontrolni volumen, totalna in komponentna diferencialna snovna bilanca za kontrolni volumen; računski primeri.

arators and other characteristics of electrochem ical reactors; industrial electrolysis and electropl ating.

High temperature processes: Electrothermal and other thermal processes; Furnaces; Metallurgical processes.
Industrial gases: Industrial technical gases; prin ciples of cryogenics; Production, storage and dis tribution.

Processing of fossil raw materials: Catalytic and noncatalytic processes; Reaction mechanisms; Products and their purification; Chemicals from the synthesis gas; Technology of reactions in a gaseous phase.

Polymerization processes: Reaction mechanisms; Examples of polymer technology.

Optimization of production processes: Sugar production example.

Quantitative description of simple reaction and separation processes: Total and component integral material balance for control volume; Total and component differential material balance for control volume; problems.

Temeljna literatura in viri / Readings:

- J. A. Moulijn, M. Makkee, A. van Diepen, Chemical Process Technology, Wiley, Chicester, 2001, 420 str. (40 %).
- R. M. Felder, R. W. Rousseau, Elementary principles of chemical processes, 3. izdaja, John Wiley and Sons, New York, 2000, 606 str. (40 %)

Dopolnilna literatura:
- Austin: Shreeves Chemical Process Industries, 6. izdaja, Mc Graw-Hill, New York, 1995, 830 str. (20 %).

Cilji in kompetence:

Slušatelji se v okviru predavanj in seminarja seznanijo z različnimi nivoji in osnovnimi značilnostmi kemijske industrijske proizvodnje, z osnovami kemijskih industrijskih procesov ter njihovimi infrastrukturnimi pogoji, možnostmi za uspešno in varno vodenje procesov.

Objectives and Competences:

Students become familiar with: different levels and basic characteristics of industrial chemical production, fundamentals of chemical industrial processes and their infrastructure requirements, possibilities for successful and safe processes management.

Predvideni študijski rezultati:

Intended Learning Outcomes:

Znanje in razumevanje Študentje se naučijo analizirati industrijske procese. Spoznajo osnovne značilnosti industrijskih procesov in potrebne pogoje za sodobno industrijsko proizvodnjo.	Knowledge and Comprehension Students learn how to analyze industrial processes, about basic features of industrial processes and necessary conditions for modern industrial production.
Uporaba Pri analizi postavitve procesov, njihovega delovanja in problemov, ki se pojavljajo v industrijskih procesih.	Application In analyses of process setup, process operation, and problem solving in industrial processes.
Refleksija Razvija sposobnost ovrednotenja in analize kompleksnih sistemov kakršni so v kemijski in procesnih industrijah vendar lahko pridobljena znanja uporabi tudi širše.	Analysis Students develop the ability of evaluation and analysis of complex systems occurring in chemical and process industries. The acquired knowledge is widely applicable.
Prenosljive spretnosti Teoretične principe dodatno spoznava pri njihovi implementaciji v industrijsko merilo in prakso ter kritično vrednoti skladnost med teoretičnimi načeli in praktičnim ravnanjem.	Skill-transference Ability Students recognise theoretical principles in industrial scale implementations. They are able of critical evaluation and comparison between theoretical principles and practice.

Metode poučevanja in učenja:	**Learning and Teaching Methods:**
Predavanja in seminar	Lectures and seminar

Načini ocenjevanja:	Delež (v %) / Weight (in %)	**Assessment:**
Pisni in ustni izpit. Možnost opravljanje pisnega izpita s kolokviji. Izpit je sestavljen iz ločenega preverjanja posameznih vsebin.		Written and oral exam. Written exam may be accomplished by written tests. The exam is consisted of partial assessments of the contents.

Reference nosilca / Lecturer's references:

- MOHORIČ, Ines, **ŠEBENIK, Urška**. Semibatch anionic ring-opening polymerization of octamethylcyclotetrasiloxane in emulsion. Polymer, ISSN 0032-3861. [Print ed.], 2011, vol. 52, no. 20, str. 4423-4428. [COBISS.SI-ID 35309317]

- **ŠEBENIK, Urška**, GOLOB, Janvit, KRAJNC, Matjaž. Comparison of properties of acrylic-polyurethane hybrid emulsions prepared by batch and semibatch processes with monomer emulsion feed. Polymer international, ISSN 0959-8103, 2003, vol. 52, no. 5, str. 740-748. [COBISS.SI-ID 24954117]

- RUČIGAJ, Aleš, ALIČ, Branko, KRAJNC, Matjaž, **ŠEBENIK, Urška**. Investigation of cure kinetics in a system with reactant evaporation : epoxidized soybean oil and maleic anhydride case study. European Polymer Journal, ISSN 0014-3057. [Print ed.], 2014, vol. 52, no. 1, str. 105-116. [COBISS.SI-ID 1667887]

- **Genorio B**, Strmcnik D, Subbaraman R, Tripkovic D, Karapetrov G, Stamenkovic V R, Pejovnik S and Marković N M 2010 Selective catalysts for the hydrogen oxidation and oxygen reduction reactions by patterning of platinum with calix [4] arene molecules Nat. Mater. 9 998–1003
- **Genorio B**, Lu W, Dimiev A M, Zhu Y, Raji A-R O, Novosel B, Alemany L B and Tour J M 2012 In Situ

Intercalation Replacement and Selective Functionalization of Graphene Nanoribbon Stacks ACS Nano 6 4231–40
- Xiang C, Behabtu N, Liu Y, Chae H G, Young C C, **Genorio B**, Tsentalovich D E, Zhang C, Kosynkin D V, Lomeda J R, Hwang C-C, Kumar S, Pasquali M and Tour J M 2013 Graphene Nanoribbons as an Advanced Precursor for Making Carbon Fiber ACS Nano 7 1628–37
- Xiang C, Cox P J, Kukovecz A, **Genorio B**, Hashim D P, Yan Z, Peng Z, Hwang C-C, Ruan G, Samuel E L G, Sudeep P M, Konya Z, Vajtai R, Ajayan P M and Tour J M 2013 Functionalized Low Defect Graphene Nanoribbons and Polyurethane Composite Film for Improved Gas Barrier and Mechanical Performances. ACS Nano 7 10380–6
- Raji A-R O, Varadhachary T, Nan K, Wang T, Lin J, Ji Y, **Genorio B**, Zhu Y, Kittrell C and Tour J M 2016 Composites of Graphene Nanoribbon Stacks and Epoxy for Joule Heating and Deicing of Surfaces ACS Appl. Mater. Interfaces 8 3551–6

UČNI NAČRT PREDMETA / COURSE SYLLABUS	
Predmet:	SINTEZNE METODE V ANORGANSKI KEMIJI
Course Title:	METHODS OF SYNTHESIS IN INORGANIC CHEMISTRY

Študijski program in stopnja Study Programme and Level	Študijska smer Study Field	Letnik Academic Year	Semester Semester
VSŠP Kemijska tehnologija, 1. stopnja	/	2.	3.
PSP Chemical Technology, 1st Cycle	/	2nd	3rd

Vrsta predmeta / Course Type: izbirni strokovni / Elective Professional

Univerzitetna koda predmeta / University Course Code: KTSI2

Predavanja Lectures	Seminar Seminar	Vaje Tutorial	Klinične vaje Work	Druge oblike študija	Samost. delo Individual Work	ECTS
/	15	60 LV	/	/	75	5

Nosilec predmeta / Lecturer: doc. dr. Andrej Pevec / Dr. Andrej Pevec, Assistant 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):
Vsebina seminarjev in vaj: Študenti bodo pri predmetu sintetizirali anorganske snovi z različnimi zahtevnejšimi sinteznimi tehnikami in dobljene snovi preiskali. Pripravili bodo nekatere kovinske acetilacetonate, fluoridooksovanadate(IV), sintetizirali kalikev tris(oksalato)ferat(III) trihidrat, heksaaminkobaltov(III) klorid in silikon. Spoznali se bodo tudi s pripravo TiO2 po sól-gel metodi. Z reakcijo v trdnem stanju bodo pripravili superprevodne spojine. Pri pripravi spojine bakrovega klorida z dimetoksietanom pa se bodo naučili dela z inertno atmosfero in vakuumom. Kot primer uporabe UV-Vis spektroskopije za določevanje kemijske kinetike bo namenjena vaja Hitrost reakcije med Cr(III) in EDTA. Spojine, ki jih	Seminars and exercises: The students synthesize inorganic compounds with various advanced synthetic techniques, and characterize the products. They prepare some metal acetylacetonates, fluoridooxovanadates(IV), potassium tris(oxalato)ferrate(III) trihydrate, hexamincobalt(III) chloride and silicone. They also learn about the preparation of TiO2 by sol - gel method. They prepare superconducting compounds by the reaction in the solid state. In the preparation of the complex copper chloride with dimethoxyethane they learn how to work with an inert atmosphere and a vacuum. The reaction between Cr(III) and EDTA is investigated by the use of UV - Vis spectroscopy

bodo študentje pripravljali bodo karakterizirali z razpoložljivimi metodami, kot so IR spektroskopija, UV-Vis spektroskopija, magnetne meritve, termična analiza, rentgenska praškovna analiza. Rezultate bodo zbrali in ovrednotili v poročilu. V projekte bomo kasneje zajeli nove snovi, ki jih uporablja pri tekočem raziskovalnem delu nosilec predmeta ali njegovi sodelavci. Pri seminarju bodo študenti dobili primerno teoretsko osnovo in navodila za vaje.	for the determination of the chemical kinetics. The compounds prepared by the students are characterized using the available methods, such as IR spectroscopy, UV - Vis spectroscopy, magnetic measurements, thermal analysis and X-ray powder analysis. The results are collected and evaluated in the report. The new compounds will be included in the project, especially those used by lecturer or his coworkers in the current research work. During the seminar, students get adequate theoretical basis and guidelines for practice.

Temeljna literatura in viri / Readings:

- S. Petriček, F. Perdih in A. Demšar, Vaje iz anorganske kemije, Založba FKKT UL, Ljubljana, 2012, strani 75 – 119.

Cilji in kompetence:	**Objectives and Competences:**
Cilj predmeta je študentom omogočiti poglobitev znanja metod sintez in preiskav anorganskih spojin kot nadgraditev predmeta Anorganska kemija II. Specifično, študenti pri projektno zasnovanemu predmetu spoznajo pristop k projektu od iskanja podatkov po bazah, preko laboratorijske sinteze in preiskav produktov do ovrednotenja in predstavitve rezultatov.	The aim of this course for students is to improve knowledge about synthetic methods and characterization of inorganic compounds to upgrade course Inorganic Chemistry II. In project-based approach of this course students learn more about search data bases, laboratory synthesis techniques, characterization of the products and evaluation and presentation of results.

Predvideni študijski rezultati:	**Intended Learning Outcomes:**
<u>Znanje in razumevanje</u> Predmet predstavlja poglobitev znanja predmeta Anorganska kemija II z zahtevnejšimi laboratorijskimi tehnikami in daje študentu celovit pogled na reševanje kemijskega problema.	<u>Knowledge and Comprehension</u> This course represents an advanced knowledge of the course Inorganic Chemistry II with advanced laboratory techniques and gives students a comprehensive view of solving chemical problems.
<u>Uporaba</u> Študent spozna zahtevnejše metode sinteze spojin in določitve njihovih lastnosti. Dobi občutek za samostojno organizacijo in izvedbo dela v laboratoriju. Rezultate svojega dela je sposoben predstaviti in razložiti.	<u>Application</u> Students learn advanced methods of synthesizing compounds and determining their properties. They get a sense of self-organizing and carrying out work in the laboratory. Results of their work are able to present and explain.
<u>Refleksija</u> S spoznavanjem zahtevnejšega eksperimentalnega dela študenti spoznajo, da imajo zahtevni teoretski principi svojo praktično uporabo.	<u>Analysis</u> By learning of advanced experimental work the students find that complex theoretical principles have their practical application.

Prenosljive spretnosti	Skill-transference Ability
Laboratorijske veščine, izkušnje in prijemi pri načrtovanje sintez so pomembni pri drugih kemijskih predmetih in pri osebnemu strokovnemu razvoju.	Laboratory skills, experience and approaches to design synthesis are important in other chemistry courses and personal professional development.

Metode poučevanja in učenja:	**Learning and Teaching Methods:**
Predmet se izvaja v obliki seminarjev in laboratorijskih vaj.	The course takes the form of seminars and laboratory exercises.

Načini ocenjevanja:	Delež (v %) / Weight (in %)	**Assessment:**
Pisni izpit po uspešno opravljenem praktičnem delu.	100 %	Written exam after successful completion of practical work.

Reference nosilca / Lecturer's references:

- **Andrej Pevec**: Syntheses and Solid-State and Solution Structures of $[Ba\{(C_5Me_5)_2Ti_2F_7\}_2(hmpa)]$ and $[Ba_8Ti_6F_{30}I_2(C_5Me_5)_6(hmpa)_6][I_3]_2$, Inorg. Chem. 2004, 43, 1250-1256.

- **Andrej Pevec**, Alojz Demšar, Jiri Pinkas, Merek Necas: Synthesis, spectroscopic and X-ray characterization of new molecular organotitanium(IV) phosphonate, Inorganic Chemistry Communications 2008, 11, 5-7.

- **Andrej Pevec**, Alojz Demšar: The variations in hydrogen bonding in hexafluorosilicate salts of protonated methyl substituted pyridines and tetramethylethylenediamine, Journal of Fluorine Chemistry 2008, 129, 707-712.

- **Andrej Pevec**, Martina Tekavec, Alojz Demšar: Cation-anion interactions involving hydrogen bonds: Syntheses and crystal structures study of hexafluorotitanate(IV) salts with pyridine and methyl substituted pyridines, Polyhedron 2011, 30, 549-555.

UČNI NAČRT PREDMETA / COURSE SYLLABUS	
Predmet:	SINTEZNE TEHNIKE V ORGANSKI KEMIJI
Course Title:	SYNTHETIC TECHNIQUES IN ORGANIC CHEMISTRY

Študijski program in stopnja Study Programme and Level	Študijska smer Study Field	Letnik Academic Year	Semester Semester
VSŠP Kemijska tehnologija, 1. stopnja	/	2.	4.
PSP Chemical Technology, 1st Cycle	/	2nd	4th

Vrsta predmeta / Course Type: izbirni strokovni / Elective Professional

Univerzitetna koda predmeta / University Course Code: KTSI6

Predavanja Lectures	Seminar Seminar	Vaje Tutorial	Klinične vaje Work	Druge oblike študija	Samost. delo Individual Work	ECTS
15	15	45 LV	/	/	75	5

Nosilec predmeta / Lecturer: izr. prof. dr. Janez Cerkovnik / Dr. Janez Cerkovnik, 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):
1) Laboratorijske operacije Uvod: varnost, uporaba in čiščenje steklovine ter aparatur v organskem laboratoriju, ravnanje z odpadki in nevarnimi snovmi, laboratorijski dnevnik in kemijska literatura. **2) Aparature in tehnike pri kemijskih reakcijah**: sestavljanje aparatur, uporaba inertne atmosfere, merjenje in kontrola osnovnih reakcijskih parametrov, dodajanje reagentov, koncentriranje, izolacija produktov. **3) Tehnike pri sintezi in transformaciji na nekaterih primerih**: - Izomerizacija adamantana - Priprava cikloheksanola iz cikloheksena in	**Laboratory operations** Introduction: safety, using and cleaning of glassware and apparatus in organic chemistry lab, disposal of waste and hazardous chemicals, the laboratory notebook, and the chemical literature. **Apparatus and techniques in chemical reactions** Assembling the apparatus, use of an inert atmosphere, measurement and control of basic reaction parameters, addition of reagents, concentration, and isolation of products. **Techniques in synthesis and transformations using some examples**

cikloheksanona - Reakcije cikloheksanola (eliminacija, substitucija, redukcija) - Priprava halidov iz alkoholov (t-butil klorid iz t-butil alkohola) - Reakcije esterifikacije (salicilna kislina, glukoza) - Adicija diklorokarbena na alkene z uporabo katalizatorja faznega prenosa - Grignardova reakcija: priprava alifatskih alkoholov in trifenilmetanola iz benzofenona - Priprava amidov - Friedel-Craftsova reakcija - Priprava in reakcije diazonijevih soli - Diels-Alderjeva reakcija - Wittigova reakcija - Priprava luminola (kemoluminiscenčna reakcija) **4) Tehnike in sinetze, ki vključujejo zaporedje reakcij (opravljanje v okviru seminarske naloge in vaj)** -Tetrafenilciklopentadienon - Pretvorba steroidov - 1-bromo-3-kloro-5-jodobenzen - Sulfanilamid - Sinteza 2,4-dinitrofenilhidrazina; - Pretvorba steroidov (holesteril acetat – efekt tekočih kristalov); - Iskanje spojin in sinteznih postopkov z uporabo literaturnih virov in podatkovnih baz **5) Sodobne analizne tehnike v organski kemiji** Spoznavanje in uporaba sodobnih kromatografskih, spektroskopskih (UV-Vis, IR, NMR) in masno-spektrometričnih metod pri zasledovanju in kontroli organskih reakcij ter karakterizaciji produktov.	Isomerisation of adamantine, preparation of cyclohexanol from cyclohexene and cyclohexanone (oxidation), reactions of cyclohexanol (elimination, substitution, reduction), preparation of halides from alcohols (*tert*-butyl chloride from *tert*-butyl alcohol), esterification (ethyl acetate), addition of dichlorocarbene to alkene using phase transfer catalyst, the Grignard reaction (preparation of aliphatic alcohols and triphenylmethanol from benzophenone), preparation of amides, preparation and reactions of diazonium salts, Diels-Alder reaction, Wittig reaction, preparation of luminol (chemiluminescent reaction). **Experiments that use a sequence of reactions** (individual work as seminars and synthesis from the literature) Tetraphenylcyclopentadienone, 1-bromo-3-chloro-5-jodobenzene, 2,4-dinitrophenylhydrazine, transformation of steroids (holesteryl acetate – liquid crystals), searching of compounds and synthetic methods using literature and databases. **Modern analytical techniques in organic chemistry** Understanding and application of modern chromatographic, spectroscopic (UV-Vis, IR, NMR) and mass-spectrometric methods in the pursuit and control of organic reactions and characterization of products.

Temeljna literatura in viri / Readings:

(1) A. Ault: *Techniques and Experiments for Organic Chemistry*, University Science Books (6th ed.), 1998.
(2) J. W. Lehman: *Student Lab Companion: Laboratory Techniques for Organic Chemistry***,** Prentice Hall, 2008.

Cilji in kompetence:	**Objectives and Competences:**
Cilji predmeta: Študent nadgradi osnovno teoretično znanje organske kemije s spoznavanjem, razumevanjem in izvajanjem nekaterih najznačilnejših in najpogosteje	**Objectives:** Build upon basic theoretical understanding of organic chemistry with recognizing, understanding, and performing of some most

uporabljanih sinteznih tehnik v organski kemiji ter pridobi osnovne veščine, ki so pri tem potrebne. **Predmetno specifične kompetence:** -uporaba literaturnih virov in baz podatkov -poznavanje sinteznih tehnik v organski kemiji -priprava in izvedba nekaterih srednje zahtevnih eksperimentov - poznavanje sodobnih analiznih tehnik	frequent synthetic and analytic techniques in organic chemistry, and gaining of some basic manual skills. **Competences:** -ability to use literature sources and databases; -familiarity with various synthetic techniques in organic chemistry; - ability to prepare and perform some intermediate pretentious experiments; - knowledge of modern analytical techniques.

Predvideni študijski rezultati:	**Intended Learning Outcomes:**
Znanje in razumevanje **Znanje:** - samostojno obvladovanje osnovnih laboratorijskih operacij in tehnik; - samostojno načrtovanje, priprava in izvedba enostavnejših kemijskih pretvorb po pravilih varnega dela v laboratoriju. **Razumevanje** teoretskih osnov enostavnejših kemijskih pretvorb in samostojno odločanje pri uporabi ustreznih laboratorjskih tehnik.	Knowledge and Comprehension **Knowledge:** -self-mastery of basic laboratory operations and techniques; -independent planning, preparation and execution of simple chemical transformations under the rules of safe work in the laboratory. **Comprehension** of the theoretical basis of simple chemical transformations and independent decision-making in the use of appropriate laboratory techniques.
Uporaba Študent utrdi osnovo znaje, ki ga je pridobil pri Praktikumu iz kemije ter ga nadgradi z tehnikami, ki se najpogosteje uporabljajo ne samo pri izvajanju pretvorb v sinteznih laboratorijih, temveč tudi v drugih kemijskih laboratorijih.	Application Students enhance their basic knowledge gained in Practicum in organic chemistry and upgrade the knowledge with the techniques that are most commonly used, not only in the implementation of transformations in synthetic laboratories, but also in other chemical laboratories.
Refleksija Študent bo na osnovi pridobljenega znanja pridobil občutek za samostojno načrtovanje, pripravo in izvedbo enostavnejših in srednje zahtevnih laboratorijskih operacij pri pretvorbah organskih spojin. Ob tem bo razumel in se zavedal nevarnosti ter tveganj uporabe posameznih tehnik pri laboratorijskem delu.	Analysis The student will gain, based on acquired knowledge, the sense of self-planning, preparation and execution of simple and moderately complex laboratory operations in the conversion of organic compounds. At the same time, he/she will understand and be aware of the dangers and risks of using specific techniques in the laboratory work.
Prenosljive spretnosti Pravilno izbiranje in izvajanje osnovnih laboratorijskih operacij ter smiselna uporaba primernih tehnik. Rokovanje z občutljivimi snovmi in delo v inertni atmosferi.	Skill-transference Ability Proper selection and application of basic laboratory operations and meaningful use of appropriate techniques. Handling of sensitive materials and work in an inert atmosphere.

Analiza, sinteza in poročanje o delu in dobljenih rezultatih.	Analysis, synthesis and reporting on the work and the results obtained.

Metode poučevanja in učenja:	**Learning and Teaching Methods:**
Predavanja, seminarske in laboratorijske vaje	Lectures, seminar and laboratory exercises

Načini ocenjevanja:	Delež (v %) / Weight (in %)	**Assessment:**
Opravljene vaje in seminar (priprava in izvedba sinteze po literaturi) in pisni izpit. 10 (odlično), 9 in 8 (prav dobro), 7 (dobro), 6 (zadostno), 5-1 (nezadostno)		Tutorials, seminar (preparation and execution of the synthesis from the literature) and written exam. 10 (excellent), 9 and 8 (very good) 7 (good) 6 (sufficient), 5-1 (inadequate)

Reference nosilca / Lecturer's references:

- **CERKOVNIK, Janez**, PLESNIČAR, Božo. Recent advances in the chemistry of hydrogen trioxide (HOOOH). Chemical reviews, ISSN 0009-2665. [Print ed.], 2013, vol. 113, no. 10, str. 7930-7951, ilustr.http://pubs.acs.org/doi/ipdf/10.1021/cr300512s, doi: 10.1021/cr300512s. [COBISS.SI-ID 1615407]
- TUTTLE, Tell, **CERKOVNIK, Janez**, KOLLER, Jože, PLESNIČAR, Božo. The search for protonated dihydrogen trioxide (HOOOH) : insights from theory and experiment. The journal of physical chemistry. A, Molecules, spectroscopy, kinetics, environment, & general theory, ISSN 1089-5639, 2010, vol. 114, no. 30, str. 8003-8008, doi: 10.1021/jp103882e. [COBISS.SI-ID 34295813]
- **CERKOVNIK, Janez**, PLESNIČAR, Božo, KOLLER, Jože, TUTTLE, Tell. Hydrotrioxides rather than cyclic tetraoxides (tetraoxolanes) as the primary reaction intermediates in the low-temperature ozonation of aldehydes. The case of benzaldehyde. Journal of organic chemistry, ISSN 0022-3263, 2009, vol. 74, no. 1, str. 96-101, doi: 10.1021/jo801594n. [COBISS.SI-ID 30098181]

UČNI NAČRT PREDMETA / COURSE SYLLABUS	
Predmet:	SPLOŠNA KEMIJA
Course Title:	GENERAL CHEMISTRY

Študijski program in stopnja Study Programme and Level	Študijska smer Study Field	Letnik Academic Year	Semester Semester
VSŠP Kemijska tehnologija, 1. stopnja	/	1.	1.
PSP Chemical Technology, 1st Cycle	/	1st	1st

Vrsta predmeta / Course Type:	obvezni / Mandatory
Univerzitetna koda predmeta / University Course Code:	KT103

Predavanja Lectures	Seminar Seminar	Vaje Tutorial	Klinične vaje Work	Druge oblike študija	Samost. delo Individual Work	ECTS
45	15	15 SV	/	/	75	5

Nosilec predmeta / Lecturer:	doc. dr. Saša Petriček / Dr. Saša Petriček, Assistant 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):
Lastnosti in sestava snovi. Naravoslovna metoda. Osnovni kemijski zakoni in pojmi. Daltonova atomska teorija. Elementi in spojine. Stehiometrija kemijskih reakcij. Eksotermna in endotermna reakcija. Zgradba atoma - osnovni delci. Radioaktivnost in jedrska energija. Valovno-mehanski model atoma. Periodni zakon. Kemijska vez. Ionska vez - ionsko zgrajene snovi. Kovalentna vez. Geometrija molekul. Teorija o odboju valenčnih elektronskih parov. Dipolni moment molekul. Molekulske vezi. Lastnosti plinov, splošna plinska enačba. Tekočine. Viskoznost in površinska napetost. Parni tlak. Trdne snovi. Kovalentni in molekulski kristali. Kovine,	- Properties and composition of matter. A scientific method. The principal chemistry laws and phenomena. Dalton atomic theory. Elements and compounds. Stoichiometry of chemical reactions. Exothermic and in endothermic reaction. - Atom and the principal particles. Radioactivity and nuclear energy. The wave-mechanistic model of an atom. The periodic law. Chemical bond. Ionic bond – ionic compounds. Covalent bond. Molecular geometry. A valence electron pair repulsion theory. Molecular dipole moment. Molecular bonds. - Properties of gases, ideal gas equation. -Liquids. Viscosity and surface tension. Vapour

kovinska vez. Raztopine. Sestava raztopin. Pojavi pri raztapljanju. Topnost, topnostni produkt. Elektroliti. Ionske reakcije. Zakon o vplivu koncentracij. Le Chatelier-ev princip. Hitrost in mehanizem kemijske reakcije. Homogena in heterogena kataliza. Voda in njene lastnosti. Brønstedova definicija kislin in baz. Protolitske reakcije. Vodikov eksponent - pH. Indikatorji. Titracija. Puferske raztopine. Redoks reakcije. Galvanski členi.	pressure. -Solid matter. Covalent and molecular crystals. Metals, metal bond. - Solutions (composition, dissolution, solubility). Electrolytes. Ionic reactions. -Principles of chemical equilibria. Le Chatelier principle. -Chemical kinetics and mechanism of the chemical reaction. Homogeneous and heterogeneous catalysis. - Water and its properties. Brønsted acid / base definition. Hydrolysis. - pH. Indicators. Titration. Buffer solutions. - Redox reactions. Galvanic cell.

Temeljna literatura in viri / Readings:

- LAZARINI, F. in BRENČIČ, J.V., Splošna in anorganska kemija. Ljubljana : FKKT, 2004, 557 str., (30%)
- ČEH, B., Splošna in anorganska kemija. Ljubljana: FKKT, 2005, 240 str., (60%)

Cilji in kompetence:	**Objectives and Competences:**
Študenti spoznajo temeljne kemijske zakonitosti in se seznanijo z osnovami kvantitativnega obravnavanja lastnosti in zgradbe snovi ter kemijskih procesov. Pridobijo pregledno osnovno znanje o zgradbi, lastnostih in vlogi značilnih skupin kemijskih elementov in njihovih najpomembnejših spojin. Predmet poteka pri predavanjih z demonstracijskimi poskusi in seminarskimi ter računskimi vajami.	Students develop fundamental chemical concepts qualitatively and quantitatively. They link composition of matter to its properties. Students practice problem solving and adopt logical approach to solving problems. They are able to think critically using basic concepts of general chemistry.

Predvideni študijski rezultati:	**Intended Learning Outcomes:**
<u>Znanje in razumevanje</u> Učna enota se navezuje na osnovno kemijsko znanje, katerega del študenti že obravnavajo v srednji šoli. Poudarek je na kemiji, ki je splošna in se kasneje nadgradi na področjih, ki se jih natančneje obravnava v naslednjih stopnjah študija pri predmetih anorganske, organske, analizne in fizikalne kemije. Študenti pri računskih vajah predvsem spoznajo pomen poznavanja in razumevanja osnovnih kemijskih pojmov in zakonitosti pri reševanju nalog in kvantitativnih problemov s področja kemijskega računanja.	<u>Knowledge and Comprehension</u> Additional depth of knowledge and understanding is built on the background obtained in previous education. Mastering core concepts of general chemistry enables successful studying of inorganic, organic, analytical and physical chemistry in higher semesters. Skills in problem solving are sharpened by practical applications.

Uporaba Znanje pridobljeno pri tem predmetu je nepogrešljivo pri nadaljnjem študiju, saj nudi osnovo in podporo vsem kemijskim področjem, s katerimi se študenti srečajo med študijem ter po njem. Študenti se seznanijo s postopki in pristopi pri reševanju računskih nalog in problemov in jih znajo uporabiti pri njihovem reševanju.	Application Knowledge of basic chemical concepts is a necessary background for a study in higher semesters. Students adopt logical approach to solving problems and learn some practical applications of general chemistry.
Refleksija Študenti so na osnovi pridobljenega znanja zmožni razumeti osnovne splošne kemijske pojme in jih uporabiti pri delu, ki ga srečajo v kemijskem laboratoriju. Sposobni so kritično ovrednotiti dobljene rezultate ter jih povezati z količinami, s katerimi se srečajo v vsakdanjem življenju.	Analysis Students are able to link various fundamental concepts to solve complex problems in a chemical laboratory and evaluate results of their work.
Prenosljive spretnosti Pri predmetu si bodo študenti pridobili spretnosti za reševanje kvantitativnih teoretičnih nalog in problemov ter lahko pridobljene izkušnje in znanje koristno uporabili tudi pri vseh drugih kemijskih predmetih.	Skill-transference Ability Skills in problem solving and critical thinking will be useful in almost all courses of higher semesters.

Metode poučevanja in učenja:	**Learning and Teaching Methods:**
Predavanja, Seminarske vaje ter vaje z računanjem Pri računskih vajah reševanje računskih nalog in kvantitativnih kemijskih problemov s poudarkom na skupinskem delu (sodelovalno učenje); možna organizacija individualne pomoči (tutorstvo).	Lectures, Seminar, Tutorial Lectures include some illustrative experiments; additional explanations and problem solving in seminars; stoichiometry and calculations in tutorial.

Načini ocenjevanja:	Delež (v %) / Weight (in %)	**Assessment:**
Pisni izpit (50%) in ustni izpit (50%). Do 10 % je možno pridobiti s sodelovanjem med semestrom (seminarji, naloge ...). Ocene 6-10 pozitivno	**50 %** **50 %**	Written exam (50%) and oral exam (50%). Up to 10% can be obtained through cooperation during the semester (seminars, functions, ...). Reviews 6-10 positive.

Reference nosilca / Lecturer's references:

- **PETRIČEK, Saša**. Octahedral and tetrahedral cobalt(II) sites in cobalt chloride complexes with polyethers. Croat. chem. acta, 2011, vol. 84, no. 4, str. 515-520, doi: 10.5562/cca1747. [COBISS.SI-ID 35780869]
- **PETRIČEK, Saša**, DEMŠAR, Alojz. Syntheses and crystal structures of manganese, nickel and zinc chloride complexes with dimethoxyethane and di(2-methoxyethyl) ether. Polyhedron. [Print ed.], 2010, vol. 29, no. 18, str. 3329-3334, doi: 10.1016/j.poly.2010.09.014. [COBISS.SI-ID 34687493]

- DEMŠAR, Alojz, KOŠMRLJ, Janez, **PETRIČEK, Saša**. Variable-temperature nuclear magnetic resonance spectroscopy allows direct observation of carboxylate shift in zinc carboxylate complexes. Journal of the American Chemical Society, ISSN 0002-7863, 2002, vol. 124, no. 15, str. 3951-3958, graf. prikazi. [COBISS.SI-ID 24242693]

UČNI NAČRT PREDMETA / COURSE SYLLABUS	
Predmet:	ŠPORTNA VZGOJA
Course Title:	PHYSICAL EDUCATION

Študijski program in stopnja Study Programme and Level	Študijska smer Study Field	Letnik Academic Year	Semester Semester
VSŠP Kemijska tehnologija, 1. stopnja	/	2. ali 3.	3. ali 5.
PSP Chemical Technology, 1st Cycle	/	2nd or 3rd	3rd or 5th

Vrsta predmeta / Course Type: izbirni splošni / Elective General

Univerzitetna koda predmeta / University Course Code: SPVZG

Predavanja Lectures	Seminar Seminar	Vaje Tutorial	Klinične vaje Work	Druge oblike študija	Samost. delo Individual Work	ECTS
15	/	60 SV	/	/	75	5

Nosilec predmeta / Lecturer: mag. Matej Jamnik, pred. šp. vzg. / Matej Jamnik, MSc., Lecturer

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):**
Predmet ŠV vključuje naslednje vsebine: • Splošno-teoretični del vsebuje predavanja, ki so skupna vsem športnim programom in se izvajajo skupno za vse študente (osnove delovanja človekovega telesa, njegovega gibalnega, srčno-žilnega in dihalnega sistema, psihomotorične in funkcionalne sposobnosti, športno-gibalna aktivnost kot preventivna in kurativna dejavnost za ohranjanje in utrjevanje zdravja, osnove zdravega prehranjevanja in regulacije telesne teže ter drugih medicinskih vidikov športa, metode preverjanja in ugotavljanja stanja psihomotoričnih in funkcionalnih sposobnosti). Študentje bodo mogli dodatno iz splošnih teoretičnih vsebin	Subject includes the following contents: • The general theoretical part contains lectures, which are common to the sports program and is carried out jointly for all students (base functioning human body, its movement, cardiovascular and respiratory system, psychomotor, and functional abilities, sports and physical activity as a preventive and curative activity for the maintenance and reinforcement of health, the basics of healthy eating and body weight regulation, and other medical aspects of sports, methods of verification and identification and functional state of psychomotor skills). • Special theoretical part is linked to a

izdelati tudi kratko seminarsko nalogo (cca. 3 - 4 strani).

- Specialno-teoretični del je vezan na izbrano športno panogo (posebnosti športne panoge in njen vpliv na človeka, tehnika, taktika in pravila, osnove telesne in tehnično taktične priprave) in se izvaja skozi praktične vaje.
- Praktične vaje: študentje izbirajo med ponujenimi športnimi panogami v okviru ponujenih dveh modulov.

Prvi modul: *Izobraževalni program*
Vsebine izobraževalnega programa športa so športne panoge, ki se izvajajo v različnih oblikah in na več stopnjah zahtevnosti. Obsega programe učenja in izpopolnjevanja v izbranih športnih panogah (ob zahtevanih dopolnilih je lahko program izpopolnjevanja primeren tudi za usposabljanje za strokovno delo v športu), ki se izvaja kontinuirano preko obeh semestrov ali v zgoščenih oblikah.

Drugi modul (lahko le kot dopolnilo prvemu modulu): *Tekmovalni program*
Tekmovalni program obsega vsa fakultetna, univerzitetna, meduniverzitetna in mednarodna tekmovanja (evropska in svetovna univerzitetna tekmovanja ter univerziade) v izbranih športnih panogah in je sestavni del dejavnega sožitja študentov, učiteljev in drugih pripadnikov univerze z namenom sodelovanja znotraj fakultet in univerz. V ta program se vključujejo predhodno selekcionirani študenti.

selected sport disciplines (specialties of sport disciplines and its impact on human body, technique, tactics and rules, basic physical, technical and tactical preparation) and is carried out through practical exercises.

- Practical exercises: The student choose between variety of sport disciplines, that are offered in four modules. Student who selected sport programe with 5 credit point will have to carry out additional two half-day trip from the range of outdoor sport activities.

The first module: *Educational programs*
Content of educational programs are sport disciplines, to be implemented in different ways and at several levels of complexity. These consist of learning and training in the selected sport disciplines (with the required supplements, the program may be suitable for advanced training for professional work in sport) to be carried out continuously over two semesters or in concentrated forms.

The second module (can also be used as a complement to the first module): *Competitive programs*
Competitive programs include all the faculty, the university, inter-university and international competitions (the European and global academic competition, and universiade) in selected sport disciplines are an integral part of the active co-existence of students, teachers and other members of the university to cooperate within the faculties and universities.

Temeljna literatura in viri / Readings:

- Splošna literatura za tiste segmente, ki so skupne vsem programom (vedenja o vplivu športne aktivnosti na zdrav način življenja in vzdrževanja psihofizičnega ravnovesja ter ohranjanja delovnih sposobnosti)/General bibliography for those segments that are common to all programs.

Obvezna literatura/ Mandatory readings:
1. Pavlin T. (2005). Zanimanje za šport je prodrlo med SLOVENCI že v široke kroge. Ljubljana: Fakulteta za šport UL, Inštitut za šport, 143 str. (44%)
2. Društvo za zdravje srca in ožilja Slovenije (2000). Lepota gibanja tudi za zdravje (izbrana poglavja). Ljubljana: Društvo za zdravje srca in ožilja Slovenije, 336 str. (25%)

3. Rotovnik-Kozjek, N. (2004). Gibanje je življenje (izbrana poglavja). Ljubljana: Domus, 238 str. (24%)
4. Bračič M. (2006). Razvijanje moči s prostimi utežmi v košarki. Ljubljana: Fakulteta za šport UL, Inštitut za šport, 119 str. (8%)

Priporočljiva literatura/ Recommended readings:

1. Berčič, H. et al. (2001). Šport v obdobju zrelosti. Ljubljana: Fakulteta za šport UL, Inštitut za šport, 210 str.
2. Tušak M., Marinšek M., Tušak M. (2009). Družina in športnik. Ljubljana: Fakulteta za šport UL, Inštitut za šport, 224 str.
3. CINDI Slovenija (2002). Krepimo zdravje z gibanjem in zdravo prehrano (mednarodna konferenca - Radenci). Ljubljana: CINDI Slovenija, 177 str.
4. Francis, P. R. (1996). Real exercise for real people : Finding your optimum level of physical activity for a life time of healty living. Rocklin: Prima Pub,178 str.
5. Inštitut za varovanje zdravja Republike Slovenije (2000). Gibanje za zdravje (svetovni dan zdravja). Ljubljana: Inštitut za varovanje zdravja Republike Slovenije, 85 str.
6. Pokorn, D. (1988). Gorivo za zmagovalce - prehrana športnika in rekreativca. Ljubljana: Inštitut za varovanje zdravja Republike Slovenije, 153 str.
7. Ušaj, A. (1997). Kratek pregled osnov športnega treniranja. Ljubljana: Fakulteta za šport UL, Inštitut za šport, 299 str.

Specifična literatura glede na izbrane programe po posameznih športnih panogah oziroma druge programe/ The specific literature in relation to the selected programs for individual sport disciplines or other programs.

Cilji in kompetence:

Cilji:

- Ozaveščanje o vrednotah športa in preko tega vplivanje na oblikovanje pozitivnih stališč do športa in navajanje na zdrav način življenja.
- Odpravljanje in preprečevanje posledic pomanjkanja gibanja oz. skrb za izboljšanje psihofizičnih sposobnosti, krepitev zdravja in ustvarjalno izrabo prostega časa.
- Izpopolnjevanje znanja v izbranih športnih panogah.

Kompetence:

- Sposobnost samostojne skrbi za zdrav način življenja skozi športno- gibalno aktivnost.
- Pripravljenost in sposobnost samostojnega vključevanja v organizirane ali neorganizirane oblike športnega udejstvovanja v novih študijskih ali delovnih okoljih.
- Oblikovanje trajnega pozitivnega odnosa do športne dejavnosti in trajne skrbi za

Objectives and Competences:

Objectives:

- Awareness of the values of sport and through this influence on the creation of positive attitudes towards sport and referencing to a healthy lifestyle.
- Removing and preventing the consequences of the lack of movement or concern for the improvement of psychophysical abilities, health promotion and the creative use of leisure time.
- Learning and training selected sport disciplines.

Competences:

- Ability to self-care for a healthy lifestyle through sport activities.
- The willingness and ability of self-involvement in organized or unorganized forms of sport participation in the new study or work environment.
- Creation of a long term positive attitude towards sport activities and a lasting

ohranjanje zdravja in delovnih sposobnosti. • Racionalno vgrajevanje športa v način življenja. Promocija in uveljavljanje fakultete in univerze.	concern for the preservation of health and working ability. • Racional incorporation sport in the way of life. Promotion and enforcement of a faculty and a university.

Predvideni študijski rezultati:	**Intended Learning Outcomes:**
Znanje in razumevanje Osvajanje vsebin športa kot temeljev, ki omogočajo kvaliteto življenja.	Knowledge and Comprehension Conquering content sport as a foundation to enable the quality of life.
Uporaba Uporaba pridobljenega znanja za kompenzacijo vsakodnevnih stresov med študijem.	Application Use the knowledge acquired to compensate for the daily stress during the study.
Refleksija Uporaba pridobljenega znanja za kompenzacijo vsakodnevnih stresov v poklicu in družini.	Analysis Use the knowledge acquired to compensate for the daily stress in the profession and family.
Prenosljive spretnosti Niso vezane le na en predmet.	Skill-transference Ability They are not tied to just one subject.

Metode poučevanja in učenja:	**Learning and Teaching Methods:**
- predavanja, - vaje, - skupinske in individualne konzultacije.	- Lectures. - Tutorial - Practical training. - Group and individual consultation.

Načini ocenjevanja:	Delež (v %) / Weight (in %)	**Assessment:**
Metoda ocenjevanja: • Kolokvij o vplivu športne aktivnosti na zdrav način življenja in vzdrževanja psihofizičnega ravnovesja ter ohranjanja delovnih sposobnosti. • Aktivna prisotnost na praktičnih vajah v izbranem vadbenem programu (90% prisotnost). Ocenjevalna lestvica: opravil-a (pozitivno), ni opravil-a (negativno).		Method of assessment: • Colloquium of behaviors on the impact of sports on healthy lifestyles and maintenance of psychophysical balance and the maintenance of work ability. • Active participation in the exercises in the practical training program selected (90% presence). Assessment scale: Pass (positive), Faile (negative).

Reference nosilca / Lecturer's references:

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UČNI NAČRT PREDMETA / COURSE SYLLABUS	
Predmet:	TEHNOLOGIJA PREMAZOV
Course Title:	COATINGS TECHNOLOGY

Študijski program in stopnja Study Programme and Level	Študijska smer Study Field	Letnik Academic Year	Semester Semester
VSŠP Kemijska tehnologija, 1. stopnja	/	3.	6.
PSP Chemical Technology, 1st Cycle	/	3rd	6th

Vrsta predmeta / Course Type: izbirni strokovni / Elective Professional

Univerzitetna koda predmeta / University Course Code: KTSI32

Predavanja Lectures	Seminar Seminar	Vaje Tutorial	Klinične vaje Work	Druge oblike študija	Samost. delo Individual Work	ECTS
45	15	15 LV	/	/	75	5

Nosilec predmeta / Lecturer: prof. dr. Matjaž Krajnc / Dr. Matjaž Krajnc, Full 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):
Temeljna vsebinska področja predmeta so: - formiranje premaznih filmov; - tokovne lastnosti organskih premazov; - mehanske lastnosti organskih premazov; - stabilnost in odpornost organskih premazov na vplive okolja; - adhezija; - korozijska zaščita premazov, - lateksi, - pregled veziv in njihove lastnosti, - topila, - barva in pigmenti; - pigmentne disperzije; - načini aplikacije organskih premazov, - defekti premaznega filma; - formulacije in priprava organskih premazov	Formation of organic coatings, flow characteristics, mechanical properties, stability and resistance to environmental effects, adhesion, corrosion protection, latexes, solvents, colour and pigments, pigment dispersions, ways of applications of organic coatings, organic coating defects, formulations and preparations, scale-up and transfer of technology to the production.

(izbrani primeri); - povečevalni kriteriji in prenos tehnologije v proizvodnjo.	

Temeljna literatura in viri / Readings:

- Z. W. Wicks, F. N. Jones, S. P. Pappas, Organic Coatings: Science and Technology, 2. izdaja, John Wiley &b Sons, Inc., New York, 1999, 595 str., (60 %).

Dopolnilna literatura:

- T. C. Patton, Paint Flow and Pigment Dispersion: A Rheological Approach to Coating and Ink Technology, 2. izdaja, John Wiley &b Sons, Inc., New York, 1979, 615 str.

Cilji in kompetence:	**Objectives and Competences:**
Cilj predmeta je, da študentje osvojijo različne stopnje razvoja organskih premazov. Študentje pri predmetu pridobijo naslednje specifične kompetence: - poznavanje nastanka oz. formiranja premaznega filma; - poznavanje tokovnih lastnosti različnih premazov; - poznavanje ključnih lastnosti premazov in premaznih filmov z vidika njihove uporabe; - poznavanje premaznih komponent in njihove vloge; - poznavanje načina aplikacije premazov; - razumevanje izbranih primerov formulacij in priprave organskih premazov: - razumevanje povečevalnih kriterijev in prenos tehnologije v proizvodnjo.	Understanding the formation of coatings. Understanding flow characteristics of various coatings. Knowing key characteristics of coatings from the application perspective. Knowing coating components and their roles. Knowing the application of coatings. Understanding selected cases of formulation and preparation of organic coatings. Understanding the scale-up criteria and transfer of a technology to production.

Predvideni študijski rezultati:	**Intended Learning Outcomes:**
<u>Znanje in razumevanje</u> Študent osvoji znanja o lastnostih organskih premazov in njihovih filmov. Razume nastanek premaznega filma. Razume vpliv sestave premaza na lastnosti premaza in premaznega filma. Pozna osnovno formulacijo premaza. Pozna povečevalne kriterije za prenos tehnologije v proizvodni proces.	<u>Knowledge and Comprehension</u> Understanding different levels in the development of organic coatings.
<u>Uporaba</u> Pridobljena znanja je študent sposoben uporabiti pri svojem raziskovalnem delu na področju razvoja in optimizacije organskih premazov.	<u>Application</u> Student is able to apply the knowledge at independent research and development work in the area of organic coatings development and optimization.
<u>Refleksija</u> Študent je sposoben sintetizirati znanja s področij polimerne kemije, polimernih materialov ter	<u>Analysis</u> Student is able of synthesis of polymer chemistry, polymer materials and product

produktnega inženirstva.	engineering scientific fields.
Prenosljive spretnosti Študent je sposoben uporabljati tujo in domačo strokovno literaturo. Sposoben je samostojno sklepati, definirati problem, postavljati zaključke in problem reševati. Sposoben je zbirati in obdelovati podatke, predstaviti rezultate v pisni in ustni obliki.	Skill-transference Ability Ability to identify and solve problems, to collect and interpret data, to analyse results critically and to synthesize knowledge.

Metode poučevanja in učenja:	**Learning and Teaching Methods:**
Predavanja, seminarji.	Lectures, seminars, laboratory practice.

Načini ocenjevanja:	Delež (v %) / Weight (in %)	**Assessment:**
(a) Poročila za vaje in zagovor vaj (1/3 ocene) (b) Pisni in ustni izpit (2/3 ocene) Ocene: 6-10 pozitivno		

Reference nosilca / Lecturer's references:

- ŠEBENIK, Urška, **KRAJNC, Matjaž**. Semibatch emulsion polymerization of methyl methacrylate using different polyurethane particles. Journal of polymer science. Part A, Polymer chemistry, ISSN 0887-624X, 2005, vol. 43, no. 4, str. 844-858, graf. prikazi. [COBISS.SI-ID 26393349]
- ŠEBENIK, Urška, **KRAJNC, Matjaž**. Properties of acrylic-polyurethane hybrid emulsions synthesized by the semibatch emulsion copolymerization of acrylates using different polyurethane particles. Journal of polymer science. Part A, Polymer chemistry, ISSN 0887-624X, 2005, vol. 43, no. 18, str. 4050-4069. [COBISS.SI-ID 26883589]
- ŠEBENIK, Urška, **KRAJNC, Matjaž**. Seeded semibatch emulsion copolymerization of methyl methacrylate and butyl acrylate using polyurethane dispersion : effect of soft segment length on kinetics. Colloids and surfaces. A, Physicochemical and Engineering Aspects, ISSN 0927-7757. [Print ed.], 2004, vol. 233, no. 1/3, str. 51-62, graf. prikazi. [COBISS.SI-ID 25609989]

UČNI NAČRT PREDMETA / COURSE SYLLABUS	
Predmet:	ZAGOTAVLJANJE KAKOVOSTI V ANALIZNEM LABORATORIJU
Course Title:	QUALITY ASSURANCE IN ANALYTICAL LABORATORY

Študijski program in stopnja Study Programme and Level	**Študijska smer Study Field**	**Letnik Academic Year**	**Semester Semester**
VSŠP Kemijska tehnologija, 1. stopnja	**/**	**3.**	**6.**
PSP Chemical Technology, 1st Cycle	**/**	**3rd**	**6th**

Vrsta predmeta / Course Type: izbirni strokovni / Elective Professional

Univerzitetna koda predmeta / University Course Code: KTSI31

Predavanja Lectures	**Seminar Seminar**	**Vaje Tutorial**	**Klinične vaje Work**	**Druge oblike študija**	**Samost. delo Individual Work**	**ECTS**
45	**15**	**15 LV**	**/**	**/**	**75**	**5**

Nosilec predmeta / Lecturer: izr. prof. dr. Nataša Gros / Dr. Nataša Gros, 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):**
- Potreba po zanesljivih rezultatih (utemeljitev, družbeno-ekonomski učinek, zahteve naročnika, namen analize) - Temeljna načela zagotavljanja in nadzora kakovosti (QA/QC, različni standardi in njihove značilnosti, najboljše prakse) - Odvzem vzorca (definicija vzorčenja, vrste vzorcev, načrt vzorčenja, število vzorcev in velikost vzorca, obravnava vzorca in shranjevanje) - Priprava za analizo (izbira metode, viri metod, dejavniki presoje in izbire metod, vzroki za nepravilne analizne rezultate, validacija metode) - Meritev (dobra laboratorijska praksa, kalibracija meritve, doseganje metrološke sledljivosti, nadzor kakovosti, okolje, oprema in pribor, kemikalije in potrošnji material, vzdrževanje in kalibracija	- The need for reliable results (justification, social and economic impact, customers' requirements, purpose of analysis) - General principles of quality assurance and quality control (QA/QC, different standards and their main features, best practices) - Sampling (sampling defined, types of samples, sampling plan, numbers and sample size, sample handling and storage) - Preparation for analysis (selecting the method, sources of methods, factors to consider when selecting a method, reasons for incorrect analytical results, method validation) - Making measurement (good laboratory practice, calibration of measurement, achieving metrological traceability, quality control,

opreme) - Vrednotenje rezultatov (uporabljana statistika, nadzorni grafi, merilna negotovost) - Medlaboratorijske primerjave (sheme, organizacija, uporabljana statistika, pomen, sodelovalne študije) - Dokumentacija in upravljanje z njo (dokumentacija, mnenja in interpretacije) - Upravljanje s kakovostjo (sistem upravljanja, standardi za laboratorije, priročniki kakovosti in druga dokumentacija, nadzor, poročila upravljanja, odgovornost laboratorijskega osebja za kakovost)	environment, equipment and glassware, chemicals and consumables, maintenance and calibration of equipment) - Data treatment (statistics, control charts, measurement uncertainty) - Proficiency testing schemes (organisation, statistics, making the most of participation in proficiency testing schemes, collaborative studies) - Documentation and its management (documentation, opinions and interpretations) - Managing quality (managing system, standards available for laboratories, quality manuals and other documentation, audits, management reviews, responsibility of laboratory staff for quality)

Temeljna literatura in viri / Readings:

- E. Prichard, V. Barwick, Quality Assurance in Analytical Chemistry, Wiley, 2007, 316 pages.

Cilji in kompetence:	**Objectives and Competences:**
Cilj predmeta je, da se študent usposobi za delovanje v analiznem laboratoriju, ki je skladno z načeli zagotavljanja kakovosti in vodi do veljavnih analiznih rezultatov. PREDMETNO SPECIFIČNE KOMPETENCE -Študent razume celovitost sistema zagotavljanja kakovosti, ki temelji na pravilnem izvajanju, nadzoru in dokumentiranju vseh stopenj analiznega procesa. -Študent razume strategije delovanja, ki vodijo do veljavnih analiznih rezultatov in zna prenesti te strategije na manj kompleksne realne primere.	Student develops skills for quality assurance in analytical laboratory leading to valid analytical results. COURSE SPECIFIC COMPETENCES Student understands the quality assurance system which depends on accurate procedures, control measures and documentation in all steps of analytical process. Student understands strategies which produce valid analytical results and is able to apply these strategies in practice.

Predvideni študijski rezultati:	**Intended Learning Outcomes:**
<u>Znanje in razumevanje</u> Študent pridobi znanja pomembna za zagotavljanje kakovosti v analiznem laboratoriju. Študent razume sistem in mehanizme zagotavljanja kakovosti.	<u>Knowledge and Comprehension</u> Student fosters knowledge which is essential for quality assurance in analytical laboratory. Student understands the quality assurance system and measures.
<u>Uporaba</u> Študent se usposobi za delovanje znotraj sistema zagotavljanja kakovosti v analiznem laboratoriju.	<u>Application</u> Student develops skills for operation in the accordance with the system of quality assurance in analytical laboratory.
<u>Refleksija</u> Študent se zaveda pomena zanesljivih analiznih rezultatov in spoštovanja načel dobre laboratorijske	<u>Analysis</u> Student fosters the awareness of the importance of the valid analytical results and

prakse.	performance in the accordance with the principles of a good laboratory practice.
Prenosljive spretnosti Študent razvija odgovornost za zanesljivo delovanje in spoštovanje postavljenih zahtev.	Skill-transference Ability Student develops personal responsibility for reliable performance and following the prescribed procedures.

Metode poučevanja in učenja:	**Learning and Teaching Methods:**
Predavanja, vodeni razgovor, sodelovalno učenje, študij primerov, reševanje problemov. Laboratorijsko projektno delo: ovrednotenje prispevkov k merilni negotovosti končnega rezultata dobljenega z analizno metodo.	Lectures, guided discussions, cooperative learning, case studies, problem solving. Laboratory project: Evaluation of the uncertainty contributions to the final result obtained by an analytical method.

Načini ocenjevanja:	Delež (v %) / Weight (in %)	**Assessment:**
Pisno preverjanje znanja.		

Reference nosilca / Lecturer's references:

- **GROS, Nataša**. Evacuated blood-collection tubes for haematological tests : a quality evaluation prior to their intended use for specimen collection. Clinical chemistry and laboratory medicine, ISSN 1434-6621, 2013, vol. 51, no. 5, str. 1043-1051.
- **GROS, Nataša**, CAMÕES, Maria Filomena, SILVA, Ricardo J. N. Bettencourt da. Detailed uncertainty budget for major and minor ions in stock combined calibration standards : influence of impurities in chemicals. Analytica chimica acta, ISSN 0003-2670.
- **GROS, Nataša**, CAMÕES, Maria Filomena, SILVA, Ricardo J. N. Bettencourt da. Uncertainty budget for simultaneous determination of minor and major ions in seawater with ion chromatography confronted with uncertainties in concentrations of calibration standards. Analytical letters, ISSN 0003-2719, 2010, vol. 43, no. 7/8, str. 1317-1329.