

UNIVERSITY OF MARIBOR
FACULTY OF CHEMISTRY AND CHEMICAL ENGINEERING

INFORMATION PACKAGE /
INTERNATIONAL EXCHANGE STUDENTS' GUIDE
2016/2017

Part II

Information on degree programmes

B) Description of individual course units

Doctoral programme Chemistry and Chemical Engineering



Univerza v Mariboru

Fakulteta za kemijo
in kemijsko tehnologijo

UČNI NAČRT PREDMETA / COURSE SYLLABUS

Predmet:	Uporabna matematika
Course title:	Mathematics applied

Študijski program in stopnja Study programme and level	Študijska smer Study field	Letnik Academic year	Semester Semester
Kemija in kemijska tehnika	Kemijska tehnika/Kemija	1	zimski
Chemistry and Chemical Engineering	Chemical Engineering/Chemistry	1	autumn

Vrsta predmeta / Course type Temeljni/Basic

Univerzitetna koda predmeta / University course code:

Predavanja Lectures	Seminar Seminar	Sem. vaje Tutorial	Lab. vaje Laboratory work	Teren. vaje Field work	Samost. delo Individ. work	ECTS
10	10				430	15

Nosilec predmeta / Lecturer: Petra Žigert Pleteršek

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

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

Znanje iz diferencialnega računa.

Prerequisites:

Knowledge of differential calculus.

Vsebina:

Verjetnost in statistika:

- osnove verjetnostnega računa: algebra dogodkov, definicije verjetnosti, pogojna verjetnost, Bayesova formula, Bernoullijevo zaporedje, slučajne spremenljivke, diskretna in zvezna porazdelitev, matematično upanje in disperzija, slučajni vektorji
- osnove matematične statistike: vzorčenje, empirična porazdelitev, ocenjevanje parametrov, testiranje statističnih domnev
- linearni model in posplošitve

ali

Content (Syllabus outline):

Probability and Statistic

- Introduction to probability: algebra of events, definitions of probability, conditional probability, Bayes's formula, Bernoulli's sequence, random variables, discrete and continuous distribution, expectation and variance, random vectors
- Introduction to statistics: sampling, empirical distribution, estimation of parameters, testing statistical hypotheses
- Linear model and generalization

or

Nelinearno programiranje: • problem nelinearnega programiranja, ekstremi funkcije brez pogojev, ekstremi funkcije pri pogojih, dualni problem • algoritmi: splošen opis algoritmov za reševanje problemov NLP in konvergenca algoritmov • reševanje problemov brez pogojev (iskanje ekstremne točke brez odvodov, iskanje ekstremne točke z odvodi) • reševanje problemov s pogoji (kazenska in odbojna funkcija, metoda dopustnih smeri, zaporedno kvadratično programiranje) Seminar: • podrobna vsebina seminarja se bo določila na osnovi dogovora z mentorjem in se bo nanašala na tematiko predmeta.	Nonlinear Programming • NLP problem, unconstrained optimization, constrained optimization, dual problem • Algorithms: general approach, convergence of algorithms • Algorithms for unconstrained optimization (derivative-free unconstrained optimization, unconstrained optimization using derivatives) • Algorithms for constrained optimization (penalty and barrier functions, methods of feasible directions, recursive quadratic programming algorithm) Seminar: • Detailed content of seminar will be determined on the basis of agreement with mentor and will be related to the subject.
---	--

Temeljni literatura in viri / Readings:

• I. Grabec, J. Gradišek, Opis naključnih pojavov, FS Univerze v Ljubljani, 2000. • Ž. L. Lazić, Design of Experiments in Chemical Engineering, Marcel Dekker Inc., Wiley-VCH Verlag GmbH & Co. KGaA, Weinheim, 2004. • P. Englezos, N. Kalogerakis, Applied Parameter Estimation for Chemical Engineers, Marcel Dekker Inc., New York, 2001. • M. S. Bazaraa, H. D. Sherali, C. M. Shetty, Nonlinear Programming: Theory and Algorithms, 3rd ed., John Wiley & Sons, Inc., 2006.

Cilji in kompetence:

• poglobljeno poznavanje verjetnostnega računa in analitične statistike, • poglobljeno poznavanje nelinearnega programiranja.
--

Objectives and competences:

• advanced knowledge of probability calculus, • advanced knowledge of nonlinear programming.

Predvideni študijski rezultati:

<u>Znanje in razumevanje:</u> Po zaključku tega predmeta bo študent sposoben: • uporabljati statistične metode pri svojem delu, • uporabljati metode nelinearnega programiranja. <u>Prenesljive/ključne spretnosti in drugi atributi:</u> • tolmačiti rezultate statističnih raziskav, • optimizacijske probleme iz stroke oblikovati v skladu z metodami NLP.

Intended learning outcomes:

<u>Knowledge and Understanding:</u> On completion of this course the student will be able to: • use statistical methods at work, • use methods of nonlinear programming . <u>Transferable/Key Skills and other attributes:</u> • explanation of results of statistical research, • transformation of optimization problems to NLP problems.
--

Metode poučevanja in učenja:

• predavanja, • seminar, • seminarska naloga.

Learning and teaching methods:

• lectures, • seminar, • seminar work.
--

Načini ocenjevanja:

Izpit je opravljen, če so pozitivno opravljene vse naslednje obveznosti: • seminarska naloga. • ustni izpit.
--

Delež (v %) /
Weight (in %)

Assessment:

Student has to pass successfully the following obligations: • seminar work, • oral examination.

30
70

Reference nosilca / Lecturer's references:

IMRICH, Wilfried, LIPOVEC, Alenka, PETERIN, Iztok, ŽIGERT PLETERŠEK, Petra. Fast recognition of subclasses of almost-median graphs. *Discrete Mathematics*, ISSN 0012-365X. [Print ed.], 2007, vol. 307, iss. 3-5, str. 464-471. <http://dx.doi.org/10.1016/j.disc.2006.07.011>, doi: [10.1016/j.disc.2006.07.011](https://doi.org/10.1016/j.disc.2006.07.011). [COBISS.SI-ID [14180697](#)],

KLAVŽAR, Sandi, ŽIGERT PLETERŠEK, Petra. Fibonacci cubes are the resonance graphs of fibonaccenes. *The Fibonacci quarterly*, ISSN 0015-0517, 2005, vol. 43, no. 3, str. 269-276. [COBISS.SI-ID [13865049](#)]

KLAVŽAR, Sandi, VESEL, Aleksander, ŽIGERT PLETERŠEK, Petra. On resonance graphs of catacondensed hexagonal graphs: structure, coding, and Hamilton path algorithm. *MATCH Communications in Mathematical and in Computer Chemistry*, ISSN 0340-6253, 2003, no. 49, str. 99-116. [COBISS.SI-ID [12620377](#)]

DOBRYNIN, Andrey A., GUTMAN, Ivan, KLAVŽAR, Sandi, ŽIGERT PLETERŠEK, Petra. Wiener index of hexagonal systems. *Acta applicandae mathematicae*, ISSN 0167-8019, 2002, vol. 72, issue 3, str. 247-294. [COBISS.SI-ID [11934297](#)]



Univerza v Mariboru

Fakulteta za kemijo
in kemijsko tehnologijo

UČNI NAČRT PREDMETA / SUBJECT SPECIFICATION

Predmet:	Produktna tehnika
Subject Title:	Product design

Študijski program in stopnja Study programme and level	Študijska smer Study field	Letnik Academic Year	Semester Semester
Kemija in kemijska tehnika, 3. stopnja Chemistry and Chemical Engineering, 3rd level	Kemijska tehnika / Kemija Chemical Engineering / Chemistry	1.	zimski Autumn

Vrsta predmeta/Course type: Temeljni/basic

Univerzitetna koda predmeta / University course code:

Predavanja Lectures	Seminar Seminar	Sem. vaje Tutorial	Lab. vaje Laboratory work	Teren. vaje Field work	Samost. delo Individ. work	ECTS
10	10				430	15

Nosilec predmeta / Lecturer: Željko Knez

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

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

- pogojev ni

Prerequisites:

- None

Vsebina:

- uvod v produktno tehniko – definiranje problematike
- "Product design"
- formulacijski postopki
- primeri produktov
- pregled tehnik za pridobivanje "inteligentnih materialov"
- pregled tehnologij za pridobivanje "inteligentnih materialov"

Seminar:

- podrobna vsebina seminarske se bo določila na osnovi dogovora z mentorjem in se bo nanašala na tematiko predmeta

Content (Syllabus outline):

- General introduction to product design – problem definition
- "Product design"
- Formulation processes
- Examples of products
- Review of processes for acquiring "intelligent materials"
- Review of technologies for acquiring "intelligent materials"

Seminar:

- Detailed content of seminar will be determined on the basis of agreement with mentor and will be related to the subject

Temeljni literatura in viri / Readings:

- U. Bröckel, W. Meier, G. Wagner, Product Design and Engineering: Best Practices, Vol. 1 & 2, Wiley-VCH, 2007.

Dodatna priporočena literatura:

- Ž. Knez, M. Škerget, M. Knez Hrnič, Separation, extraction and concentration processes in the food, beverage and nutraceutical industries, by Syed S. H. Rizvi (editor), Publisher: Woodhead Publishing, 2010.
- E. Favre, L. Marchal-Heusler, M. Kind, Chemical product engineering: Research and educational challenges, Trans IchemE, 80(A): 65-74, 2002.
- J. C. Charpentier, The triplet "molecular processes – product – process" engineering: the future of chemical engineering?, Chem. Eng. Science, 57: 4667-4690, 2002.

Cilji in kompetence:

- pridobivanje poglobljenih znanj na področju produktne tehnike
- poglobljanje znanj na področju produktov v različnih industrijskih panogah
- poglobljanje znanj na področju uporabe procesnih tehnik za pridobivanje produktov s točno definiranimi lastnostmi

Objectives and competences:

- To gain advanced knowledge about product design
- Widening of knowledge about products in different industrial branches
- Widening of knowledge about application of process technics for acquiring of products with defined properties

Predvideni študijski rezultati:

Znanje in razumevanje:

- zmožnost načrtovanja in uporaba procesnih tehnik za pridobivanje produktov z različnimi lastnostmi

Prenesljive/ključne spretnosti in drugi atributi:

- vsebina predmeta podaja znanja koristna za industrijo, kot npr. za Farmacevtsko industrijo

Intended learning outcomes:

Knowledge and Understanding:

- Ability to design of process technics and its application for acquiring of products with different properties

Transferable/Key Skills and other attributes:

- The subject gives the knowledge important for industry, such as Pharmaceutical industry

Metode poučevanja in učenja:

- predavanja
- seminar
- seminarska naloga

Learning and teaching methods:

- Lectures
- Seminar
- Seminar work

Načini ocenjevanja:

Izpit je opravljen, če so pozitivno opravljene vse naslednje obveznosti:

- seminarska naloga
- ustni izpit

Delež (v %) /

Weight (in %)

Assessment:

Student has to pass successfully the following obligations:

- Seminar work
- Oral examination

Reference nosilca / Lecturer's references:

VERONOVSKI, Anja, TKALEC, Gabrijela, KNEZ, Željko, NOVAK, Zoran. Characterisation of biodegradable pectin aerogels and their potential use as drug carriers. *Carbohydrate polymers*, ISSN 0144-8617. [Print ed.], 26 Nov. 2014, vol. 113, str. 272-278, doi:[10.1016/j.carbpol.2014.06.054](https://doi.org/10.1016/j.carbpol.2014.06.054). [COBISS.SI-ID 18000150],

ŠTANDEKER, Suzana, VERONOVSKI, Anja, NOVAK, Zoran, KNEZ, Željko. Silica aerogels modified with mercapto functional groups used for Cu(II) and Hg(II) removal from aqueous solutions. *Desalination*, ISSN 0011-9164. [Print ed.], 15. Mar. 2011, vol. 269, iss. 1-3, str. 223-230, doi: [10.1016/j.desal.2010.10.064](https://doi.org/10.1016/j.desal.2010.10.064). [COBISS.SI-ID 14822678]

MANDŽUKA, Zoran, KNEZ, Željko. Influence of temperature and pressure during PGSS[sup]TM micronization and storage time on degree of crystallinity and crystal forms of monostearate and tristearate. *The Journal of supercritical fluids*, ISSN 0896-8446. [Print ed.], May 2008, vol. 45, iss. 1, str. 102-111. <http://dx.doi.org/10.1016/j.supflu.2007.11.006>, doi: [10.1016/j.supflu.2007.11.006](https://doi.org/10.1016/j.supflu.2007.11.006). [COBISS.SI-ID 12228886]



Univerza v Mariboru

Fakulteta za kemijo
in kemijsko tehnologijo

UČNI NAČRT PREDMETA / SUBJECT SPECIFICATION

Predmet:	Napredna organska kemija
Subject Title:	Advanced organic chemistry

Študijski program Study programme	Študijska smer Study field	Letnik Year	Semester Semester
Kemija in kemijska tehnika Chemistry and Chemical Engineering	Kemija Chemistry	1.	zimski Autumn

Vrsta predmeta/Course type:

Temeljni/basic

Univerzitetna koda predmeta / University subject code:

	Seminar Seminar	Sem. vaje Tutorial	Lab. vaje Labor work	Teren. vaje Field work	Samost. delo Individ. work	ECTS
10	10				430	15

Nosilec predmeta / Lecturer:

Peter Krajnc

Jeziki /
Languages:

Predavanja / Lecture: slovenski / Slovene
Vaje / Tutorial: slovenski / Slovene

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

- pogojev ni

Prerequisites:

- None

Vsebina:

- strukturno- reaktivnostni odnosi pri organskih spojinah
- tok elektronov v organskih reakcijah
- načrtovanje organskih sintez (t.i. »Disconnection approach«)

Seminar:

- podrobna vsebina seminarja se bo določila na osnovi dogovora z mentorjem in se bo nanašala na tematiko predmeta

Content (Syllabus outline):

- Structure- reactivity relations at organic compounds
- Electron flow in organic chemistry
- Organic synthesis planning (the disconnection approach)

Seminar:

- Detailed content of seminar will be determined on the basis of agreement with mentor and will be related to the subject

Temeljni literatura in viri / Textbooks:

- M. B. Smith, J. March, March's Advanced Organic Chemistry, Wiley, 2007.
- P. H. Scudder, Electron Flow in Organic Chemistry, Wiley, 1992.
- Primarna literatura (npr. članki) s tematiko glede na študentovo področje raziskovanja / Primary literature (e.g. papers) corresponding to the student's research interest.

Cilji:

Objectives:

- spoznati povezave med strukturo organske spojine in njeno reaktivnostjo
- znati napovedati reakcijski mehanizem
- načrtovati sintezo organskih spojin iz enostavnih sintonov

- To know relations between structure of organic compound and their reactivity
- To be able to foresee reaction mechanism
- Design of organic compound synthesis from simple synthons

Predvideni študijski rezultati:

Znanje in razumevanje:

- znati povezovati med strukturo organske spojine in njeno reaktivnostjo
- razumeti vplive strukture na potek reakcij
- znati načrtovati sintezo organskih spojin

Prenesljive/ključne spretnosti in drugi atributi:

- suvereno obvladovanje fizikalne organske kemije
- načrtovanje sintez organskih spojin

Intended learning outcomes:

Knowledge and Understanding:

- To be able to understand and foresee the relations between structure and reactivity of organic compounds
- To understand the influences of compound structure on the course of reactions
- To be able to plan organic synthesis

Transferable/Key Skills and other attributes:

- Solid knowledge of physical organic chemistry
- Planning of organic synthesis.

Metode poučevanja in učenja:

- predavanja
- seminar
- seminarska naloga

Learning and teaching methods:

- Lectures
- Seminar
- Seminar work

Načini ocenjevanja:

Delež (v %) /
Weight (in %)

Assessment:

Izpit je opravljen, če so pozitivno opravljene vse naslednje obveznosti:

- ustni izpit
- seminarska naloga
- pisni izpit

30
30
40

Student has to pass successfully the following obligations:

- Oral examination
- Seminar work
- Written examination

Reference nosilca / Lecturer's references:

MERT, E. H., SLUGOVČ, Christian, KRAJNC, Peter. Tailoring the mechanical and thermal properties of dicyclopentadiene polyHIPEs with the use of a comonomer. *Express polymer letters*, ISSN 1788-618X, 2015, vol. 9, no. 4, str. 344-353. <http://www.expresspolymlett.com/>.

BUNDERŠEK, Alenka, JAPELJ, Boštjan, MUŠIČ, Branka, RAJNAR, Nevenka, GYERGYEK, Sašo, KOSTANJŠEK, Rok, KRAJNC, Peter. Influence of Al(OH)₃ nanoparticles on the mechanical and fire resistance properties of poly(methyl methacrylate) nanocomposites : Elektronski vir. *Polymer composites*, ISSN 0272-8397. [Print ed.], Article first published online: 23 DEC 2014, let. , no. , str. 1-7, ilustr., doi: [10.1002/pc.23338](https://doi.org/10.1002/pc.23338).

HUŠ, Sebastjan, KRAJNC, Peter. PolyHIPEs from methyl methacrylate : hierarchically structured microcellular polymers with exceptional mechanical properties. *Polymer*, ISSN 0032-3861. [Print ed.], Avg. 2014, vol. 55, iss. 17, str. 4420-4424, doi: [10.1016/j.polymer.2014.07.007](https://doi.org/10.1016/j.polymer.2014.07.007).

SEVŠEK, Urška, KRAJNC, Peter. Methacrylic acid microcellular highly porous monoliths : preparation and functionalisation. *Reactive & functional polymers*, ISSN 1381-5148. [Print ed.], Jan. 2012, vol. 72, iss. 1, str. 221-226, doi: [10.1016/j.reactfunctpolym.2012.02.007](https://doi.org/10.1016/j.reactfunctpolym.2012.02.007).

JERENEC, Simona, ŠIMIČ, 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](https://doi.org/10.1016/j.reactfunctpolym.2014.02.011).



Univerza v Mariboru

Fakulteta za kemijo
in kemijsko tehnologijo

UČNI NAČRT PREDMETA / COURSE SYLLABUS

Predmet:	Sinteza sistemov
Course title:	System synthesis

Študijski program in stopnja Study programme and level	Študijska smer Study field	Letnik Academic year	Semester Semester
Kemija in kemijska tehnika, 3. stopnja	Kemijska tehnika / Kemija	1.	zimski
Chemistry and Chemical Engineering, 3rd level	Chemical Engineering / Chemistry	1.	Autumn

Vrsta predmeta / Course type

Temeljni/Basic

Univerzitetna koda predmeta / University course code:

Predavanja Lectures	Seminar Seminar	Sem. vaje Tutorial	Lab. vaje Laboratory work	Teren. vaje Field work	Samost. delo Individ. work	ECTS
10	10				430	15

Nosilec predmeta / Lecturer:

Zdravko Kravanja

Jeziki /

Predavanja / Lectures:

slovenski / Slovenian

Languages:

Vaje / Tutorial:

slovenski / Slovenian

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

Pogojev ni

Prerequisites:

None

Vsebina:

- matematično programirni pristop k optimalni sintezi procesov in drugih tehniških struktur
- modeliranje diskretnih in kontinuirnih odločitev za strukturno in parametrično optimiranje superstruktur; drevesno ter mrežno predstavljanje tehniških superstruktur; uporaba visokih programskih jezikov za vnos modelov (npr. GAMS)
- nelinearno programiranje (NLP) in Karush-Kuhn-Tuckerjevi pogoji optimalnosti; predstavitev algoritmov in programov NLP (SQP, MINOS, CONOPT)
- mešano celoštevilsko linearne programirne (MILP)

Content (Syllabus outline):

- Mathematical programming approach to the optimal synthesis of processes and other engineering structures
- Modeling of discrete and continuous decisions for the structural and parametric optimization of engineering superstructures. Basic concepts of mathematical modeling, tree and network problem representations. The use of high programming languages (e.g. GAMS)
- Nonlinear programming (NLP) and the Karush-Kuhn-Tucker optimality conditions. NLP algorithms and solvers (SQP, MINOS, CONOPT)
- Mixed-integer linear programming (MILP) techniques

tehnike za strukturno in parametrično optimiranje linearnih ali lineariziranih modelov; MILP aplikacija za sintezo

- mešano celoštevilsko nelinearni programirni (MINLP) algoritmi za strukturno in parametrično optimiranje nelinearnih modelov (GBD, OA/ER, AP/OA/ER, modificiran AP/OA/ER)
- računalniška aplikacija sinteznih problemov MINLP z DICOPT++ in/ali MIPSYN; modelna dekompozicijska strategija in disjunktno programiranje s konveksno lupino za optimiranje večjih modelov MINLP

Seminar:

aplikacije optimiranja/sinteze procesov in drugih tehniških struktur z matematičnim programiranjem, po potrebi prilagojeno študentovi temi raziskovanja

for the structural and parametric optimization of linear and linearized models. Application of MILP in the synthesis

- Mixed-integer nonlinear programming (MINLP) algorithms for the structural and parametric optimization of nonlinear models (GBD, OA/ER, AP/OA/ER, the modified AP/OA/ER)
- Computerized application of MINLP synthesis problems with DICOPT++ and/or MIPSYN. The modeling and decomposition strategy and disjunctive programming with convex hull representation for the optimization of large-scale MINLP models

Seminar:

Various applications of optimization/synthesis of processes and other engineering structures, adapted to the student research needs

Temeljni literatura in viri / Readings:

- A. Brooke, D. Kendrick, A. Meeraus, R. Raman, GAMS - A user Guide, Scientific Press, GAMS Development Corporation, 2015. <http://www.gams.com/dd/docs/bigdocs/GAMSUsersGuide.pdf>
- L. T. Biegler, I. E. Grossmann and A. W. Westerberg, Systematic Methods of Chemical Process Design, Prentice Hall, New Jersey, ponovna izdaja 1999.
- Primarna literatura (npr. članki) s tematiko glede na študentovo področje raziskovanja / Primary literature (e.g. papers) corresponding to the student's research interest.

Cilji in kompetence:

Cilj je podati sodobno znanje o sintezi procesov in drugih tehniških struktur

Objectives and competences:

The aim is to give advanced knowledge about the synthesis of process schemes and other engineering structures

Predvideni študijski rezultati:

Znanje in razumevanje:

- obvladovanje teorije in aplikacij sodobnega matematičnega programiranja (optimiranja) pri sintezi procesov in drugih tehniških struktur

Prenesljive/ključne spretnosti in drugi atributi:

- sposobnost pridobiti dober pregled nad trenutnim stanjem sodobnih raziskav na študirani tematiki in na tej osnovi predlagati ter po potrebi kreirati novo znanje na področju

Intended learning outcomes:

Knowledge and Understanding:

- Understand theory and have advanced knowledge of some practical applications of mathematical programming (optimization) in synthesizing processes and other engineering structures

Transferable/Key Skills and other attributes:

- To be able to construct a thorough overview of the topic studied under this course and acquire basic skills to propose and possibly create new knowledge in the field

Metode poučevanja in učenja:

- predavanja
- seminar
- seminarska naloga

Learning and teaching methods:

- Lectures
- Seminar
- Seminar work

Načini ocenjevanja:	Delež (v %) / Weight (in %)	Assessment:
Način (pisni izpit, ustno izpraševanje, naloge, projekt) Izpit je opravljen, če so pozitivno opravljene vse naslednje obveznosti: seminarska naloga	100	Type (examination, oral, coursework, project): Student has to pass successfully the following obligations: Seminar work

Reference nosilca / Lecturer's references:

AHMETOVIĆ, Elvis, KRAVANJA, Zdravko. Simultaneous optimization of heat-integrated water networks involving process-to-process streams for heat integration. *Applied thermal engineering*, ISSN 1359-4311. [Print ed.], Jan. 2014, vol. 62, iss. 1, str. 302-217, doi: [10.1016/j.applthermaleng.2013.06.010](https://doi.org/10.1016/j.applthermaleng.2013.06.010).

NEMET, Andreja, KLEMEŠ, Jiri, KRAVANJA, Zdravko. Designing a Total Site for an entire lifetime under fluctuating utility prices. *Computers & chemical engineering*, ISSN 0098-1354. [Print ed.], Available online 18 July 2014, vol. , str. 1-24, doi: [10.1016/j.compchemeng.2014.07.004](https://doi.org/10.1016/j.compchemeng.2014.07.004).

ČUČEK, Lidija, MARTÍN, Mariano, GROSSMANN, Ignacio E., KRAVANJA, Zdravko. Multi-period synthesis of optimally-integrated biomass and bioenergy supply network. *Computers & chemical engineering*, ISSN 0098-1354. [Print ed.], 4 Jul. 2014, vol. 66, str. 57-70, doi: [10.1016/j.compchemeng.2014.02.020](https://doi.org/10.1016/j.compchemeng.2014.02.020).

KRAVANJA, Zdravko, ČUČEK, Lidija. Multi-objective optimisation for generating sustainable solutions considering total effects on the environment. V: DUIĆ, Neven (ur.). *Sustainable development of energy, water and environment systems*, (Applied Energy, ISSN 0306-2619, Vol. 101, (2012)). Oxford: Elsevier, cop. 2012, vol. 101, str. 67-80, doi: [10.1016/j.apenergy.2012.04.025](https://doi.org/10.1016/j.apenergy.2012.04.025).

ČUČEK, Lidija, KLEMEŠ, Jiri, KRAVANJA, Zdravko. A Review of Footprint analysis tools for monitoring impacts on sustainability. *Journal of cleaner production*, ISSN 0959-6526. [Print ed.], Oct. 2012, vol. 34, str. 9-20, doi: [10.1016/j.jclepro.2012.02.036](https://doi.org/10.1016/j.jclepro.2012.02.036).



Univerza v Mariboru

Fakulteta za kemijo
in kemijsko tehnologijo

UČNI NAČRT PREDMETA / COURSE SYLLABUS

Predmet:	Visokotlačni in drugi napredni separacijski procesi
Subject Title:	High-pressure and other advanced separation processes

Študijski program in stopnja Study programme and level	Študijska smer Study field	Letnik Academic year	Semester Semester
Kemija in kemijska tehnika, 3.stopnja Chemistry and Chemical Engineering, 3rd level	Kemijska tehnika Chemical Engineering	1.	zimski Autumn

Vrsta predmeta / Course type	Temeljni/basic
-------------------------------------	----------------

Univerzitetna koda predmeta / University course code:	
--	--

Predavanja Lectures	Seminar Seminar	Sem. vaje Tutorial	Lab. vaje Laboratory work	Teren. vaje Field work	Samost. delo Individ. work	ECTS
10	10				430	15

Nosilec predmeta / Lecturer:	Željko Knez
-------------------------------------	-------------

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

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

- pogojev ni

Prerequisites:

- None

Vsebina:

- separacijske operacije in oprema
- ekstrakcija, membranske operacije, kristalizacija, uparjevanje, destilacija itd. (ravnotežje, operacijski aparati in dimenzioniranje, prenos snovi in toplote, aplikacije v industrijskih procesih)
- termodinamske in kinetične lastnosti pri visokih tlakih
- razvoj visokotlačne opreme, industrijske reakcijske enote
- ekonomika visokotlačnih procesov
- aplikacije superkritičnih fluidov (SCF): kemijske reakcije v SCF, encimske reakcije v superkritičnih pogojih, superkritična oksidacija vode (SCWO) in njena uporaba pri čiščenju industrijskih odpadnih voda, ekstrakcija s SCF in frakcionacija iz trdnih materialov, visokotlačna polimerizacija, precipitacija trdnih delcev s plini visoke gostote, uporaba SCF v farmaciji, obdelava mikroorganizmov z visokimi tlaki, suho čiščenje s tekočim ogljikovim dioksidom)

Seminar:

podrobna vsebina seminarja se bo določila na osnovi dogovora z mentorjem in se bo anašala na tematiko predmeta

Content (Syllabus outline):

- Separation operations and equipment
- Extraction, membrane operations, crystallization, evaporation, distillation etc. (equilibrium, apparatus and designing, mass and heat transfer, application in industrial processes)
- Thermodynamic and kinetic properties at high-pressures
- High-pressure equipment development, industrial reaction unit development
- Economics of high-pressure processes
- Applications of supercritical fluids (SCF): chemical reactions SCF, enzymatic reactions in supercritical conditions, supercritical water oxidation (SCWO) and its application for purification of industrial waste-water, extraction with SCF and fractionation from solid materials, high-pressure polymerization, precipitation of solid particles with dense gases, application of SCF in pharmaceutical industry, high-pressure treatment of microorganisms, dry cleaning with liquid carbon dioxide)

Seminar:

	Detailed content of seminar will be determined on the basis of agreement with mentor and will be related to the subject
--	---

Temeljni literatura in viri / Readings:

- F. Feeherry, C. Doona, High Pressure Processing of Foods (Institute of Food Technologists Series), Blacwell Publishing Professional, USA, 2007.
- F. B. Petlyuk, Distillation Theory and its Application to Optimal Design of Separation Units (Cambridge Series in Chemical Engineering), Cambridge University Press, USA, 2004.

Dodatna priporočena literatura:

- Ž. Knez, M. Škerget, M. Knez Hrnič, Separation, extraction and concentration processes in the food, beverage and nutraceutical industries, by Syed S. H. Rizvi (editor), Publisher: Woodhead Publishing, 2010.
- A. Bertucco, G. Vetter, High Pressure Process Technology: Fundamentals and Applications, Elsevier, Vol. 9, 2001.
- Primarna literatura (npr. članki) s tematiko glede na študentovo področje raziskovanja / Primary literature (e.g. papers) corresponding to the student's research interest.

Cilji in kompetence:

- poglobljanje znanj na področju modernejših separacijskih metod in visokotlačnih tehnologij
- celovito obvladovanje separacijskih postopkov s sub- in superkritičnimi plini
- pridobitev znanj potrebnih za ustrezno načrtovanje visokotlačne opreme in operacij, ki so pomembna v posameznih procesnih industrijah
- pogloblitev poznavanja aplikacij visokotlačnih tehnologij

Objectives and competences:

- Widening of knowledge about modern separation methods and high-pressure technologies
- To gain integral view on the separation processes with sub- and supercritical gases
- To gain basic knowledge needed for appropriate development of high-pressure equipment and operations, which are important for individual process industry
- Widening of knowledge about applications of high-pressure technologies

Predvideni študijski rezultati:

Znanje in razumevanje:

- celovito razumevanje modernih separacijskih metod in visokotlačnih tehnologij
- obvladovanje separacijskih postopkov, kot so ekstrakcije in membranski postopki s sub- in superkritičnimi plini
- sposobnost načrtovanja različnih separacijskih procesov in visokotlačne opreme
- poznavanje posameznih aplikacij visokotlačnih tehnologij v različnih industrijskih panogah

Prenesljive/ključne spretnosti in drugi atributi:

- vsebina predmeta je povezana z vsebino drugih predmetov podiplomskega študija in podaja znanja potrebna za razumevanje vsebin, ki so zajeta npr. pri predmetu Prenos snovi in fazna ravnotežja ter znanja koristna za industrijo

Intended learning outcomes:

Knowledge and Understanding:

- Integral understanding of modern separation methods and of high-pressure technologies
- Mastering the separation processes, such as extractions and membrane processes with sub- and supercritical gases
- Ability to design different separation processes and high-pressure equipment
- Being familiar with applications of high-pressure technologies in different industrial branches

Transferable/Key Skills and other attributes:

- The subject is connected to other postgraduate subjects and gives the knowledge which is necessary for understanding other subjects such as Mass transfer and phase equilibria, and the knowledge important for industry

Metode poučevanja in učenja:

- predavanja
- seminar
- seminarska naloga

Learning and teaching methods:

- Lectures
- Seminar
- Seminar work

Načini ocenjevanja:

Izpit je opravljen, če so pozitivno opravljene vse naslednje obveznosti:

- seminarska naloga
- ustni izpit

Delež (v %) /
Weight (in %)

Assessment:

Student has to pass successfully the following obligations:

- Seminar work
- Oral examination

50
50

Reference nosilca / Lecturer's references:

KNEZ, Željko, MARKOČIČ, Elena, LEITGEB, Maja, PRIMOŽIČ, Mateja, KNEZ HRNČIČ, Maša, ŠKERGET, Mojca. Industrial applications of supercritical fluids : a review. *Energy*, ISSN 0360-5442. [Print ed.], Available online 10 August 2014, str. 1-9, doi:[10.1016/j.energy.2014.07.044](https://doi.org/10.1016/j.energy.2014.07.044). [COBISS.SI-ID [18010134](#)],

CÖR, Darija, ŠKERGET, Mojca, KNEZ, Željko. Solubility of [beta]-carotene and glyceryl trioleate mixture in supercritical CO₂. *Journal of chemical and engineering data*, ISSN 0021-9568, 2014, vol. 59, no. 3, str. 653-658, doi: [10.1021/je400553y](https://doi.org/10.1021/je400553y). [COBISS.SI-ID [17647894](#)]

KNEZ, Željko, MARKOČIČ, Elena, NOVAK, Zoran, KNEZ HRNČIČ, Maša. Processing polymeric biomaterials using supercritical CO₂. *Chemie Ingenieur Technik*, ISSN 0009-286X, 2011, vol. 83, no. 9, str. 1371-1380. [COBISS.SI-ID [15347734](#)]

KNEZ, Željko. Particle formation using supercritical fluids : a short review. *Chemical industry & chemical engineering quarterly*, ISSN 1451-9372, 2006, vol. 12, no 3, str. 141-146. <http://www.ache.org.rs/CICEQ/2006/No3/knez.pdf>. [COBISS.SI-ID [10648854](#)]

KNEZ, Željko. High pressure process technology - quo vadis?. *Transactions of the Institution of Chemical Engineers. Part A, Chemical engineering research and design*, ISSN 0263-8762, dec. 2004, vol. 82, št. 12, str. 1541-1548. [COBISS.SI-ID [9342230](#)],



Fakulteta za kemijo
in kemijsko tehnologijo

UČNI NAČRT PREDMETA / COURSE SYLLABUS

Predmet:	Prenosni pojavi v kemijski tehniki
Course title:	Transmission Phenomena in Chemical Engineering

Študijski program in stopnja Study programme and level	Študijska smer Study field	Letnik Academic year	Semester Semester
Kemija in kemijska tehnika	Kemijska tehnika	1.	zimski
Chemistry and Chemical Engineering	Chemical Engineering	1.	Autum

Vrsta predmeta / Course type

Temeljni/Basic

Univerzitetna koda predmeta / University course code:

Predavanja Lectures	Seminar Seminar	Sem. vaje Tutorial	Lab. vaje Laboratory work	Teren. vaje Field work	Samost. delo Individ. work	ECTS
10	10				430	15

Nosilec predmeta / Lecturer:

Darko Goričanec

Jeziki /

Predavanja / Lectures:

slovenski / Slovene

Languages:

Vaje / Tutorial:

slovenski / Slovene

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

pogojev ni

Prerequisites:

None

Vsebina:

- zakonitosti pretoka fluidov in prenosa toplote
- pretočno – tlačna analiza razmer v procesnih omrežjih
- optimalno načrtovanje procesnih omrežij
- faktor istočasnosti
- optimalna izolacija procesnih omrežij in naprav
- sodobni sistemi oskrbe objektov z grelno in hladilno energijo

Seminar

Reševanje primerov in izdelava seminarske naloge iz vsebine predmeta z uporabo računalniških programov

Content (Syllabus outline):

- Characteristics of fluid flow and heat transfer
- Flow – pressure analysis of conditions in process networks
- Optimal design of process network
- Factor of simultaneity
- Optimal isolation of process network equipment
- Contemporary systems of supply with heat and cooling energy

Seminar:

Solving cases and preparation of seminar work from the content of the subject using computer programs

Temeljni literatura in viri / Readings:

Tuncer Cebeci et.al: Computational Fluid Dynamics for Engineers : From Panel to Navier-Stokes Methods with Computer Programs, Springer, 2005.

Priporočena dodatna literatura:

J. H. Ferziger, M. Peric: Computational Methods for Fluid Dynamics, Springer Verlag, 2001.

J. P. Holman: Heat Transfer, McGraw Hill Science/Engineering/Math, 2001.

Cilji in kompetence:

Objectives and competences:

- poglobljeno razumevanje prenosnih pojavov v kemijski tehniki
- sposobnost uporabe različnih naprednih matematičnih metod za analizo pretočno-tlačnih razmer in prenosa toplote v procesnih omrežjih

- Advanced understanding of transmission phenomena in chemical engineering
- Ability to use different novel mathematical methods for analysis of flow-pressure conditions and heat transfer in process networks

Predvideni študijski rezultati:

Znanje in razumevanje:

- sposobnost priprave matematičnih modelov različnih procesnih omrežij
- sposobnost uporabe ustrezne programske opreme in računalniško načrtovanje zahtevnejših energetskega sistemov

Prenesljive/ključne spretnosti in drugi atributi:

- oblikovanje načrtov za doseg najzahtevnejših procesnih omrežij
- avtonomnost v strokovnem in raziskovalnem delu

Intended learning outcomes:

Knowledge and Understanding:

- Ability to develop mathematical models of different process networks
- Ability to use appropriate software and computer aided design of more complex energy systems

Transferable/Key Skills and other attributes:

- Developing plans for realisation of the most complex process networks
- Autonomy in professional and research work

Metode poučevanja in učenja:

- predavanja
- seminar
- seminarska naloga

Learning and teaching methods:

- Lectures
- Seminar
- Seminar work

Načini ocenjevanja:

Izpit je opravljen, če so pozitivno opravljene vse naslednje obveznosti:

- seminarska naloga
- ustni izpit

Delež (v %) /

Weight (in %)

Assessment:

Student has to pass successfully the following obligations:

- Seminar work
- Oral examination

50

50

Reference nosilca / Lecturer's references:

ZORKO, Jerneja, GORIČANEC, Darko, KROPE, Jurij. Process of oxygen transfer and power requirements in activated sludge wastewater treatment plant. Res. J. Chem. Environ., 2011, vol. 15, no. 2, str. 1-3, graf. prikazi. [COBISS.SI-ID 15168534], [JCR, Scopus do 28. 9. 2011: št. citatov (TC): 0, čistih citatov (CI): 0, normirano št. čistih citatov (NC): 0]

TORHAČ, Evgen, GORIČANEC, Darko, KROPE, Jurij, TROP, Peter, SALJNIKOV, Aleksandar. *Geothermal gravity heat pipe for exploitation of geothermal energy from unproductive wells : končno poročilo = Geotermalna gravitacijska toplotna cev za izkoriščanje geotermalne energije neproduktivnih vrtin : final report*. Maribor: Fakulteta za kemijo in kemijsko tehnologijo, 2012. 213 str., ilustr. [COBISS.SI-ID [16626966](#)]

KROPE, Jurij, GORIČANEC, Darko, DOBERŠEK, Danijela, TROP, Peter. Preveritev možnosti izrabe odpadne toplote v HE Dravograd : končno poročilo. Maribor: Fakulteta za kemijo in kemijsko tehnologijo, 2012. 119 str., ilustr. [COBISS.SI-ID 16626454]

KULČAR, Bojan, GORIČANEC, Darko, KROPE, Jurij. Economy of replacing a refrigerant in a cooling system for preparing chilled water = Remplacement du frigorigene dans un systeme utilisé pour préparer de l'eau glacée : impact financier. International journal of refrigeration, ISSN 0140-7007. [Print ed.], Aug. 2010, vol. 33, iss. 5, str. 989-994.

DOBERŠEK, Danijela, GORIČANEC, Darko, KROPE, Jurij. Use of drag-reducing additives in district heating systems. V: The fifth International Conference on Thermal Engineering: Theory and Applications [also] ICTEA, May 10-14, 2010, Marrakesh, Morocco. Proceeding. [S. l.]: ICTEA, cop. 2010, str. 231-234. [COBISS.SI-ID 14194454]



Univerza v Mariboru

Fakulteta za kemijo
in kemijsko tehnologijo

UČNI NAČRT PREDMETA / COURSE SYLLABUS

Predmet:	Izbrana poglavja v analizni kemiji
Course title:	Selected topics in Analytical Chemistry

Študijski program in stopnja Study programme and level	Študijska smer Study field	Letnik Academic year	Semester Semester
Kemija in kemijska tehnika, 3. stopnja	Kemija	1.	zimski
Chemistry and Chemical Engineering, 3rd level	Chemistry	1.	Autumn

Vrsta predmeta / Course type

Temeljni/Basic

Univerzitetna koda predmeta / University course code:

Predavanja Lectures	Seminar Seminar	Sem. vaje Tutorial	Lab. vaje Laboratory work	Teren. vaje Field work	Samost. delo Individ. work	ECTS
10	10				430	15

Nosilec predmeta / Lecturer:

Mitja Kolar

Jeziki /

Languages:

Predavanja / Lectures:

Vaje / Tutorial:

slovenski / Slovene

slovenski / Slovene

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

Dobro znanje analizne kemije in statističnih metod.

Prerequisites:

Good knowledge of analytical chemistry and basic level of statistical methods

Vsebina:

Predmet izbrana poglavja v analizni kemiji obravnava:

- uporabo sodobnih in sklopljenih analiznih metod za reševanje kompleksnih analiznih problemov,
- pripravo vzorcev za analizo, separacija in ekstrakcija analitov iz matrice,
- identifikacijo in kvantitativno določanje analitov v kompleksnih vzorcih.

Seminar:

Vsebina seminarja bo povezana z analizo problematiko in se bo nanašala na tematiko doktorskega dela.

Content (Syllabus outline):

Subject Selected topics in Analytical Chemistry covers:

- Use of modern and hyphenated analytical methods for solving complex analytical problems,
- Preparation of samples, separation and extraction of analytes from matrix solution,
- Identification and quantitative determination of analytes in complex samples.

Seminar:

- Content of seminar is connected with analytical problems and will be related to the topic of doctoral thesis.

Temeljni literatura in viri / Readings:

- D. A. Skoog, J. J. Leary: Principles of Instrumental Analysis, Saunders College Publishing, 6. izdaja, New York 2004.
- D. A. Skoog, F. J. Holler, T. A. Nieman, Principles of Instrumental Analysis, Saunders College Publishing, 7. izdaja, New York 2004.
- Primarna literatura (npr. članki) s tematiko glede na študentovo področje raziskovanja / Primary literature (e.g. papers) corresponding to the student's research interest.

Cilji in kompetence:

Spoznati, izbrati in uporabiti nove analizne metode za določevanje nizkih koncentracij različnih organskih in anorganskih spojin v različnih matricah

Načrtovati analitski postopek za točno določevanje analiziranih spojin.

Objectives and competences:

To develop, select and use appropriate analytical methods for determination of different organic and inorganic compounds in different matrices.

Design of an analytical procedure for accurate determination of measured compounds.

Predvideni študijski rezultati:

Znanje in razumevanje:

- razumevanje principov modernih analiznih metod
- točnost merjenih analiznih rezultatov

Prenesljive/ključne spretnosti in drugi atributi:

oblikovanje kompleksnih odločitev za doseg najzahtevnejših ciljev

Intended learning outcomes:

Knowledge and Understanding:

- Understanding of principles of modern analytical methods
- Accuracy of measured analytical results

Transferable/Key Skills and other attributes:

Developing the complex decisions for realization of the most demanding goals

Metode poučevanja in učenja:

Predavanja v učilnici, ki je opremljena z osnovnimi avdio-vizualnimi pripomočki.

Individualna priprava seminarskih nalog s predstavitvijo in diskusijo, konzultacije.

Learning and teaching methods:

Lectures in lecture room, equipped with basic audio-visual equipment

Individual preparation of seminars and their presentation with discussion, consultations.

Načini ocenjevanja:

Izpit je opravljen, če so pozitivno opravljene vse naslednje obveznosti:

- pisni izpit
- seminarska naloga

Delež (v %) /
Weight (in %)

60
40

Assessment:

Student has to pass successfully the following obligations:

- Written examination
- Seminar work

Reference nosilca / Lecturer's references:

BRGLEZ, Polonca, HOLOBAR, Andrej, PIVEC, Aleksandra, KOLAR, Mitja. Spin-coating for optical-oxygen-sensor preparation = Uporaba spinskega nanosa pri izdelavi optičnih senzorjev za kisik. *Mater.&tehn*, ISSN 1580-2949., 2014, letn. 48, št. 2, str. 181-188. [COBISS.SI-ID [17746454](#)]

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](https://doi.org/10.1016/j.reactfunctpolym.2014.02.011). [COBISS.SI-ID [17661718](#)]

PIVEC, Tanja, PERŠIN, Zdenka, KOLAR, Mitja, MAVER, Tina, DOBAJ, Andreja, VESEL, Alenka, MAVER, Uroš, STANA-KLEINSCHKEK, Karin. Modification of cellulose non-woven substrates for preparation of modern wound dressings. *Textile research journal*, ISSN 0040-5175, Jan. 2014, vol. 84, iss. 1, str. 96-112, ilustr.

<http://trj.sagepub.com/content/84/1/96.full.pdf+html>, doi: [10.1177/0040517513483855](https://doi.org/10.1177/0040517513483855). [COBISS.SI-ID [16864022](#)]

ZAJŠEK, Katja, GORŠEK, Andreja, KOLAR, Mitja. Cultivating conditions effects on kefir production by the mixed culture of lactic acid bacteria imbedded within kefir grains. *Food chemistry*, ISSN 0308-8146. [Print ed.], Jan. 2013, vol. 139, iss. 1-4, str. 970-977, doi: [10.1016/j.foodchem.2012.11.142](https://doi.org/10.1016/j.foodchem.2012.11.142). [COBISS.SI-ID [16645142](#)]

BRGLEZ, Polonca, HOLOBAR, Andrej, PIVEC, Aleksandra, BELŠAK, Nataša, KOLAR, Mitja. Determination of oxygen by means of a biogas and gas - interference study using an optical tris (4,7-diphenyl-1,10-phenanthroline) ruthenium(II) dichloride complex sensor. *Acta chimica slovenica*, ISSN 1318-0207, 2012, vol. 59, no. 1, str. 50-58, ilustr.

<http://acta.chem-soc.si/59/59-1-50.pdf>. [COBISS.SI-ID [15889686](#)]

ZAJŠEK, Katja, KOLAR, Mitja, GORŠEK, Andreja. Characterisation of the exopolysaccharide kefir produced by lactic acid bacteria entrapped within natural kefir grains. *International journal of dairy technology*, ISSN 1364-727X, 2011, vol. 64, issue 4, str. 544-548, doi: [10.1111/j.1471-0307.2011.00704.x](https://doi.org/10.1111/j.1471-0307.2011.00704.x). [COBISS.SI-ID [15278870](#)]



Univerza v Mariboru

Fakulteta za kemijo
in kemijsko tehnologijo

UČNI NAČRT PREDMETA / SUBJECT SPECIFICATION

Predmet:	Izbrana poglavja iz anorganske kemije
Subject Title:	Selected chapters of inorganic chemistry

Študijski program Study programme	Študijska smer Study field	Letnik Year	Semester Semester
Kemija in kemijska tehnika Chemistry and Chemical Engineering	Kemija Chemistry	1.	zimski Autumn

Univerzitetna koda predmeta / University subject code:

Predavanja Lectures	Seminar Seminar	Sem. vaje Tutorial	Lab. vaje Labor work	Teren. vaje Field work	Samost. delo Individ. work	ECTS
10	10				430	15

Vrsta predmeta / Course type:

Temeljni/ Basi

Nosilec predmeta / Lecturer:

Mihael Drofenik

Jeziki /

Predavanja / Lecture:

slovenski / Slovene

Languages:

Vaje / Tutorial:

slovenski / Slovene

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

- pogojev ni

Prerequisites:

- None

Vsebina:

- struktura, simetrija in kemijska vez v anorganskih spojinah
- kemija elementov *s* – *bloka*: alkalijski elementi (1A), zemljoalkaliskai elementi (2A)
- kemija elementov *p* – *bloka*: skupina bora 13 (IIIA), skupina ogljika 14 (IVA), skupina dušika 15 (VA), halkogeni elementi 16 (VIA), halogeni 17 (VIIA), žlahtni plini 18 (skupina 0)
- kemija elementov *d* – *bloka*: elementi skupin 3B, 4B, 5B, 6B, 7B, 8B, 1B in 2B
- kemija *f* – *bloka*: lantanoidi, aktinoidi

Seminar:

- podrobna vsebina seminarja se bo določila na osnovi dogovora z mentorjem in se bo nanašala na tematiko predmeta

Content (Syllabus outline):

- Structure, symmetry and chemical bounding of inorganic compounds
- Chemistry of *s*-*block* elements: Alkali metals, Alkaline earth metals
- The chemistry of *p*-*block* elements: 13 (IIIA) – Boron Group, 14 (IVA) – Carbon Group, 15 (VA) – Nitrogen Group, 16 (VIA) – Chalcogens, 17 (VIIA) – Halogens, 18 (Group 0) – Noble gases
- Chemistry of *d*-*block* elements: 3B, 4B, 5B, 6B, 7B, 8B, 1B and 2B group elements
- The chemistry of *f*-*block*: Lanthanides, Actinides

Seminar:

- Detailed content of seminar will be determined on the basis of agreement with mentor and will be related to the subject

Temeljni literatura in viri / Textbooks:

- F. A Cotton, G. Wilkinson, Advanced Inorganic Chemistry, Wiley, New York, 1980.
- Primarna literatura (npr. članki) s tematiko glede na študentovo področje raziskovanja / Primary literature (e.g. papers) corresponding to the student's research interest.

Cilji:

- pridobiti znanje o izbranih lastnostih reprezentativnih elementov, prehodnih elementov, lantanoidov in aktinoidov
- pridobiti znanje za razumevanje sinteze anorganskih spojin in materialov

Objectives:

- Acquirement of chemical knowledge on selected chemical properties of representative elements, transition elements, lanthanides and actinides
- Acquirement the knowledge for understanding the synthesis of inorganic compounds and/or materials

Predvideni študijski rezultati:Znanje in razumevanje:

- poglobljeno razumevanje anorganske kemije
- pridobitev kemijskih znanj potrebnih za razumevanje znanstvene literature

Prenesljive/ključne spretnosti in drugi atributi:

- samostojno načrtovanje usmerjenih kemijskih raziskav
- pridobitev kemijskega znanja za sodelovanje z drugimi raziskovalnimi skupinami

Intended learning outcomes:Knowledge and Understanding:

- Deepened understanding of inorganic chemistry
- Acquirement of chemical knowledge needed for the understanding of scientific literature

Transferable/Key Skills and other attributes:

- Autonomous planning of directed chemical investigations
- Acquirement of chemical knowledge for the cooperation with other research groups

Metode poučevanja in učenja:

- predavanja
- seminar
- seminarska naloga

Learning and teaching methods:

- Lectures
- Seminar
- Seminar work

Načini ocenjevanja:

Delež (v %) /
Weight (in %)

Assessment:

Izpit je opravljen, če so pozitivno opravljene vse naslednje obveznosti:

- seminarska naloga
- ustni zagovor

50
50

Student has to pass successfully the following obligations:

- Seminar work
- Oral examination

Reference nosilca / Lecturer's references:

HOJNIK, Nuša, KRISTL, Matjaž, GOLOBIČ, Amalija, JAGLIČIČ, Zvonko, DROFENIK, Mihael. Hydrolytic synthesis of novel lanthanide(III) complexes with pyridine-2,6-dicarboxylic acid. *Journal of molecular structure*, 2015, vol. 1079, str. 54-60,

HOJNIK, Nuša, KRISTL, Matjaž, GOLOBIČ, Amalija, JAGLIČIČ, Zvonko, DROFENIK, Mihael. The synthesis, structure and physical properties of lanthanide(III) complexes with nicotinic acid. *Central European Journal of Chemistry*, 2014, vol. 12, iss. 2, str. 220-226,

KRISTL, Matjaž, HOJNIK, Nuša, GYERGYEK, Sašo, DROFENIK, Mihael. Sonochemical preparation of copper sulfides with different phases in aqueous solutions. *Materials research bulletin*, 2013, vol. 48, iss. 3, str. 1184-1188,

LISJAK, Darja, DROFENIK, Mihael. Chemical substitution - an alternative strategy for controlling the particle size of barium ferrite. *Crystal growth & design*, 2012, vol. 12, no. 11, str. 5174-5179,

DOJER, Brina, PEVEC, Andrej, JAGODIČ, Marko, KRISTL, Matjaž, DROFENIK, Mihael. Three new cobalt(II) carboxylates with 2-, 3- and 4-aminopyridine : syntheses, structures and magnetic properties. *Inorganica Chimica Acta*, 2012, vol. 383, str. 98-104,



Univerza v Mariboru

Fakulteta za kemijo
in kemijsko tehnologijo

UČNI NAČRT PREDMETA / SUBJECT SPECIFICATION

Predmet:	Procesna termodinamika
Subject Title:	Process thermodynamics

Študijski program Study programme	Študijska smer Study field	Letnik Year	Semester Semester
Kemija in kemijska tehnika Chemistry and Chemical Engineering	Kemijska tehnika / Kemija Chemical Engineering / Chemistry	1.	zimski Autumn

Vrsta predmeta / Course type:

Temeljni / Basic

Univerzitetna koda predmeta / University subject code:

Predavanja Lectures	Seminar Seminar	Sem. vaje Tutorial	Lab. vaje Labor work	Teren. vaje Field work	Samost. delo Individ. work	ECTS
10	10				430	15

Nosilec predmeta / Lecturer:

Valter Doleček

Jeziki /

Languages:

Predavanja / Lecture:

Vaje / Tutorial:

slovenski / Slovene

slovenski / Slovene

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

- pogojev ni

Prerequisites:

- None

Vsebina:

- uporaba termodinamike v pretočnih procesih
- proizvodnja moči na osnovi toplote
- hlajenje in utekočinjenje
- klasična termodinamika faznih ravnotežij
- termodinamske lastnosti iz volumetričnih podatkov
- fugativnost v plinskih mešanica
- fugativnost v mešanica kaplevin, presežne funkcije, modeli in teorije raztopin
- topnost plinov v kaplevinah
- topnost trdnih snovi v kaplevinah
- visokotlačna fazna ravnotežja
- merjenje in izračuni različnih faznih ravnotežij
- termodinamska analiza procesov
- uvod v molekulske termodinamiko

Seminar:

- izbrane različne termodinamske vsebine

Content (Syllabus outline):

- Application of thermodynamics to flow processes
- Production of power from heat
- Refrigeration and liquefaction
- Classical thermodynamics of phase equilibria
- Thermodynamic properties from volumetric data
- Fugacity in gas mixtures
- Fugacity in liquid mixtures, excess functions, models and theories of solutions
- Solubility of gases in liquids
- Solubility of solids in liquids
- High pressure phase equilibria
- Measurements and calculations of different phase equilibria
- Thermodynamic analysis of processes
- Introduction to molecular thermodynamics

Seminar:

- Selected different thermodynamic topics

Temeljni literatura in viri / Textbooks:

- Molecular Thermodynamics of Fluid-Phase Equilibria, J. M. Prausnitz, R. N. Lichtenthaler, E. Gomes de Azevedo, 3th Ed., Prentice Hall PTR, 1999.

Priporočena dodatna literatura:

- Phase Equilibria, Measurement and Computation, J. D. Raal, A. L. Mühlbauer, Taylor & Francis, 1998.

- The Bases of Chemical Thermodynamics, M. Graetzel, P. Infelta, Vol. 1,2, Universal Publishers/uPublish.com, 2002.
- Introduction to Chemical Engineering Thermodynamics, J. M. Smith, H. C. Van Ness, M. M Abbott, 7th Ed., Mc Graw Hill, 2005.

Cilji:

- poglobljena uporaba termodinamskih izračunov za industrijske procese s poudarkom na pretočnih sistemih in faznih ravnotežij
- uporaba modelov in enačb stanja potrebnih za kvantitativno obravnavo praktičnih fiziko-kemijskih sistemov

Objectives:

- Deepening of the application of thermodynamic calculations to industrial processes, with emphasis on flow systems and phase equilibria
- The use of models and equations of state needed for quantitative treatment of practical physico-chemical processes

Predvideni študijski rezultati:

Znanje in razumevanje:

- celovito obvladovanje procesne termodinamike in praktičnih izračunov, ki so na njej osnovani
- obvladovanje termodinamske analize različnih sistemov
- razvijanje sposobnosti predvidevanja obnašanja procesnih sistemov na osnovi termodinamike

Prenesljive/ključne spretnosti in drugi atributi:

- spretnost komuniciranja, razvijanje predvsem sposobnosti zbiranja potrebnih informacij ter uporaba ustreznih modelov in teorij

Intended learning outcomes:

Knowledge and Understanding:

- Integral governing of process thermodynamics and of practical calculations based on it
- Governing of thermodynamical analysis of different systems
- Development of the capability to foresee the behavior of process systems on the basis of thermodynamics

Transferable/Key Skills and other attributes:

- Communication skills, preferable the capability collecting needed information's and the use of appropriate models and theories

Metode poučevanja in učenja:

- predavanja
- seminar
- seminarska naloga

Learning and teaching methods:

- Lectures
- Seminar
- Seminar work

Načini ocenjevanja:

Izpit je opravljen, če so pozitivno opravljene vse naslednje obveznosti:

- seminarska naloga
- ustni izpit

Delež (v %) /
Weight (in %)

Assessment:

Student has to pass successfully the following obligations:

- Seminar work
- Oral examination

Reference nosilca / Lecturer's references:

PEČAR, Darja, DOLEČEK, Valter. Thermodynamic properties of coenzyme Q10 in supercritical carbon dioxide. *The Journal of supercritical fluids*, ISSN 0896-8446. [Print ed.], Mar. 2007, vol. 40, iss. 2, str. 200-207.

<http://dx.doi.org/10.1016/j.supflu.2006.07.007>, doi: [10.1016/j.supflu.2006.07.007](https://doi.org/10.1016/j.supflu.2006.07.007). [COBISS.SI-ID [10643990](https://cobiss.si/10643990)], [JCR, SNIP]

2. SKALE, Saša, DOLEČEK, Valter, SLEMNIK, Mojca. Substitution of the constant phase element by Warburg impedance for protective coatings. *Corrosion science*, ISSN 0010-938X. [Print ed.], Mar. 2007, vol. 49, iss. 3, str. 1045-1055.

<http://dx.doi.org/10.1016/j.corsci.2006.06.027>. [COBISS.SI-ID [10666518](https://cobiss.si/10666518)], [JCR, SNIP]

3. PEČAR, Darja, DOLEČEK, Valter. Densities of [beta]-carotene-supercritical carbon dioxide mixtures. *Journal of chemical and engineering data*, ISSN 0021-9568, Nov. 2007, vol. 52, no. 6, str. 2442-2445.

<http://dx.doi.org/10.1021/je700373r>. [COBISS.SI-ID [11910678](https://cobiss.si/11910678)], [JCR, SNIP]

4. PEČAR, Darja, DOLEČEK, Valter. Densities of [alpha]-tocopherol + supercritical carbon dioxide mixtures. *Journal of chemical and engineering data*, ISSN 0021-9568, Mar. 2008, vol. 53, no. 4, str. 929-932.

<http://dx.doi.org/10.1021/je7005538>, doi: [10.1021/je7005538](https://doi.org/10.1021/je7005538). [COBISS.SI-ID [12176662](https://cobiss.si/12176662)], [JCR, SNIP]



Univerza v Mariboru

Fakulteta za kemijo
in kemijsko tehnologijo

UČNI NAČRT PREDMETA / COURSE SYLLABUS

Predmet:	Kemijsko-tehniško poučevanje in učenje
Course title:	Chemical-technical teaching and learning

Študijski program in stopnja Study programme and level	Študijska smer Study field	Letnik Academic year	Semester Semester
Kemija in kemijska tehnika	Kemijska tehnika / Kemija	1.	Zimski
Chemistry and Chemical technics	Chemical Engineering / Chemistry	1.	Autumn

Vrsta predmeta / Course type

Temeljni /Basic

Univerzitetna koda predmeta / University course code:

Predavanja Lectures	Seminar Seminar	Sem. vaje Tutorial	Lab. vaje Laboratory work	Teren. vaje Field work	Samost. delo Individ. work	ECTS
10	10				430	15

Nosilec predmeta / Lecturer:

Majda Krajnc

**Jeziki /
Languages:**

Predavanja / Lectures: slovenski/ Slovene

Vaje / Tutorial: slovenski/Slovene

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

Študent mora obvladati angleški jezik, iskanje po spletu, uporabo programov za pisanje poročil in pripravo predavanj.

Prerequisites:

Student should be acquainted with english, searching on the internet and with the use of programs for writing reports and lecture preparation.

Vsebina:

Pri predmetu študentje usvojijo naslednja znanja in veščine:

- netradicionalne pristope poučevanja in učenja (aktivno, sodelovalno delo v skupinah, e-učenje),
- uporabo modernih tehnologij in pripomočkov pri poučevanju in učenju (e-učna okolja, internet, interaktivna multimedijška učna gradiva),
- razvoj kritičnih sposobnosti (pisanje poročil, priprava predavanj, učenje v delavnicah, mentorstvo, tutorstvo),

Content (Syllabus outline):

At the course students adopt the following knowledge and skills:

- nontraditional manners of teaching and learning (active, cooperative work in groups, e-learning),
- modern technologies and tools at teaching and learning (e-learning environments, internet, interactive multimedia learning material),
- critical skills development (writing reports, lecture preparation, learning in workshops, mentoring, tutoring),
- strategies of creative problems solving.

- strategije kreativnega reševanja problemov. Seminar: - izdelava seminarske naloge iz primerov uporabe netradicionalnih pristopov poučevanja in učenja.	Seminar: - elaboration of the seminary work from examples of nontraditional approaches of teaching and learning.
---	---

Temeljni literatura in viri / Readings:

1. Wankat P.C., The effective, efficient professor, Teaching, Scholarship and Service, Allyn and Bacon, Boston, 2002.
2. Krajnc M., Tehniško poučevanje in učenje, zbrano gradivo, 2012 (v izdelavi).

Dodatna priporočena literatura:

3. KRAJNC, Majda. E-learning environment integration in the chemical engineering educational process. *Int. j. eng. educ.*, 2009, vol. 25, no. 2, str. 349-357. http://www.ijee.ie/latestissues/Vol25-2/s18_ijee2119.pdf.
4. KRAJNC, Majda, LUKMAN, Rebeka. Izkušnje e-izobraževanja v študijskem procesu. *Kemija v šoli in družbi*, ISSN 1855-3478, feb. 2011, letn. 23, št. 1, str. 2-8.
5. KRAJNC, Majda. E-learning usage during chemical engineering courses. V: ANDERSON, Silva (ur.). *E-learning – engineering, on-job training and interactive teaching*. Rijeka: InTech, cop. 2012, str. 123-138. http://cdn.intechopen.com/pdfs/32045/InTech-E_learning_usage_during_chemical_engineering_courses.pdf.
6. E-učno/poučevalno okolje Moodle, <https://estudij.um.si> (dostop: 15. oktober 2014).
7. eXe – orodje za pripravo interaktivnih, multimedijskih e-gradiv, <http://www.exelearning.org/> (dostop: 15. oktober 2014)
8. TechSmith Corporation, TechSmith-Screen Capture and Recording Software, <http://www.techsmith.com> (dostop: 15. oktober 2014)

Cilji in kompetence:

- spoznati in osvojiti metode netradicionalnega izobraževanja ter
- osvojiti moderne tehnologije, ki izboljšajo in olajšajo delo v izobraževalnem procesu.

Objectives and competences:

- perceive and adopt nontraditional methods of education and
- adopt the technologies which improve and ease work in educational process.

Predvideni študijski rezultati:

Znanje in razumevanje:

- razumevanje in uporaba novih, naprednih metod poučevanja in učenja,
- razumevanje in uporaba elektronskih tehnologij za učinkovitejši študij,
- usvajanje veščin (komunikacija, reševanje problemov, pisanje poročil) aktivnega in sodelovalnega dela.

Intended learning outcomes:

Knowledge and understanding:

- understanding and use of new, progressive methods of teaching and learning,
- understanding and use of electronic technologies for efficient study,
- mastering the skills (communication, problem solving, writing reports) of active and cooperative work.

Metode poučevanja in učenja:

Learning and teaching methods:

- elektronski način poučevanja in učenja,
- mentorski način poučevanja.

- electronic manner of teaching and learning,
- mentoring manner of teaching.

Načini ocenjevanja:	Delež (v %) / Weight (in %)	Assessment:
Izpit je opravljen, če so pozitivno opravljene naslednje obveznosti: - ustno izpraševanje ali e-test, - ustni zagovor izdelane seminarske naloge.	50 % 50 %	Student passes the examination if s(he) successfully passed all the following obligations: - oral examination or e-test, - oral presentation of the prepared seminary work.

Reference nosilca / Lecturer's references:

TODORVIČ, Anita, KRAJNC, Majda, ZORIČ-VENUTI, Metka. Analiza kakovosti e-preverjanja znanja. V: KRAVANJA, Zdravko (ur.), BOGATAJ, Miloš (ur.), NOVAK-PINTARIČ, Zorka (ur.). *Slovenski kemijski dnevi 2014, Maribor, 11. - 12. september 2014*. Maribor: Fakulteta za kemijo in kemijsko tehnologijo, 2014, str. 1-7, ilustr.

LUKMAN, Rebeka, KRAJNC, Majda. Exploring non-traditional learning methods in virtual and real-world environments. *Educ. technol. soc.*, 2012, vol. 15, no. 1, str. 237-247. http://www.ifets.info/journals/15_1/21.pdf

KRAJNC, Majda. E-learning usage during chemical engineering courses. V: ANDERSON, Silva (ur.). *E-learning - engineering, on-job training and interactive teaching*. Rijeka: InTech, cop. 2012, str. 123-138. http://cdn.intechopen.com/pdfs/32045/InTech-E_learning_usage_during_chemical_engineering_courses.pdf

KRAJNC, Majda. Interactive, multimedia e-material usage in Chemical Engineering Courses. 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. 1-6.

KRAJNC, Majda, LUKMAN, Rebeka. Izkušnje e-izobraževanja v študijskem procesu. *Kemija v šoli in družbi*, ISSN 1855-3478, feb. 2011, letn. 23, št. 1, str. 2-8.

KRAJNC, Majda. E-learning environment integration in the chemical engineering educational process. *Int. j. eng. educ.*, 2009, vol. 25, no. 2, str. 349-357. http://www.ijee.ie/latestissues/Vol25-2/s18_ijee2119.pdf.



Univerza v Mariboru

Fakulteta za kemijo
in kemijsko tehnologijo

UČNI NAČRT PREDMETA / COURSE SYLLABUS

Predmet:	Načrtovanje (bio)reaktorskih sistemov
Course title:	Design of (bio)reactor systems

Študijski program in stopnja Study programme and level	Študijska smer Study field	Letnik Academic year	Semester Semester
Kemija in kemijska tehnika	Kemijska tehnika	1.	poletni
Chemistry and Chemical Engineering	Chemical Engineering	1.	Spring

Vrsta predmeta / Course type

Temeljni/ Basic

Univerzitetna koda predmeta / University course code:

Predavanja Lectures	Seminar Seminar	Sem. vaje Tutorial	Lab. vaje Laboratory work	Teren. vaje Field work	Samost. delo Individ. work	ECTS
10	10				430	15

Nosilec predmeta / Lecturer:

Andreja Goršek

Jeziki /

Predavanja / Lectures:

slovenski / Slovenian

Languages:

Vaje / Tutorial:

slovenski / Slovenian

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

Pogojev ni

Prerequisites:

None

Vsebina:

- analiza več-faznih (bio)reaktorskih sistemov
- struktura (bio)katalitskih reaktorjev
- sinteza integriranih kompleksnih (bio)reaktorskih sistemov
- modeliranje več-stopenjskih (bio)reaktorskih sistemov
- integracija kinetskih in termodinamskih modelov pri načrtovanju (bio)reaktorjev
- strategije zagona kontinuirnega obratovanja
- planiranje šaržnega obratovanja
- povečevalne metode
- vpliv nekonvencionalnih (bio)reakcijskih in procesnih pogojev na optimalno konfiguracijo (bio)reaktorskih

Content (Syllabus outline):

- Analysis of multiphase (bio)reactor systems
- Structure of (bio)catalytic reactors
- Synthesis of integrated complex (bio)reactor systems
- Modeling of multistage (bio)reactor systems
- Integration of kinetic and thermodynamic models in (bio)reactor design
- Start up strategies of continuous operation
- Scheduling of batch operation
- Scale up methods
- Influence of non-conventional (bio)reaction and process conditions on optimal configuration of (bio)reactor systems
- Innovative control strategies for batch and continuous

sistemov • napredne nadzorne strategije šaržnih in kontinuirnih (bio)reaktorjev • strategije načrtovanja (bio) reaktorskih poostretev • ekonomsko vrednotenje reaktorskih konfiguracij • študijski primeri trajnostnega načrtovanja (bio)reaktorskih sistemov Laboratorijske in seminarske vaje: • eksperimentalno določanje parametrov (bio)kinetskih in termodinamskih modelov • uporaba računalniških orodij pri načrtovanju kompleksnih (bio)reaktorskih sistemov • izdelava projekta načrtovanja industrijskega (bio)reaktorskega sistema	(bio)reactors • Design strategies for (bio)reactor intensification • Economic assessment of different reactor configurations • Case studies of sustainable (bio)reactor systems design Laboratory work and tutorial: • Experimental determination of parameters in (bio)kinetic and thermodynamic models • Use of computer tools in design of complex (bio)reactor systems • Project elaboration with design of industrial (bio)reactor system
---	--

Temeljni literatura in viri / Readings:

- U. Mann, Principles of chemical reactor analysis and design, New tools for industrial chemical reactor operations, A John Wiley & Sons, New Jersey, 2008.
- E.B. Nauman, Chemical reactor design, optimization and scaleup, A John Wiley & Sons, New Jersey, 2008.
- Primarna literatura (npr. članki) s tematiko glede na študentovo področje raziskovanja / Primary literature (e.g. papers) corresponding to the student's research interest.

Cilji in kompetence:

- celovito obvladovanje načrtovanja kompleksnih industrijskih več-faznih in/ali več-stopenjskih (bio)reaktorskih sistemov
- sposobnost analize in priprava strategije obratovanja industrijskih (bio)reaktorjev v pogojih negotovosti
- obvladovanje konceptov tehnološko-ekonomskega vrednotenja različnih konfiguracij (bio)reaktorskih sistemov

Objectives and competences:

- To gain an integral view on the design of complex industrial multiphase and/or multi-stage (bio)reactor systems
- Ability to analyse and preparing operation strategies of industrial bioreactors under uncertainty
- Mastering the concepts of technological and economical assessment of different bioreactor systems configurations

Predvideni študijski rezultati:

- Znanje in razumevanje:
- celovito razumevanje načrtovanja kompleksnih industrijskih (bio)reaktorskih sistemov
 - obvladovanje strategij obratovanja industrijskih bioreaktorjev v pogojih negotovosti
 - sposobnost določanja tehnološko-ekonomsko optimalnih konfiguracij (bio)reaktorskih sistemov

Prenesljive/ključne spretnosti in drugi atributi:

- oblikovanje kompleksnih odločitev za doseg najzahtevnejših ciljev
- priprava načrtov in strategij obratovanja najkompleksnejših časovno odvisnih in neodvisnih procesov
- vodenje projektne skupine za načrtovanje nalog v negotovih pogojih

Intended learning outcomes:

- Knowledge and Understanding:
- Integral understanding of the design of complex industrial (bio)reactor systems
 - Mastering the operation strategies of industrial (bio)reactors under uncertainty
 - Ability to determine technologically and economically optimal (bio)reactor systems configurations

Transferable/Key Skills and other attributes:

- Developing the complex decisions for realization of the most demanding goals
- Preparing the operation plans and strategies of the most complex time dependent and non-dependent processes
- Leading a project group for the design of tasks in uncertain conditions

Metode poučevanja in učenja:

- predavanja
- laboratorijske vaje
- priprava projektne naloge
- diskusija s predavateljem
- samostojnin študij

Learning and teaching methods:

- Lectures
- Laboratory work
- Preparation of project work
- Consultation with lecturer
- Independent study

Načini ocenjevanja:

Delež (v %) /
Weight (in %)

Assessment:

Izpit je opravljen, če so pozitivno opravljene vse naslednje obveznosti:		Student has to pass successfully the following obligations:
• izdelava projekta	80	• Project work report
• zagovor projektne naloge	20	• Project work presentation

Reference nosilca / Lecturer's references:

- VNUČEC, Doroteja, GORŠEK, Andreja, KUTNAR, Andreja, MIKULJAN, Marica. Thermal modification of soy proteins in the vacuum chamber and wood adhesion. *Wood science and technology*, ISSN 1432-5225, 2015, iss. 2, vol. 49, str. 225-239, ilustr. http://download.springer.com/static/pdf/998/art%253A10.1007%252Fs00226-014-0685-5.pdf?auth66=1424165536_29dddbd923722faa704d59f8c95cce04&ext=.pdf, doi: [10.1007/s00226-014-0685-5](https://doi.org/10.1007/s00226-014-0685-5). [COBISS.SI-ID [1536965572](#)], [JCR, SNIP]
2. LEŠER, Tadej, ANŽEL, Ivan, GORŠEK, Andreja. The use of water atomisation for the production of frits. *Metalurgija*, ISSN 0543-5846, 2015, vol. 54, no. 3, str. 485-488, ilustr. <http://pubweb.carnet.hr/metalurg/arhiva/848>. [COBISS.SI-ID [18353942](#)], [JCR, SNIP]
3. KRIŽAN, Janja, PETRINIČ, Irena, GORŠEK, Andreja, SIMONIČ, Marjana. Ultrafiltration of oil-in-water emulsion by using ceramic membrane : Taguchi experimental design approach. *Central European Journal of Chemistry*, ISSN 1895-1066, Feb. 2014, vol. 12, iss. 2, str. 242-249, ilustr., doi: [10.2478/s11532-013-0373-6](https://doi.org/10.2478/s11532-013-0373-6). [COBISS.SI-ID [17373718](#)], [JCR, SNIP]
4. PEČAR, Darja, GORŠEK, Andreja. Saponification reaction system : a detailed mass transfer coefficient determination. *Acta chimica slovenica*, ISSN 1318-0207. [Tiskana izd.], 2015, vol. 62, no. 1, str. 237-241. [COBISS.SI-ID [18583830](#)], [JCR, SNIP]
5. PEČAR, Darja, GORŠEK, Andreja. Oxidation of menthol : reaction-rate determination based on thermodynamic profiles. *Chemical engineering communications*, ISSN 0098-6445, 2014, vol. 201, iss. 11, str. 1548-1554. <http://www.tandfonline.com/doi/full/10.1080/00986445.2013.819353#.U6E-jU-KDq4>. [COBISS.SI-ID [17918998](#)], [JCR, SNIP]



Fakulteta za kemijo
in kemijsko tehnologijo

UČNI NAČRT PREDMETA / SUBJECT SPECIFICATION

Predmet:	Mikromreže in sistemska biologija
Subject Title:	Microarrays and systems biology

Študijski program Study programme	Študijska smer Study field	Letnik Year	Semester Semester
Kemija in kemijska tehnika Chemistry and Chemical Engineering	Kemija Chemistry	1.	zimski Autumn

Vrsta predmeta / Course type:

Izbirni/ Elective

Univerzitetna koda predmeta / University subject code:

Predavanja Lectures	Seminar Seminar	Sem. vaje Tutorial	Lab. vaje Labor work	Teren. vaje Field work	Samost. delo Individ. work	ECTS
10	10				430	15

Nosilec predmeta / Lecturer:

Uroš Potočnik

Jeziki /

Languages:

Predavanja / Lecture:

Vaje / Tutorial:

slovenski / Slovene

slovenski / Slovene

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

- pogojev ni

Prerequisites:

- None

Vsebina:

- statistična analiza ekspresijskih biočipov: načrtovanje eksperimenta, normalizacija, statistika primerjalne analize ekspresije dveh vzorcev, linearni modeli in njihova uporaba pri kompleksnih eksperimentih, kjer primerjamo gensko ekspresijo v dveh ali večih situacijah (npr. različni tretmaji celic), postopki za sestavljanje klastrov, validacija podatkov, funkcijsko vrednotenje z uporabo podatkovnih zbirk Gene ontology in DNA sekvenc
- proteinske mikromreže
- mikromreže za določanje genetskih polimorfizmov
- regulacija genske ekspresije z vezavo trans delujočih proteinov na cis delujoče regulatorna zaporedja, modifikacija histonov in remodulacija strukture kromatina
- alternativna transkripcija in procesiranje posameznih genov
- alelna specifična ekspresija: metilacija, DNA vtisnjevanje (imprinting), polimorfizmi v regulatornih zaporedjih
- transkriptomika
- kemija vezave molekul na površino, priprava biočipov (vezava cDNA in oligo nukleotidnih sond), uporaba mikromrež v diagnostiki, načrtovanju in razvoju novih zdravil

Content (Syllabus outline):

- statistical analysis of microarray data: experimental design, normalization issues, Two-sample statistics for differential expression (DE) and multiple testing issues, linear models and its application in analyzing complex gene expression experiments with two or more treatment comparisons, clustering algorithms, cross – validation, functional annotation using Gene Ontology and sequence information
- Protein microarrays
- Microarrays for analysis of DNA polymorphisms
- Regulation of gene expression: binding of trans-acting proteins to cis elements, modification of histones, chromatin remodeling
- Alternative transcription and gene processing
- Allele specific expression: DNA methylation, imprinting, SNPs in regulatory regions
- Transcriptomics
- Chemistry of binding to surface, preparation of microarrays (cDNA and oligo probes), application of microarray technology in diagnostics and in drug design and development

Seminar: podrobna vsebina seminarja se bo določila na osnovi dogovora z mentorjem in se bo nanašala na tematiko predmeta	Seminar: Detailed content of seminar will be determined on the basis of agreement with mentor and will be related to the subject
---	---

Temeljni literatura in viri / Textbooks:

- Statistical Analysis of Gene Expression Microarray Data edited by T.P. Speed. 2003. Chapman & Hall/CRC.
- Palsson, B. O.: Systems biology Properties of Reconstructed Networks. 2006, Cambridge University Press, Cambridge, UK.

Cilji:

- naučiti študenta uporabljati in analitično primerjati statistične metode za analizo podatkov pridobljenih z mikromrežami (biočipi)
- napredni pristopi analize bodo vključevali: procesiranje in normalizacijo rezultatov, linearni modeli, testiranje večih hipotez, sestavljanje klastrov, predikcija in funkcijsko ovrednotenje na osnovi genske ontologije in genomske sekvence

Objectives:

- To teach student use and evaluate a variety of statistical methods employed in the context of microarray data analysis
- Advanced analytical methods include: preprocessing/normalization, linear models, multiple hypothesis testing, clustering, discrimination, prediction and annotation with gene ontology and sequence information

Predvideni študijski rezultati:

Znanje in razumevanje:

- izvedba analize podatkov pridobljenih z ekspresijskimi mikromrežami
- odkrivanje in uporaba relevantnih virov (orodij bioinformatike in podatkov o genomu) za lastne analize
- analiza podatkov analiz z biočipi, ki so jih izvedli drugi raziskovalci

Prenesljive/ključne spretnosti in drugi atributi:

- načrtovanje študij z uporabo mikromrež

Intended learning outcomes:

Knowledge and Understanding:

- Perform microarray data analyses
- Identify and use relevant resources (genomic data and tools) for their own research
- Assess microarray data analyses performed by others.

Transferable/Key Skills and other attributes:

- Design studies using microarray technology

Metode poučevanja in učenja:

- predavanja
- seminar
- seminarska naloga

Learning and teaching methods:

- Lectures
- Seminar
- Seminar work

Načini ocenjevanja:

Izpit je opravljen, če so pozitivno opravljene vse naslednje obveznosti:

- seminarska naloga

Delež (v %) /

Weight (in %)

100

Assessment:

Student has to pass successfully the following obligations:

- Seminar work

Reference nosilca / Lecturer's references:

JOSTINS, Luke, MITROVIČ, Mitja, POTOČNIK, Uroš. Host-microbe interactions have shaped the genetic architecture of inflammatory disease. *Nature* (Lond.), 2012, vol. 491, no. 7422, str. 119-124, doi: 10.1038/nature11582. [COBISS.SI-ID 512230968],

BERCE, Vojko, PINTO KOZMUS, Carina, POTOČNIK, Uroš. Association among ORMDL3 gene expression, 17q21 polymorphism and response to treatment with inhaled corticosteroids in children with asthma. *Pharmacogenomics journal*, ISSN 1470-269X, Dec. 2013, vol. 13, issue 529. <http://www.nature.com/tpj/journal/vaop/ncurrent/full/tpj201236a.html>, doi: 10.1038/tpj.2012.36. [COBISS.SI-ID 4406079],

KODER, Silvo, REPNIK, Katja, FERKOLJ, Ivan, PERNAT DROBEŽ, Cvetka, SKOK, Pavel, WEERSMA, Rinse K., POTOČNIK, Uroš. Genetic polymorphism in ATG16L1 gene influences the response to adalimumab in Crohn's disease patients. *Pharmacogenomics*, ISSN 1462-3703, 2015, vol. 16, no. 3, str. 191-204, doi: [10.2217/pgs.14.172](https://doi.org/10.2217/pgs.14.172). [COBISS.SI-ID [512474168](#)],

FRANSEN, Karin, MITROVIČ, Mitja, POTOČNIK, Uroš, et al. Limited evidence for parent-of-origin effects in inflammatory bowel disease associated loci. *PloS one*, ISSN 1932-6203, 2012, vol. 7, iss. 9, str. 1-8, e45287. <http://www.plosone.org/article/info%3Adoi%2F10.1371%2Fjournal.pone.0045287>, doi: [10.1371/journal.pone.0045287](https://doi.org/10.1371/journal.pone.0045287). [COBISS.SI-ID [512221240](#)],

REPNIK, Katja, POTOČNIK, Uroš. Haplotype in the IBD5 region is associated with refractory Crohn's disease in Slovenian patients and modulates expression of the SLC22A5 gene. *J Gastroenterol*, 2011, vol. 46, no. 9, str. 1081-1091, doi: [10.1007/s00535-011-0426-6](https://doi.org/10.1007/s00535-011-0426-6). [COBISS.SI-ID [15110422](#)].



Fakulteta za kemijo
in kemijsko tehnologijo

UČNI NAČRT PREDMETA / SUBJECT SPECIFICATION

Predmet:	Projektiranje procesov
Subject Title:	Detailed process design

Študijski program Study programme	Študijska smer Study field	Letnik Year	Semester Semester
Kemija in kemijska tehnika Chemistry and Chemical Engineering	Kemijska tehnika Chemical Engineering	1.	zimski Autumn

Vrsta predmeta / Course type:

Temeljn/ Basic

Univerzitetna koda predmeta / University subject code:

Predavanja Lectures	Seminar Seminar	Sem. vaje Tutorial	Lab. vaje Labor work	Teren. vaje Field work	Samost. delo Individ. work	ECTS
10	10				430	15

Nosilec predmeta / Lecturer:

Peter Glavič

Jeziki /

Predavanja / Lecture: slovenski / Slovene

Languages:

Vaje / Tutorial: slovenski / Slovene

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

- pogojev ni

Prerequisites:

- None

Vsebina:

- sinteza procesov (taktika in strategija, reakcijske poti, zaporedja separatorjev, omrežja toplotnih prenosnikov, omrežja reaktorjev, procesni sistemi, vodenje procesov)
- procesne bilance (teoretične osnove, postavljanje bilanc, bilance procesnih enot, procesov in procesnih sistemov, računalniška podpora, formalno prikazovanje)
- modeliranje osnovnih operacij (transportna, mehanska, toplotna, termodifuzijska, reakcijska, regulacijska tehnika)
- načrtovanje procesov (analiza, sinteza, odločanje, strukturno in parametrično optimiranje, ocenjevanje stroškov, analiza občutljivosti, izbira med alternativami, varnost procesov, dispozicija naprav, pogonska sredstva)
- termodinamska analiza procesov (uščip: vodni, vodikovi, omrežja masnih menjalnikov idr.)
- kombinacija termodinamskih in matematičnih metod optimiranja
- trajnostni vidiki načrtovanja (okoljski, ekonomski, družbeni)
- organizacija projektiranja (faze in postopek)

Content (Syllabus outline):

- Process synthesis (tactics, strategy, reaction pathways, separators sequencing, heat exchanger networks, process systems, process control)
- Process balances (theory, balancing, software support, formal design)
- Modelling of process operations (transports, mechanical, thermal, thermo-diffusion, reaction, and control engineering)
- Process design (analysis, synthesis, decision making, structural and parameter optimization, cost estimation, sensitivity analysis, selection between alternatives, process safety, equipment layout, utilities)
- Thermodynamic analysis of processes (pinch: thermal, water, hydrogen). Heat and mass exchanger networks
- Combination of thermodynamic and mathematical optimization methods. Sustainable approach to process design (environmental, economic, social components)
- Project organization (design phases, procedure, techniques, detailed engineering)

načrtovanja, tehnika projektiranja, izvedbeno načrtovanje)

Seminar:

- projektna naloga obsega detaljni študij izbranih poglavij s praktičnim primerom uporabe pridobljenega znanja

Seminar:

- Project includes a detailed study of selected chapters and a practical case study in which the theoretical approach is carried out practically

Temeljni literatura in viri / Textbooks:

- R. Turton et al., Analysis, Synthesis, and Design of Chemical Processes, Prentice Hall, Upper Saddle River, 2002.
- R. Smith, Chemical Process Design and Integration, McGraw-Hill, New York, 2005.
- C. Dimian and C. S. Bildea, Chemical Process Design, Wiley-VCH, Weinheim, 2008.
- R. C. Reid, J. M. Prausnitz, T.K. Sherwood, The Properties of Gases and Liquids, McGraw-Hill, New Towards the circular economy, Ellen McArthur Foundation, 2012.
- Handbook of process integration, J. Klemes (Ed.), Woodhead Publishing, Cambridge, 2013.
- A. E. Marteel-Parrish, M. A. Abraham, Green Chemistry and Engineering, Wiley, 2013.

Cilji:

- Projektiranje procesnih sistemov je postopek določanja optimalnih povezav procesnih enot ter optimalnega izbora in dimenzioniranja enot v procesnem sistemu. Služatelj spozna določanje ciljev sistema, kriterijev za njegovo ovrednotenje in izbiro poti za doseganje cilja (snovanje procesa). Problem je možno razčleniti v vrsto med seboj povezanih opravil, ki jih študent izvede v okviru izbrane tehnologije (projektiranje procesa).

Objectives:

- Process systems design is a procedure to determine optimal connections between process units, and to select and rate the process units of the process system. The student becomes familiar with the process systems goals, criteria for its evaluation, and choice of the path to achieve the goal (conceptual process design). The problem can be decomposed into a series of interconnected tasks, which can be integrated in the particular process as a case study.

Predvideni študijski rezultati:

Znanje in razumevanje:

- sistemski pristop k načrtovanju z upoštevanjem kompleksnosti, medsebojnega vplivanja in integracije
- študent se nauči prilagajati spreminjajočim se tehnologijam in novim tehnikam, sodelovanju z industrijo

Prenesljive/ključne spretnosti in drugi atributi:

- sporočanje informacij, zamisli, problemov in njihovih rešitev
- učinkovito delovanje v projektnih skupinah
- razumevanje vpliva tehniških aktivnosti na ekonomiko, družbo in okolje

Intended learning outcomes:

Knowledge and Understanding:

- System approach to design appreciating complexity, interaction and integration
- Adapt the student to changing technology and new techniques
- A greater extent of involvement with industry

Transferable/Key Skills and other attributes:

- Communicate information, ideas, problems, and the solutions
- Function efficiently in project groups and teamwork
- Understanding of influence of engineering activity on the economics, society and environment

Metode poučevanja in učenja:

- predavanja
- seminar
- seminarska naloga

Learning and teaching methods:

- Lectures
- Seminar
- Seminar work

Načini ocenjevanja:

Delež (v %) /
Weight (in %)

Assessment:

Izpit je opravljen, če so pozitivno opravljene vse naslednje obveznosti:

- seminarska naloga
- pisni izpit
- ustni izpit

60
20
20

Student has to pass successfully the following obligations:

- Seminar work
- Written examination
- Oral examination

Reference nosilca / Lecturer's references:

J. Petek, P. Glavič and A. Kostevšek, Total Site Cleaner production – Energy Efficiency – Optimisation Approach Based on In-depth Analyses of Versatile Industrial Practices, 17th European Roundtable on Sustainable Consumption and Production, ERSCP 2014, Nigrad, Portorož, 14.–16. 10. 2014, *Conference Proceedings*, 1041–1062, ISBN 978-961-93738-1-1.

Glavič P., Bogataj M., *Water Networks – Theory and Practice*, September 13–15, 2010. In: A. T. Atimtay and S. K. Sikdar (eds.), *Security of Industrial Water Supply and Management*, NATO science for Peace and Security Series C: Environmental Security, Springer, Dordrecht, 2011, ISBN 978-007-1867-8, pp. 13–30.

H. Tokos, Z. Novak Pintarič, P. Glavič, Energy saving opportunities in heat integrated beverage plant retrofit, *Applied Thermal Engineering* **30**, 36–44 (2010), ISSN 1359-4311.

A. Kovač Kralj, P. Glavič, Multi-criteria optimization of a methanol process, *Applied Thermal Engineering* **29**, 1043–1495 (2009), ISSN 1359-4311.

D. Krajnc, P. Glavič, Assessment of different strategies for the co-production of bioethanol and beet sugar, *Chem. Eng. Res. Des.* **87**, 1217–1231 (2009), ISSN 0263-8762.



Univerza v Mariboru

Fakulteta za kemijo
in kemijsko tehnologijo

UČNI NAČRT PREDMETA / COURSE SYLLABUS

Predmet:	Računalniške simulacije termodinamskih lastnosti
Course title:	Computer simulations of thermodynamic properties

Študijski program in stopnja Study programme and level	Študijska smer Study field	Letnik Academic year	Semester Semester
Kemija in kemijska tehnika, 3. stopnja	Kemija	1.	zimski
Chemistry and Chemical Technology, 3rd level	Chemistry	1.	Autumn

Vrsta predmeta / Course type

Temeljni / Basic

Univerzitetna koda predmeta / University course code:

Predavanja Lectures	Seminar Seminar	Sem. vaje Tutorial	Lab. vaje Laboratory work	Teren. vaje Field work	Samost. delo Individ. work	ECTS
10	10				430	15

Nosilec predmeta / Lecturer:

Urban Bren

Jeziki /

Predavanja / Lectures: slovenski / Slovene

Languages:

Vaje / Tutorial: slovenski / Slovene

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

Osnovno znanje fizikalne kemije, molekularnega modeliranja, statistične termodinamike ter strukture atomov in molekul

Prerequisites:

Basic knowledge of physical chemistry, of molecular modeling, of statistical thermodynamics and of structure of atoms and molecules

Vsebina:

Content (Syllabus outline):

- 1) Solvatacijska prosta energija in vezavna prosta energija. Povezava s koeficientom porazdelitve ter s konstanto inhibicije. Termodinamski cikli. Prostoenergijska perturbacija. Termodinamska integracija. Metoda počasne rasti. Razčlemba proste energije. Empirične metode: Linearna interakcijska enegija, Aproksimacija linearnega odziva, Molecular Mechanics/Poisson Boltzmann Surface Area MM/PBSA, Molecular Mechanics/Generalized Born Surface Area MM/GBSA.
- 2) Aktivacijska prosta energija in povezava s konstanto reakcijske hitrosti. Kvantnomehanski izračuni. Vibracijski popravek in solvatacijski popravek. Metoda empirične valenčne vezi.
- 3) Ostale termodinamske lastnosti: entalpija, entropija, specifična toplota, stisljivost.
- 4) Metode ojačenega vzorčenja redkih dogodkov.

- 1) Solvation free energy and binding free energy. Relation to partition coefficient and to inhibition constant. Thermodynamic cycles. Free Energy Perturbation (FEP). Thermodynamic Integration (TI). Slow Growth. Free energy decomposition. Empirical methods: Linear Interaction Energy (LIE), Linear Response Approximation (LRA), Molecular Mechanics/Poisson Boltzmann Surface Area MM/PBSA, Molecular Mechanics/Generalized Born Surface Area MM/GBSA.
- 2) Activation free energy and relation to reaction rate constant. Quantum calculations. Zero-point energy correction, solvation free energy correction. Empirical Valence Bond (EVB) method.
- 3) Other thermodynamic properties: enthalpy, entropy, specific heat, compressability.
- 4) Enhanced sampling techniques of rare events.

Temeljni literatura in viri / Readings:

A.R. Leach, Molecular Modelling, Principles and Applications, 2nd edition, Pearson Education Limited, Harlow: 2001.

A. Warshel, Computer Modeling of Chemical Reactions in Enzymes and Solutions, Wiley, 1997.

Cilji in competence:

Cilji:

Predmet nudi uvod v termodinamske simulacije na osnovi molekulske dinamike ter kvantne mehanike.

Kompetence:

Termodinamske simulacije omogočajo izračun pomembnih količin kot so kontanta inhibicije, koeficient porazdelitve ter konstanta reakcijske hitrosti, ki jih lahko preverjamo z eksperimentalnimi metodami.

Objectives and competences:

Objectives:

This course provides an introduction to thermodynamic simulations using molecular dynamics and quantum mechanics.

Competences:

Thermodynamic simulations give access to important properties like inhibition constants, partition coefficients and reaction-rate constants, that can be also accessed by experimental means.

Predvideni študijski rezultati:

Znanje in razumevanje:

Predmet je namenjen nadgradnji znanja klasične in kvantne termodinamike ter njeni praktični uporabi. Študente seznani s pojmom termodinamskih simulacij, ki so že dalj časa močno orodje za pomoč eksperimentalistom, saj omogočajo vpogled na nekatera eksperimentom nedostopna področja znanosti. Ob koncu so sposobni formulirati problem, izbrati primerno metodo simulacij in kritično ovrednotiti dobljene rezultate. Pomembno je potem tudi iskanje korespondence med dobljenimi

Intended learning outcomes:

Knowledge and Understanding:

This course is designed to upgrade the knowledge of quantum and classical thermodynamics and its practical application. During this course the students will be introduced to thermodynamic simulation methods and principles. Thermodynamic simulations became an excellent tool that serves as support to experimentalist for better understanding of fundamental and applicative science. At the end of the course, students will be able to formulate a problem, to select and to set up a proper

teoretičnimi in izmerjenimi ali v literaturi poiskanimi rezultati.

Uporaba:
 Slušatelj je sposoben uporabiti znanje klasične in kvantne termodinamike za modeliranje danega kemijskega ali biokemijskega problema, komercialne računalniške programske sisteme s tega področja mu ni več potrebno uporabljati kot "black box", zaradi česar lahko tudi mnogo bolj kompetentno razlaga dobljene rezultate.

Refleksija:
 Študent si pridobi občutek, da se lahko v primeru nepremostljivih eksperimentalnih težav še vedno zateče k računu, kjer so problemi drugačni in navadno drugače, kar pogosto privede do zadovoljive razjasnitve termodinamskega problema.

Prenosljive spretnosti:
 Pri predmetu se študenti naučijo prepoznavati problem, ga prevesti v matematično obliko, rešiti in na koncu interpretirati rezultate. Poseben poudarek je na kritičnem ovrednotenju dobljenih rezultatov. Naučijo se uporabe domače in tuje literature ter podajanja zaključenega dela v pisni obliki.

thermodynamic simulation technique, and also to evaluate the obtained results critically. They will be also able to compare the experimental data either from literature and/or laboratory with the data resulted from thermodynamic simulation approach.

Application:
 The student is able to use quantum and classical thermodynamic knowledge for modeling of certain chemical or biochemical problems. The background that the student obtains in the course transforms her/him into an advanced user of thermodynamic simulation software. They are able to competently interpret thermodynamic simulation results.

Analysis:
 The information from the computational experiment are often complementary to those obtained from laboratory experiment. The proper combination of laboratory and chemical simulations often leads to a more relevant description of the thermodynamic problem.

Skill-Transference Ability:
 In this course the students are able to recognize a problem, to transform it to a mathematical form, to solve the problem and at the end to interpret the results. The critical evaluation of the results is one of the most important skills that students learn during the course. At the end of the course the students know how to write a scientific report and to give a scientific presentation.

Metode poučevanja in učenja:

Predavanja
 Seminar
 Praktične vaje na računalniku

Learning and teaching methods:

Lectures
 Seminars
 Practicle exercises using computers

Načini ocenjevanja:	Delež (v %) / Weight (in %)	Assessment:
Seminarska naloga	100	Seminar work

Reference nosilca / Lecturer's references:

UDOMMANEETHANAKIT, Thanyarat, RUNGROTMONGKOL, Thanyada, FRECEER, Vladimir, SENECE, Pierfausto, STANISLAV, Miertus, BREN, Urban. Drugs against avian influenza A virus : design of novel sulfonate inhibitors of neuraminidase N1. *Current pharmaceutical design*, ISSN 1381-6128, 2014, vol. 20, issue 21, str. 3478-3487. <http://www.eurekaselect.com/114879/article>, doi: [10.2174/13816128113199990629](https://doi.org/10.2174/13816128113199990629). [COBISS.SI-ID 5396250], [JCR, SNIP, WoS do 4. 8. 2014: št. citatov (TC): 1, čistih citatov (CI): 1, normirano št. čistih citatov (NC): 0, Scopus do 22. 7. 2014: št. citatov (TC): 1, čistih citatov (CI): 1, normirano št. čistih citatov (NC): 0]

GRAF, Michael, BREN, Urban, HALTRICH, Dietmar, OOSTENBRINK, Chris. Molecular dynamics simulations give insight into D-glucose dioxidation at C [sub] 2 and C [sub] 3 by Agaricus meleagris pyranose dehydrogenase. *Journal of computer-aided molecular design*, ISSN 0920-654X, 2013, vol. 27, iss. 4, str. 295-304, ilustr., doi: [10.1007/s10822-013-9645-7](https://doi.org/10.1007/s10822-013-9645-7). [COBISS.SI-ID 5218330], [JCR, SNIP, WoS do 4. 6. 2014: št. citatov (TC): 3, čistih citatov (CI): 3, normirano št. čistih citatov (NC): 2, Scopus do 28. 5. 2014: št. citatov (TC): 3, čistih citatov (CI): 3, normirano št. čistih citatov (NC): 2]

BREN, Urban, OOSTENBRINK, Chris. Cytochrome P450 3A4 inhibition by ketoconazole : tackling the problem of ligand

cooperativity using molecular dynamics simulations and free-energy calculations. *Journal of chemical information and modeling*, ISSN 1549-9596. [Print ed.], 2012, vol. 52, issue 6, str. 1573-1582.
<http://pubs.acs.org/doi/abs/10.1021/ci300118x>, doi: [10.1021/ci300118x](https://doi.org/10.1021/ci300118x). [COBISS.SI-ID [4965658](#)], [JCR, SNIP, WoS do 3. 9. 2014: št. citatov (TC): 15, čistih citatov (CI): 13, normirano št. čistih citatov (NC): 10, Scopus do 20. 8. 2014: št. citatov (TC): 15, čistih citatov (CI): 13, normirano št. čistih citatov (NC): 42]

BREN, Urban, JANEŽIČ, Dušanka. Individual degrees of freedom and the solvation properties of water. *The Journal of chemical physics*, ISSN 0021-9606, 2012, vol. 137, iss. 2, str. 024108-1-024108-11.
http://jcp.aip.org/resource/1/jcpsa6/v137/i2/p024108_s1?isAuthorized=no. [COBISS.SI-ID [5014554](#)], [JCR, SNIP, WoS do 4. 8. 2014: št. citatov (TC): 10, čistih citatov (CI): 9, normirano št. čistih citatov (NC): 4, Scopus do 13. 8. 2014: št. citatov (TC): 12, čistih citatov (CI): 11, normirano št. čistih citatov (NC): 5]

BREN, Matevž, JANEŽIČ, Dušanka, BREN, Urban. Microwave catalysis revisited : an analytical solution. *The journal of physical chemistry. A, Molecules, spectroscopy, kinetics, environment, & general theory*, ISSN 1089-5639, 2010, vol. 114, iss. 12, str. 4197-4202, ilustr. [COBISS.SI-ID [1851882](#)], [JCR, SNIP, WoS do 8. 7. 2014: št. citatov (TC): 6, čistih citatov (CI): 5, normirano št. čistih citatov (NC): 3, Scopus do 12. 8. 2014: št. citatov (TC): 6, čistih citatov (CI): 5, normirano št. čistih citatov (NC): 3]



Fakulteta za kemijo
in kemijsko tehnologijo
BIOCATALYSIS

UČNI NAČRT PREDMETA / COURSE SYLLABUS

Predmet:	Biokataliza
Course title:	Biocatalysis

Študijski program in stopnja Study programme and level	Študijska smer Study field	Letnik Academic year	Semester Semester
Kemija in kemijska tehnika	Kemija	1.	zimski
Chemistry and Chemical Engineering	Chemistry	1	Autumn

Vrsta predmeta / Course type

Temeljni/ Basic

Univerzitetna koda predmeta / University course code:

Predavanja Lectures	Seminar Seminar	Sem. vaje Tutorial	Lab. vaje Laboratory work	Teren. vaje Field work	Samost. delo Individ. work	ECTS
10	10				430	15

Nosilec predmeta / Lecturer:

Maja Leitgeb

Jeziki /

Predavanja / Lectures:

slovenski / Slovene

Languages:

Vaje / Tutorial:

slovenski / Slovene

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

Pogojev ni

Prerequisites:

None

Vsebina:

- stabilnost imobiliziranih in neimobiliziranih biokatalizatorjev v vodnem mediju, ionskih tekočinah ter organskih in superkritičnih medijih
- nekonvencionalni mediji za biokatalizirane reakcije: organski mediji, sub- in superkritični mediji, reverzni miceli, ionske tekočine in njihova primerjava z vodnimi mediji
- biokatalizirane reakcije v sistemih brez topil
- reakcijski parametri, ki vplivajo na biokatalizo v nekonvencionalnih medijih
- imobilizacija biokatalizatorjev na različne nosilce: membrane, solgeli, monoliti, magnetni nano-delci

Seminarske vaje:

- študija na primeru uporabe različnih topil za biokatalizirane reakcije
- priprava različnih nosilcev za imobilizacijo biokatalizatorjev

Content (Syllabus outline):

- Stability of immobilized and non-immobilized biocatalysts in aqueous medium, in ionic liquids and in organic, as well as supercritical media
- Unconventional media for biocatalyzed reactions: organic media, sub- and supercritical media, reversed micelles, ionic liquids and their comparison with aqueous media
- Biocatalytic reactions in non-solvent systems
- Reaction parameters, which influence biocatalysis in nonconventional media
- Immobilization of biocatalysts on different supports: membranes, sol-gels, monolys, magnetic nano-particles

Seminar work:

- Study of the use of different solvents for biocatalyzed reactions
- Different carriers preparation for immobilization of biocatalysts

Temeljni literatura in viri / Readings:

- A.S. Bommarius, B.R. Riebel, Biocatalysis. Wiley-VCH, Weinheim, 2004.
- P.G. Jessop, W. Leitner, Chemical Synthesis Using Supercritical Fluids, Wiley-VCH, Weinheim, online 2007.
- P. Wasserscheid, T. Welton, Ionic Liquids in Synthesis, 2nd ed., Wiley-VCH, Weinheim, 2007.
- Primarna literatura (npr. članki) s tematiko glede na študentovo področje raziskovanja / Primary literature (e.g. papers) corresponding to the student's research interest.

Cilji in kompetence:

- poglobljena znanja s področja biokatalize v nekonvencionalnih medijih
- usvojitev načrtovanja biokataliziranih reakcij v različnih medijih
- pregled uporabe različnih nosilcev za imobilizacijo biokatalizatorjev

Objectives and competences:

- Deep knowledge in the field of biocatalysis in nonconventional media
- Adoption of the design of biocatalytic reactions in different media
- Overview of the use of different carriers for biocatalysts immobilization

Predvideni študijski rezultati:

Znanje in razumevanje:

- poznavanje biokatalize v nekonvencionalnih medijih
- znanja iz načrtovanja biokataliziranih reakcij v različnih medijih
- sposobnost priprave imobiliziranih biokatalizatorjev na različne nosilce
- znanja o uporabi imobiliziranih biokatalizatorjev

Prenesljive/ključne spretnosti in drugi atributi:

- sposobnost uvajanja trajnostne kemije
- načrtovanje izvedbe biokataliziranih reakcij v nekonvencionalnih medijih
- načrtovanje in izvajanje zahtevnejših nalog

Intended learning outcomes:

Knowledge and Understanding:

- Understanding of biocatalysis in nonconventional media
- Knowledge of the design of biocatalytical reactions in different media
- Ability to prepare immobilized biocatalysts on different carriers
- Knowledge about the use of immobilized biocatalysts

Transferable/Key Skills and other attributes:

- Ability to introduce sustainable chemistry
- Design of performance of biocatalysed reactions in nonconventional media
- Designing and performing of exacting piece of work

Metode poučevanja in učenja:

- predavanja v učilnici, ki je opremljena z avdio-vizualnimi pripomočki
- samostojni študij
- individualna priprava seminarских nalog s predstavitvijo in diskusijo

Learning and teaching methods:

- Lectures in a lecture room, equipped with audio-visual equipment
- Independent study
- Individual preparation of seminars and their presentation with discussion

Načini ocenjevanja:

Izpit je opravljen, če so pozitivno opravljene vse naslednje obveznosti:

- ustni izpit
- seminarska naloga

Delež (v %) /
Weight (in %)

50%
50%

Assessment:

Student has to pass successfully the following obligations:

- Oral examination
- Seminar work

Reference nosilca / Lecturer's references:

LEITGEB, Maja, ČOLNIK, Maja, PRIMOŽIČ, Mateja, ZALAR, Polona, GUNDE-CIMERMAN, Nina, KNEZ, Željko. Activity of cellulase and [alpha]-amylase from *Hortaea werneckii* after cell treatment with supercritical carbon dioxide. *The Journal of supercritical fluids*, ISSN 0896-8446. 2013, 78, 143-148, doi: [10.1016/j.supflu.2013.03.029](https://doi.org/10.1016/j.supflu.2013.03.029). [COBISS.SI-ID 16864790]

ČOLNIK, Maja, PRIMOŽIČ, Mateja, KNEZ, Željko, LEITGEB, Maja. Use of supercritical carbon dioxide for proteins and alcohol dehydrogenase release from yeast *Saccharomyces cerevisiae*. *The Journal of supercritical fluids*, ISSN 0896-8446. 2012, 65, 11-17, doi: [10.1016/j.supflu.2012.02.018](https://doi.org/10.1016/j.supflu.2012.02.018). [COBISS.SI-ID [15901462](#)]

LEITGEB, Maja, HERŽIČ, Katja, HOJNIK PODREPŠEK, Gordana, HOJSKI, Aljaž, CRNJAC, Anton, KNEZ, Željko. Toxicity of magnetic chitosan micro and nanoparticles as carriers for biologically active substances. *Acta chimica slovenica*, ISSN 1318-0207. [Tiskana izd.], 2014, vol. 61, no. 1, str. 145-152, ilustr. <http://acta.chem-soc.si/61/61-1-145.pdf>. [COBISS.SI-ID [4955199](#)]

KNEZ, Željko, KAVČIČ, Sabina, GUBICZA, László, BÉLAFI-BAKÓ, Katalin, NÉMETH, Gergely, PRIMOŽIČ, Mateja, LEITGEB, Maja. Lipase-catalyzed esterification of lactic acid in supercritical carbon dioxide. *The Journal of supercritical fluids*, ISSN 0896-8446. [Print ed.], Jun. 2012, vol. 66, str. 192-197, doi: [10.1016/j.supflu.2011.11](https://doi.org/10.1016/j.supflu.2011.11). [COBISS.SI-ID [15598102](#)]

ŠULEK, Franja, PÉREZ FERNÁNDEZ, Daniel, KNEZ, Željko, LEITGEB, Maja, SHELDON, Roger A. Immobilization of horseradish peroxidase as crosslinked enzyme aggregates (CLEAs). *Process biochemistry*, ISSN 1359-5113, 2011, vol. 46, iss. 3, str. 765-769, doi: [10.1016/j.procbio.2010.12.001](https://doi.org/10.1016/j.procbio.2010.12.001). [COBISS.SI-ID [14712598](#)]



Univerza v Mariboru

Fakulteta za kemijo
in kemijsko tehnologijo

UČNI NAČRT PREDMETA / COURSE SYLLABUS

Predmet:	Optični kemijski senzorji
Course title:	Optical Chemical Sensors

Študijski program in stopnja Study programme and level	Študijska smer Study field	Letnik Academic year	Semester Semester
Kemija in kemijska tehnika, 3.stopnja	Kemija	1. / 2.	poletni /zimski
Chemistry and Chemical Engineering, 3rd level	Chemistry	1. / 2.	Spring/ Autumn

Vrsta predmeta / Course type

Izbirni/Elective

Univerzitetna koda predmeta / University course code:

Predavanja Lectures	Seminar Seminar	Sem. vaje Tutorial	Lab. vaje Laboratory work	Teren. vaje Field work	Samost. delo Individ. work	ECTS
10	10				430	15

Nosilec predmeta / Lecturer:

Aleksandra Lobnik

Jeziki /

Predavanja / Lectures:

slovenski / Slovene

Languages:

Vaje / Tutorial:

slovenski / Slovene

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

pogojev ni

Prerequisites:

None

Vsebina:

- uvod v senzorske sisteme in njihova in definicija
- kemija indikatorjev
- pregled najpomembnejših polimernih nosilcev optičnih kemijskih senzorjev, ki se uporabljajo pri detekciji različnih analitov (plinov, ionov).
- pregled najpomembnejših indikatorskih barvil (pH indikatorji, lantanidni kelati, ionoforji, kromoionoforji, itd.)
- imobilizacijske metode (elektrostatska vezava, kovalentna vezava, doping metoda, itd.)
- molekularno imprintani senzorski sistemi za

Content (Syllabus outline):

- Introduction to sensor systems and their definition
- Indicator chemistry
- Review of most important polymer matrixes used in optical chemical sensors which are used by different analyte detection (gases, ions)
- Overview of the most important indicator dyes
- (pH indicator dyes, lanthanides chelates, ionophores, chromionophores, etc.)
- Immobilization methods (electrostatic, covalent, doping methods, etc.)
- Molecular imprinted polymers as sensors for toxic

toksične analite (kovalentna in elektrostatska vezava, polimerni matriksi, analiti, primeri) • optični kemijski senzorji in optična vlakna za in-situ in on-line detekcijo • mikro in nano senzorji • primeri optičnih kemijskih senzorjev in njihova aplikacija v ekologiji, kliniki, procesnih tehnologijah, osebni zaščiti, obrambi, itd.	analytes (covalent and electrostatic binding, polymer matrices, analyt, examples) • Optical chemical sensors and optical fibres for in-situ, on-line detection • Micro and nano sensors • Examples of optical chemical sensors and their applications in ecology, clinics, process technologies, personal safety, defence, etc.
<u>Seminar:</u> • podrobna vsebina seminarja se bo določila na osnovi dogovora z mentorjem in se bo nanašala na tematiko predmeta	<u>Seminar:</u> • Detailed content of seminar will be determined on the basis of agreement with mentor and will be related to the subject

Temeljni literatura in viri / Readings:

- O. S. Wolfbeis (ed.), Fiber Optic Chemical Sensors and Biosensors, Vols. I and II, CRC Press, Boca Raton, 1991.
- W. Göpel, J. Hesse, J. N. Zemel (eds.), Sensors - A Comprehensive Survey, VCH, Weinheim, 1991-1993.
- Primarna literatura (npr. članki) s tematiko glede na študentovo področje raziskovanja / Primary literature (e.g. papers) corresponding to the student's research interest.

Cilji in kompetence:

- uvod v optične senzorske sisteme za detekcijo plinov, ionov na različnih področjih uporabe
- osvojiti načrtovanje novega senzorskega sistema
- za točno določen vzorec
- prepoznati možnost uporabe optičnega senzorskega sistema v realnem okolju
- razširiti svoje znanje s področja instrumentalne analize na in-situ, on-line mikro in nano senzorske sisteme

Objectives and competences:

- Introduction to optical chemical sensors for gas and ion detection in different area of applications
- To gain planning of specific sensors system for determinate analyte
- To identify possibility to use optical chemical sensors in real environment
- To widen knowledge from instrumental analytics to in-situ, on-line sensor micro and nano systems

Predvideni študijski rezultati:

Znanje in razumevanje:

- celovito razumevanje senzorjev
- razvijanje novih senzorskih sistemov
- testiranje in karakterizacija novih senzorskih sistemov
- prepoznavanje potrebe po razvoju novih

Prenesljive/ključne spretnosti in drugi atributi:

- sistemih detektiranja in možnosti uporabe optičnih senzorskih sistemov
- uvajanje novih senzorskih sistemov na področju ekologije, osebnega varstva, procesnih tehnologij, kliniki.

Intended learning outcomes:

Knowledge and understanding:

- Integral understanding of sensors
- Development of new sensor systems
- Testing and characterization of new sensor systems

Transferable/Key skills and other attributes:

- Recognition of the need for development of new detection systems and possible application of optical chemical sensor systems
- Introduction of new optical chemical sensors in the area of ecology, personal safety, process technology, clinics

Metode poučevanja in učenja:

- predavanja
- seminar
- seminarska naloga

Learning and teaching methods:

- Lectures
- Seminar
- Seminar work

Načini ocenjevanja:

Delež (v %) /
Weight (in %)

Assessment:

Način (pisni izpit, ustno izpraševanje, naloge, projekt) Izpit je opravljen, če so pozitivno opravljene vse naslednje obveznosti: • pisni izpit • seminarska naloga	70 30	Type (examination, oral, coursework, project): Student has to pass successfully the following obligations: • Written examination • Seminar work
---	--------------------------------	---

Reference nosilca / Lecturer's references:

FRANČIČ, Nina, BELLINO, Martin G., SOLER ILLIA, Galo, LOBNIK, Aleksandra. Mesoporous titania thin films as efficient enzyme carriers for paraoxon determination/detoxification: effects of enzyme binding and pore hierarchy in biocatalyst activity and reusability. *Analyst*, ISSN 0003-2654, 2014, vol. 139, iss. 12, str. 3127 - 3136. <http://pubs.rsc.org/en/content/articlelanding/2014/an/c4an00152d#ldivAbstract>, doi: [10.1039/C4AN00152D](https://doi.org/10.1039/C4AN00152D). [COBISS.SI-ID [17536790](https://cobiss.si/17536790)]

WIDMER, Susanne, DORRESTIJN, Marko, CAMERLO, Agathe, KORENT UREK, Špela, LOBNIK, Aleksandra, HOUSECROFT, Catherine E., CONSTABLE, Edwin C., SCHERER, Lukas J. Coumarin meets fluorescein: a Förster resonance energy transfer enhanced optical ammonia gas sensor. *Analyst*, ISSN 0003-2654, 28 Jul. 2014, vol. 139, iss. 17, str. 4335-4342. <http://www.ncbi.nlm.nih.gov/pubmed/25004956>, doi: [10.1039/c4an00061g](https://doi.org/10.1039/c4an00061g). [COBISS.SI-ID [18048278](https://cobiss.si/18048278)]

LOBNIK, Aleksandra, KORENT UREK, Špela, TUREL, Matejka. Quantum dots based optical sensors. V: 7th International Conference on Diffusion in Solids and Liquids, Mass Transfer - Heat Transfer - Microstructure & Properties - Nanodiffusion and Nanostructured Materials (DSL 2011), June 26 - 30, 2011, Algarve, Portugal. ÖCHSNER, Andreas (ur.). *Diffusion in solids and liquids VII : selected, peer reviewed papers from the 7th International Conference on Diffusion in Solids and Liquids, Mass Transfer - Heat Transfer - Microstructure & Properties - Nanodiffusion and Nanostructured Materials (DSL 2011), June 26 - 30, 2011, Algarve, Portugal*, (Defect and Diffusion Forum, ISSN 1012-0386, Vol. 326-328, 2012). Zurich: Trans Tech Publications, cop. 2012, str. 682-689, doi: [10.4028/www.scientific.net/DDF.326-328.682](https://doi.org/10.4028/www.scientific.net/DDF.326-328.682). [COBISS.SI-ID [15972118](https://cobiss.si/15972118)]
tipologija 1.08 -> 1.01

FRANČIČ, Nina, KOŠAK, Aljoša, LYAGINI, Ilya V., EFREMENKO, Elena N., LOBNIK, Aleksandra. His[₆]-OPH enzyme-based bio-hybrid material for organophosphate detection. *Analytical and bioanalytical chemistry*, ISSN 1618-2642, 2011, vol. 401, no. 8, str. 2631-2638, doi: [10.1007/s00216-011-5336-1](https://doi.org/10.1007/s00216-011-5336-1). [COBISS.SI-ID [15269398](https://cobiss.si/15269398)]

LOBNIK, Aleksandra, KORENT UREK, Špela. Nano-based optical chemical sensors. *Journal of nano research*, ISSN 1662-5250. [Print ed.], 2011, vol. 13, str. 99-110, doi: [10.4028/www.scientific.net/JNanoR.13.99](https://doi.org/10.4028/www.scientific.net/JNanoR.13.99). [COBISS.SI-ID [14803990](https://cobiss.si/14803990)]
5. TUREL, Matejka, DÜRKOP, Axel, YEGOROVA, Alla, KARASYOV, Alexander, SCRIPINETS, Yulia, LOBNIK, Aleksandra. Microtiterplate phosphate assay based on luminescence quenching of a terbium complex amenable to decay time detection. *Analytica chimica acta*, ISSN 0003-2670. [Print ed.], 2010, vol. 675, iss. 1, str. 42-48, doi: [10.1016/j.aca.2010.06.034](https://doi.org/10.1016/j.aca.2010.06.034). [COBISS.SI-ID [14268694](https://cobiss.si/14268694)]



Univerza v Mariboru

Fakulteta za kemijo
in kemijsko tehnologijo

UČNI NAČRT PREDMETA / SUBJECT SPECIFICATION

Predmet:	Polimerna kemija
Subject Title:	Polymer chemistry

Študijski program Study programme	Študijska smer Study field	Letnik Year	Semester Semester
Kemija in kemijska tehnika Chemistry and Chemical Engineering	Kemija Chemistry	1. / 2.	zimski / poletni Autumn / Spring

Vrsta predmeta / Course type:

Temeljni/ Basic

Univerzitetna koda predmeta / University subject code:

Predavanja Lectures	Seminar Seminar	Sem. vaje Tutorial	Lab. vaje Labor work	Teren. vaje Field work	Samost. delo Individ. work	ECTS
10	10				430	15

Nosilec predmeta / Lecturer:

Peter Krajnc

**Jeziki /
Languages:**

Predavanja / Lecture: slovenski / Slovene
Vaje / Tutorial: slovenski / Slovene

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

- dobro znanje organske in fizikalne kemije osnovnega nivoja

Prerequisites:

- Good knowledge of organic and physical chemistry of basic level

Vsebina:

- radikalske polimerizacije
- kondenzacijske polimerizacije
- mediji za polimerizacijo
- nivoji strukture polimerov
- porozni polimeri
- sodobne metode analize polimerov

Seminar:

- seminarska naloga iz tematike po dogovoru med nosilcem predmeta in mentorjem študenta

Content (Syllabus outline):

- Radical polymerisations
- Condensation polymerisations
- Media for polymerisations
- Levels of polymer structure
- Porous polymers
- Current methods of polymer analysis

Seminar:

- Seminar on the thematic agreed between the lecturer and supervisor of the student

Temeljni literatura in viri / Textbooks:

- G. Odian, Principles of Polymerization, Wiley, 2004.
- D. Braun, H. Cherdrone, H. Ritter, B. Voit, Polymer Synthesis: Theory and practice, Springer, 2005.
- Pregledni članki s tematiko glede na študentovo področje raziskovanja.

Cilji:

- spoznati sodobne metode sinteze polimerov
- razumeti vpliv strukture polimera na lastnosti
- spoznati nivoje organiziranosti makromolekul

Objectives:

- To know contemporary methods of polymer synthesis
- To understand the influence of polymer structure on its characteristics
- To know the levels of macromolecule organization

Predvideni študijski rezultati:Znanje in razumevanje:

- znati načrtovati sinteze polimerov
- načrtovati strukturo polimera v smeri željenih lastnosti

Prenesljive/ključne spretnosti in drugi atributi:

- obvladovanje sintetskih metod in medijev za pripravo polimerov

Intended learning outcomes:Knowledge and Understanding:

- To be able to plan polymer synthesis
- To be able to plan the structure of polymer in the direction of desired characteristics

Transferable/Key Skills and other attributes:

- Solid knowledge of methods of polymer synthesis and media for polymerisations

Metode poučevanja in učenja:

- predavanja
- seminar
- seminarska naloga

Learning and teaching methods:

- Lectures
- Seminar
- Seminar work

Načini ocenjevanja:

Delež (v %) /
Weight (in %)

Assessment:

Izpit je opravljen, če so pozitivno opravljene vse naslednje obveznosti:

- ustni izpit
- seminarska naloga
- pisni izpit

30
30
40

Student has to pass successfully the following obligations:

- Oral examination
- Seminar work
- Written examination

Reference nosilca / Lecturer's references:

MERT, E. H., SLUGOVČ, Christian, KRAJNC, Peter. Tailoring the mechanical and thermal properties of dicyclopentadiene polyHIPEs with the use of a comonomer. *Express polymer letters*, ISSN 1788-618X, 2015, vol. 9, no. 4, str. 344-353. <http://www.expresspolymlett.com/>.

BUNDERŠEK, Alenka, JAPELJ, Boštjan, MUŠIČ, Branka, RAJNAR, Nevenka, GYERGYEK, Sašo, KOSTANJŠEK, Rok, KRAJNC, Peter. Influence of Al(OH)₃ nanoparticles on the mechanical and fire resistance properties of poly(methyl methacrylate) nanocomposites : Elektronski vir. *Polymer composites*, ISSN 0272-8397. [Print ed.], Article first published online: 23 DEC 2014, let. , no. , str. 1-7, ilustr., doi: [10.1002/pc.23338](https://doi.org/10.1002/pc.23338).

HUŠ, Sebastjan, KRAJNC, Peter. PolyHIPEs from methyl methacrylate : hierarchically structured microcellular polymers with exceptional mechanical properties. *Polymer*, ISSN 0032-3861. [Print ed.], Avg. 2014, vol. 55, iss. 17, str. 4420-4424, doi: [10.1016/j.polymer.2014.07.007](https://doi.org/10.1016/j.polymer.2014.07.007).

SEVŠEK, Urška, KRAJNC, Peter. Methacrylic acid microcellular highly porous monoliths : preparation and functionalisation. *Reactive & functional polymers*, ISSN 1381-5148. [Print ed.], Jan. 2012, vol. 72, iss. 1, str. 221-226, doi: [10.1016/j.reactfunctpolym.2012.02.007](https://doi.org/10.1016/j.reactfunctpolym.2012.02.007).

JERENEC, Simona, ŠIMIČ, 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](https://doi.org/10.1016/j.reactfunctpolym.2014.02.011).

SUŠEC, Maja, LISKA, Robert, RUSSMÜLLER, Günther, KOTEK, Jiří, KRAJNC, Peter. Microcellular open porous monoliths for cell growth by thiol-ene polymerization of low-toxicity monomers in high internal phase emulsions. *Macromolecular bioscience*, ISSN 1616-5187. [Print ed.], Feb. 2015, vol. 15, issue 2, str. 253-261, doi: [10.1002/mabi.201400219](https://doi.org/10.1002/mabi.201400219).



Univerza v Mariboru

Fakulteta za kemijo
in kemijsko tehnologijo

UČNI NAČRT PREDMETA / SUBJECT SPECIFICATION

Predmet:	Sinteza in karakterizacija koordinacijskih spojin
Subject Title:	Synthesis and characterization of coordination compounds

Študijski program Study programme	Študijska smer Study field	Letnik Year	Semester Semester
Kemija in kemijska tehnika Chemistry and Chemical Engineering	Kemija Chemistry	1. / 2.	zimski / poletni Autumn / Spring

Vrsta predmeta / Course type:

Izbirni/ Elective

Univerzitetna koda predmeta / University subject code:

Predavanja Lectures	Seminar Seminar	Sem. vaje Tutorial	Lab. vaje Labor work	Teren. vaje Field work	Samost. delo Individ. work	ECTS
10	10				430	15

Nosilec predmeta / Lecturer:

Matjaž Kristl

Jeziki /

Predavanja / Lecture:

slovenski / Slovene

Languages:

Vaje / Tutorial:

slovenski / Slovene

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

- dobro znanje iz kemije in fizike

Prerequisites:

- Good knowledge of chemistry and physics

Vsebina:

- kovinski kompleksi elementov *d*-bloka
- princip nastanka koordinacijskih spojin ter njihove značilnosti
- struktura in zgradba koordinacijskega iona in kemijska vez
- vrste ligandov in njihova geometrijska razporeditev
- izomerija
- Oblike koordinacijskih poliedrov in Jahn-Tellerjev teorem
- kemijska vez: teorija valenčne vezi, teorija kristalnega polja, teorija polja ligandov, teorija MO
- barva in magnetne lastnosti
- stabilnost koordinacijskih spojin in značilne kemijske reakcije
- mehanizmi substitucije ligandov
- koordinacijsko ravnotežje
- eksperimentalne metode za karakterizacijo spojin

Seminar:

- sinteza koordinacijske spojine

Content (Syllabus outline):

- Coordination compounds of *d-block* elements
- Formation and properties of coordination compounds
- The structure of coordination ion and chemical bond
- Geometry of Coordination compounds
- Ligand Groups and their geometry
- Isomerism
- Coordination polihedra and Jahn-Teller theorem
- Bonding in coordination compounds: valence bond theory, crystal field theory, ligand field theory, molecular orbital theory
- Color and magnetic properties
- Stability and reactions of Complexes
- Mechanism of ligand substitution
- Coordinative equilibria
- Experimental methods for characterization of complexes

Seminar:

- Synthesis of a coordination compound

Temeljni literatura in viri / Textbooks:

- D. F. Shriver, P. W. Atkins, Inorganic Chemistry, Oxford, University Press, 1999.
- O. Khan, Molecular Magnetism, VCH Publishers, Inc., New York, 1992.
- Primarna literatura (npr. članki) s tematiko glede na študentovo področje raziskovanja / Primary literature (e.g. papers) corresponding to the student's research interest.

Cilji:

Cilj tega predmeta je:

- seznanjanje z poglobljena znanja koordinacijske kemije
- osvojitev metodike dela, zastavitve problema in njegovega reševanja
- kritično ocenjevanje pristopov in teorij
- vzpodbuditi slušatelje za delo na tem področju in ga opremiti z osnovnim potrebnim znanjem
- širitev področja te kemijske znanosti zaradi pomena kemijskih spojin za tehniko in medicino

Objectives:

The objective of this course is to:

- To acquaint with advanced knowledge of coordination compounds
- To give knowledge of methodology, to set up the problem and its solution
- To encourage students for the research and development work in the field of coordination chemistry and to give the basic knowledge
- To develop the scientific area because of the importance of chemical compounds for technique and medicine

Predvideni študijski rezultati:

Znanje in razumevanje:

Po zaključku tega predmeta bo študent sposoben:

- celovitega razumevanja zahtevnejših vidikov koordinacijske kemije
- samostojnega obvladovanja sintez novih in/ali znanih koordinacijskih spojin
- obvladovanja metod za karakterizacijo koordinacijskih spojin

Prenesljive/ključne spretnosti in drugi atributi:

- pridobitev kemijskih znanj potrebnih za razumevanje in praktična uporaba pri sintezi koordinacijskih spojin

Intended learning outcomes:

Knowledge and Understanding:

On completion of this course the student will be able to:

- Integral understanding of advanced knowledge of coordination compounds
- Autonomous planning of synthesis of new and / or known coordination complex compounds
- Planning of methods for characterization of coordination compounds

Transferable/Key Skills and other attributes:

- Acquisition of chemical knowledge needed for the synthesis of coordination compounds

Metode poučevanja in učenja:

- predavanja
- seminar
- seminarska naloga

Learning and teaching methods:

- Lectures
- Seminar
- Seminar work

Načini ocenjevanja:

Izpit je opravljen, če so pozitivno opravljene vse naslednje obveznosti:

- ustni izpit
- seminarska naloga

Delež (v %) /
Weight (in %)

Assessment:

Student has to pass successfully the following obligations:

- Oral examination
- Seminar work

Reference nosilca / Lecturer's references:

HOJNIK, Nuša, KRISTL, Matjaž, GOLOBIČ, Amalija, JAGLIČIČ, Zvonko, DROFENIK, Mihael. Hydrolytic synthesis of novel lanthanide(III) complexes with pyridine-2,6-dicarboxylic acid. *Journal of molecular structure*, ISSN 0022-2860. [Print ed.], 5 Jan. 2015, vol. 1079, str. 54-60, ilustr., doi: [10.1016/j.molstruc.2014.09.029](https://doi.org/10.1016/j.molstruc.2014.09.029). [COBISS.SI-ID [18148118](https://www.cobiss.si/id/18148118)]

HOJNIK, Nuša, KRISTL, Matjaž, GOLOBIČ, Amalija, JAGLIČIČ, Zvonko, DROFENIK, Mihael. The synthesis, structure and physical properties of lanthanide(III) complexes with nicotinic acid. *Central European Journal of Chemistry*, ISSN 1895-1066, Feb. 2014, vol. 12, iss. 2, str. 220-226, ilustr., doi: [10.2478/s11532-013-0366-5](https://doi.org/10.2478/s11532-013-0366-5). [COBISS.SI-ID [17388822](https://www.cobiss.si/id/17388822)]

KRISTL, Matjaž, DOJER, Brina, HOJNIK, Nuša, GOLOBIČ, Amalija. Synthesis and characterization of new hydroxylammonium fluoromanganates and fluoroscandates. *Journal of fluorine chemistry*, ISSN 0022-1139. [Print

ed.], Sep. 2014, vol. 166, str. 15-21, doi: [10.1016/j.jfluchem.2014.07.006](https://doi.org/10.1016/j.jfluchem.2014.07.006). [COBISS.SI-ID [18000662](#)]

DOJER, Brina, PEVEC, Andrej, JAGODIČ, Marko, KRISTL, Matjaž, DROFENIK, Mihael. Three new cobalt(II) carboxylates with 2-, 3- and 4-aminopyridine : syntheses, structures and magnetic properties. *Inorganica Chimica Acta*, ISSN 0020-1693. [Print ed.], 2012, vol. 383, str. 98-104, doi: [10.1016/j.ica.2011.10.056](https://doi.org/10.1016/j.ica.2011.10.056). [COBISS.SI-ID [15502614](#)]

KRISTL, Matjaž, GOLOBIČ, Amalija, DOJER, Brina, DROFENIK, Mihael. Synthesis and structure of hydroxylammonium fluoroaluminate. *Monatshefte für Chemie*, ISSN 0026-9247, 2011, vol. 142, no. 8, str. 755-762, doi: [10.1007/s00706-011-0508-4](https://doi.org/10.1007/s00706-011-0508-4). [COBISS.SI-ID [15004182](#)]



Univerza v Mariboru

Fakulteta za kemijo
in kemijsko tehnologijo

UČNI NAČRT PREDMETA / COURSE SYLLABUS

Predmet:	Industrijske aplikacije membranskih separacijskih procesov
Course title:	Industrial Application of membrane separation processes

Študijski program in stopnja Study programme and level	Študijska smer Study field	Letnik Academic year	Semester Semester
Kemija in kemijska tehnika/3.stopnja	Kemijska tehnika	1./2.	poletni /zimski
Chemistry and Chemical Engineering, 3 rd level		1./2.	Spring /Autumn

Vrsta predmeta / Course type

Izbirni/Elective

Univerzitetna koda predmeta / University course code:

Predavanja Lectures	Seminar Seminar	Sem. vaje Tutorial	Lab. vaje Laboratory work	Teren. vaje Field work	Samost. delo Individ. work	ECTS
10	10				430	15

Nosilec predmeta / Lecturer:

Marjana Simonič

**Jeziki /
Languages:**

Predavanja / Lectures: Slovenski/Slovene
Vaje / Tutorial: Slovenski/Slovene

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

Tehnologija vod
Organska kemija
Znanje anorganske kemije

Prerequisites:

Introduction to water treatment
Organic chemistry
Inorganic Chemistry

Vsebina:

Content (Syllabus outline):

Pregled membranskih separacij: - mikrofiltracija - ultrafiltracija - nanofiltracija - reverzna osmoza Prednosti in slabosti uporabe membran Konfiguracije Hibridni postopki - membranski bioreaktor MBR - membranski kontaktor Pregled materialov - polimerni - keramični Karakterizacija membran - permeabilnost - zamašitve - stični kot - zeta potencial Področja uporabe Seminarska naloga obsega samostojno delo študenta povezano s proučevanjem problematike iz področja membranskih tehnologij.	Overview of membrane separation - microfiltration - ultrafiltration - nanofiltration - reverse osmosis Advances and drawbacks of membrane application konfiguracije Hybrid processes - membrane bioreactor MBR - membrane contactor Membrane materials - polymer - ceramic Membrane characterisation - permeability - fouling - contact angle - zeta potential Use of membranes <i>Seminar work</i> deals in depth with certain issues from the field of membrane technology.
--	--

Temeljni literatura in viri / Readings:

Roš M., Simonič M., Šostar-Turk S., Priprava in čiščenje vod, Tiskarna tehniških fakultet, 2005

Dodatni priporočeni viri:

Mulder M., Basic principles of membrane technology, Kluwer, Netherland 2003

Judd S., The MBR book, UK, 2006

E. Drioli, L. Giorno, Comprehensive membrane science and engineering, 1st ed., Elsevier Science, United Kingdom, 2010.

Cilji in kompetence:

- celovito obvladovanje sistemov čiščenja vod v delovnem okolju,
- obvladovanje naprednih računalniško-podprtih metodologij za čiščenje vod,
- razvijanje hibridnih tehnologij.

Objectives and competences:

- Mastering the integral principles for water treatment at workplace,
- Knowledge of the advanced computer-aided methodologies for water treatment processes,
- Mastering the hybrid technique development.

Predvideni študijski rezultati:

Znanje in razumevanje:

- celovito razumevanje membranske tehnologije,
- obvladovanje karakterizacije,
- izbira najustreznejše membranske filtracije za različne industrijske aplikacije,
- zmožnost analize problema čiščenja vod ter optimalna izbira rešitve problema.

Prenesljive/ključne spretnosti in drugi atributi:

- celovita skrb za vode,
- delo v skupini in vodenje skupine za izbiro ustreznega tehnološkega postopka,
- oblikovanje načrtov in strategij za doseg najzahtevnejših ciljev.

Intended learning outcomes:

Knowledge and Understanding:

- Integral knowledge of membrane,
- Integral knowledge of membrane characterisation,
- Ability of analyzing the problem of water treatment and ability to choose the optimum problem solution,
- skills for independent solving problems related to water treatment.

Transferable/Key Skills and other attributes:

- o Integral concern for water management,
- o Achieving knowledge for good policy making in industry,
- o Ability to develop new plans and concepts to reach arduous goals.

Metode poučevanja in učenja:

Samostojni študij,
seminarske naloge

Learning and teaching methods:

Independent study,
Preparation of seminar work

Načini ocenjevanja:

Delež (v %) /
Weight (in %)

Assessment:

Način (pisni izpit, ustno izpraševanje, naloge, projekt)
Ustni izpit
Seminarska naloga

60
40

Type (examination, oral, coursework, project):
Oral examination
Seminar work

Reference nosilca / Lecturer's references:

PETROVIČ, Aleksandra, SIMONIČ, Marjana. The effect of carbon source on nitrate and ammonium removal from drinking water by immobilised *Chlorella sorokiniana*. *International journal of environmental science and technology*, ISSN 1735-1472, 15. jan. 2015, vol. , issue , str. 1-14, doi: [10.1007/s13762-014-0747-0](https://doi.org/10.1007/s13762-014-0747-0). [COBISS.SI-ID [18378518](#)], [JCR, SNIP]

kategorija: 1A2 (Z, A1/2); uvrstitev: SCI, Scopus, MBP; tipologija ni verificirana

KRIŽAN, Janja, PETRINIČ, Irena, GORŠEK, Andreja, SIMONIČ, Marjana. Ultrafiltration of oil-in-water emulsion by using ceramic membrane : Taguchi experimental design approach. *Central European Journal of Chemistry*, ISSN 1895-1066, Feb. 2014, vol. 12, iss. 2, str. 242-249, ilustr., doi: [10.2478/s11532-013-0373-6](https://doi.org/10.2478/s11532-013-0373-6). [COBISS.SI-ID [17373718](#)], [JCR, SNIP, WoS do 30. 12. 2013: št. citatov (TC): 0, čistih citatov (CI): 0, čistih citatov na avtorja (CIAu): 0, normirano št. čistih citatov (NC): 0, Scopus do 21. 3. 2014: št. citatov (TC): 0, čistih citatov (CI): 0, čistih citatov na avtorja (CIAu): 0, normirano št. čistih citatov (NC): 0]

kategorija: 1A3 (Z); uvrstitev: SCI, Scopus, MBP; tipologijo je verificiral OSICN

VINDER, Aleksandra, SIMONIČ, Marjana. Removal of AOX from waste water with mixed surfactants by MEUF. *Desalination*, ISSN 0011-9164. [Print ed.], 15. Mar. 2012, vol. 289, str. 51-57, doi: [10.1016/j.desal.2012.01.007](https://doi.org/10.1016/j.desal.2012.01.007). [COBISS.SI-ID [15820566](#)], [JCR, SNIP, WoS do 17. 9. 2014: št. citatov (TC): 5, čistih citatov (CI): 4, čistih citatov na avtorja (CIAu): 2.00, normirano št. čistih citatov (NC): 3, Scopus do 16. 7. 2014: št. citatov (TC): 5, čistih citatov (CI): 4, čistih citatov na avtorja (CIAu): 2.00, normirano št. čistih citatov (NC): 3]

kategorija: 1A1 (Z, A', A1/2); uvrstitev: SCI, Scopus, MBP; tipologijo je verificiral OSICT



Univerza v Mariboru

Fakulteta za kemijo
in kemijsko tehnologijo

UČNI NAČRT PREDMETA / COURSE SYLLABUS

Predmet:	Obratovanje procesov
Course title:	Process operability

Študijski program in stopnja Study programme and level	Študijska smer Study field	Letnik Year	Semester Semester
Kemija in kemijska tehnika / 3. stopnja Chemistry and Chemical Engineering / 3. Level	Kemijska tehnika Chemical Engineering	1. / 2.	zimski / poletni Autumn / Spring

Vrsta predmeta / Course type:

Izbirni / Elective

Univerzitetna koda predmeta / University course code:

Predavanja Lectures	Seminar Seminar	Sem. vaje Tutorial	Lab. vaje Labor work	Teren. vaje Field work	Samost. delo Individ. work	ECTS
10	10				430	15

Nosilec predmeta / Lecturer:

Zorka Novak Pintarič

Jeziki /

Predavanja / Lecture: slovenski / Slovene

Languages:

Vaje / Tutorial: slovenski / Slovene

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

Pogojev ni

Prerequisites:

None

Vsebina:

Nekatere komponente obratovanja procesov:

1. fleksibilnost
 - test in indeks fleksibilnosti
 - dvostopenjsko stohastično programiranje s fiksnim rekurzom
 - deterministični ekvivalent stohastičnega programiranja
 - Gaussova kvadratura; Monte Carlo simulacija in druge tehnike vzorčenja
 - večperiodni modeli
 - načrtovanje procesov in odločanje v pogojih tveganja in negotovosti
2. zanesljivost
 - zanesljivost nekaterih standardnih sistemov
 - odpovedi in njihove verjetnostne porazdelitve
 - načrtovanje periodičnega vzdrževanja
 - popravila in zamenjave procesnih enot, zagon in zaustavitev obrata
3. varnost
 - analize obratovanja in nevarnosti
 - modeliranje scenarijev in analize posledic

Content (Syllabus outline):

Some important topics of process operability:

1. Flexibility
 - Flexibility test and flexibility index problems
 - Two-stage stochastic programming with fixed recourse
 - Deterministic equivalent of stochastic programming
 - Gaussian quadrature; Monte Carlo simulation and other sampling techniques
 - Multi-period models
 - Process design and decision-making under risk and uncertainty
2. Reliability
 - Reliability of some standard systems
 - Failure rate and failure distribution
 - Maintainability, maintenance scheduling
 - Repair or replacement of equipment, startup and shutdown
3. Safety
 - Hazard and operability studies
 - Scenario modelling and consequence analysis
 - Advanced methods for event probability and failure frequency analysis

- napredne metode za analize verjetnosti in frekvenc nevarnih dogodkov
- merjenje, izračunavanje in interpretacija tveganja
- analize nezgod, učenje iz preteklih nezgod in prenos znanja
- sistemi vodenja zdravja in varnosti pri delu

Seminar:

- aplikacije načrtovanja in sinteze operabilnih procesov v pogojih negotovosti, analize obratovanja in nevarnosti, ocene tveganja, aplikacije teorije zanesljivosti

- Measurement, calculation and presentation of risk estimates
- Accident research, learning from accidents and knowledge transfer
- Occupational health and safety systems

Seminar:

- various applications of design and synthesis of operable processes under uncertainty, hazard and operability studies, risk assessment, applications of reliability theory

Temeljni literatura in viri / Textbooks:

- I. E. Grossmann, B. A. Calfa, P. Garcia-Herreros, Evolution of concepts and models for quantifying resiliency and flexibility of chemical processes, Computers & Chemical Engineering, 70, 22-34, 2014.
- Z. Novak Pintarič. Načrtovanje fleksibilnih procesov v pogojih negotovosti, Design of flexible processes under uncertainty. Slovenski kemijski dnevi 2011, Portorož, 14-16 september 2011. Maribor: FKKT, 2011, 19 str. [COBISS.SI-ID 15326742]
- J. R. Birge, F. Louveaux, Introduction to Stochastic Programming (izbrana poglavja), Springer, New York, 2011. <http://link.springer.com/book/10.1007%2F978-1-4614-0237-4>.
- A. Saltelli, S. Tarantola, F. Campolongo, M. Ratto. Sensitivity Analysis in Practice (izbrana poglavja). A Guide to Assessing Scientific Models. John Wiley & Sons, West Sussex, 2007.
- AIChE/CCPS, Guidelines for chemical process quantitative risk analysis (izbrana poglavja), Centre for Chemical Process Safety of the American Institute of Chemical Engineers, New York, 2000.

Dodatna priporočena literatura:

- Z. Novak Pintarič, Z. Kravanja, A methodology for the synthesis of heat exchanger networks having large numbers of uncertain parameters. Energy, Available online 29 March 2015, str. 1-10, doi: 10.1016/j.energy.2015.02.106. [COBISS.SI-ID 18589462]
- R. A. Brealey, S. C. Myers, A. J. Marcus, Fundamentals of Corporate Finance. Sixth Edition (poglavji 11, 12), McGraw Hill, New York, 2009.
- D. A. Crowl, J. F. Louvar, Chemical Process Safety: Fundamentals with Applications (izbrana poglavja). Prentice Hall PTR, 2nd Edition, 2008.
- Z. N. Pintarič, Assessment of the Consequences of Accident Scenarios Involving Dangerous Substances. Process Saf. Environ. Prot. 85 (B1), 23-38, 2007.
- L. T. Biegler, I. E. Grossmann, A. W. Westerberg, Systematic Methods of Chemical Process Design (poglavje 21). Prentice Hall, New Jersey, 1999.

Cilji:

- poznavanje dejavnikov obratovanja procesov (fleksibilnost, zanesljivost, varnost)
- sposobnost načrtovanja operabilnih procesov
- obvladovanje odločanja v pogojih negotovosti in tveganja
- priprava novih strategij, konceptov in načrtov za varno obratovanje, zagon in zaustavitev obratov ter za ravnanje v izrednih razmerah

Predvideni študijski rezultati:

Znanje in razumevanje:

- obvladovanje sodobnih računalniških metod za načrtovanje operabilnih procesov
- sposobnost vključitve tehnik stohastičnega programiranja v raziskovalne projekte
- sposobnost analize tveganj in priprave strategij za preprečevanje izgub in ravnanje v izrednih razmerah

Prenesljive/ključne spretnosti in drugi atributi:

- sposobnost odločanja v negotovih okoliščinah
- celovita skrb za varnost ljudi in okolja

Objectives:

- Knowledge of operability issues (flexibility, reliability, safety)
- Ability to design operable processes
- Ability of decision making under conditions of uncertainty and risks
- Ability to develop new strategies, concepts and plans for safe operation, start-up and shut-down of plants as well as for emergency planning

Intended learning outcomes:

Knowledge and Understanding:

- Mastering the advanced computer-aided methods for design of operable processes
- Ability to incorporate stochastic programming techniques into research projects
- Ability for risk analyses and development of strategies for loss prevention and emergency planning

Transferable/Key Skills and other attributes:

- Improving the judgments in uncertain situations
- Responsible care for human and environmental safety

Metode poučevanja in učenja:

- predavanja
- seminar
- seminarska naloga

Learning and teaching methods:

- Lectures
- Seminar
- Seminar work

Načini ocenjevanja:

Delež (v %) /
Weight (in %)

Assessment:

Izpit je opravljen, če so pozitivno opravljene vse naslednje obveznosti:

- seminarska naloga – pisno poročilo
- zagovor seminarske naloge

50
50

Student has to pass successfully the following obligations:

- Seminar work – written report
- Defense of the seminar work

Reference nosilca / Lecturer's references:

NOVAK-PINTARIČ, Zorka, KRAVANJA, Zdravko. The importance of proper economic criteria and process modeling for single- and multi-objective optimizations. *Computers & Chemical Engineering*, Available online 18 February 2015, 1-49, doi: 10.1016/j.compchemeng.2015.02.008. [COBISS.SI-ID 18472470]

NOVAK-PINTARIČ, Zorka, KASAŠ, Mihael, KRAVANJA, Zdravko. Sensitivity analyses for scenario reduction in flexible flow sheet design with a large number of uncertain parameters. *AIChE journal*, ISSN 0001-1541. [Print ed.], Avg. 2013, vol. 59, iss. 8, str. 2862-2871, doi: 10.1002/aic.14061. [COBISS.SI-ID 16795926]

TOKOS, Hella, NOVAK-PINTARIČ, Zorka, YANG, Yongrong. Bi-objective optimization of a water network via benchmarking. *Journal of cleaner production*, ISSN 0959-6526. [Print ed.], 2013, vol. 39, str. 168-179, doi: 10.1016/j.jclepro.2012.07.051. [COBISS.SI-ID 16240918]

KASAŠ, Mihael, KRAVANJA, Zdravko, NOVAK-PINTARIČ, Zorka. A novel method for identification of critical points in flow sheet synthesis under uncertainty. V: BOGLE, Ian David Lockhart (ur.), FAIRWEATHER, Michael (ur.). *22nd European Symposium on Computer Aided Process Engineering*, (Computer aided chemical engineering, 30). 1st ed. Amsterdam: Elsevier, cop. 2012, str. 1-5. <http://booksite.elsevier.com/9780444594310/downloads/ESC.369%20-%20A%20novel%20method%20for%20identification%20of%20critical%20points%20in%20flow%20sheet.pdf>, <http://booksite.elsevier.com/9780444594310/papers.php>. [COBISS.SI-ID 17021462]

KASAŠ, Mihael, KRAVANJA, Zdravko, NOVAK-PINTARIČ, Zorka. Suitable modeling for process flow sheet optimization using the correct economic criterion. *Industrial & engineering chemistry research*, ISSN 0888-5885. [Print ed.], 2011, vol. 50, iss. 6, str. 3356-3370, doi: 10.1021/ie101485z. [COBISS.SI-ID 14805526]



Univerza v Mariboru

Fakulteta za kemijo
in kemijsko tehnologijo

UČNI NAČRT PREDMETA / COURSE SYLLABUS

Predmet:	Biotransformacije
Course title:	Biotransformations

Študijski program in stopnja Study programme and level	Študijska smer Study field	Letnik Academic year	Semester Semester
Kemija in kemijska tehnika, 3.stopnja	Kemija	1. / 2.	Poletni/zimski
Chemistry and Chemical Engineering, 3rd level	Chemistry	1. / 2.	Spring/ Autumn

Vrsta predmeta / Course type

Izbirni / Elective

Univerzitetna koda predmeta / University course code:

Predavanja Lectures	Seminar Seminar	Sem. vaje Tutorial	Lab. vaje Laboratory work	Teren. vaje Field work	Samost. delo Individ. work	ECTS
10	10				430	15

Nosilec predmeta / Lecturer:

Maja Leitgeb

Jeziki /

Languages:

Predavanja / Lectures:

Vaje / Tutorial:

slovenski / Slovene

slovenski / Slovene

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

Pogojev ni

Prerequisites:

None

Vsebina:

- homogena in heterogena biokataliza
- biokatalizatorji in biotransformacije
- industrijska uporaba encimov in celic
- šaržni in kontinuirani procesi za izvedbo biotransformacije
- optimiranje biotransformacij
- pregled nekaterih industrijsko pomembnih procesov biotransformacije
- razvoj in optimiranje procesa na praktičnem primeru (npr. sinteza v encimskem membranskem reaktorju)

Seminarske vaje:

Novejše teme s področja biotransformacij

Content (Syllabus outline):

- Homogeneous and heterogenous biocatalysis.
- Biocatalysis and biotransformations
- Industrial use of enzymes and whole cells
- Batch and continuous processes for biotransformations
- Biotransformation optimisation
- Overview of some industrial important biotransformations
- Process development and optimisation on practical case (e.g. synthesis in enzymatic membrane reactor)

Seminar work:

Modern themes from the field of biotransformations

Temeljni literatura in viri / Readings:

- U.T. Bornscheuer, R.J. Kazlauskas, *Hydrolases in Organic Synthesis*. Wiley-VCH, Weinheim, 2nd Edition, 2006.
- J. Whittall., P. Sutton, *Practical Methods for Biocatalysis and Biotransformations*, Wiley-VCH, Weinheim, 2009.
- Primarna literatura (npr. članki) s tematiko glede na študentovo področje raziskovanja / Primary literature (e.g. papers) corresponding to the student's research interest.

Cilji in kompetence:

- poglobljena znanja s področja biotransformacij
- usvajanje znanj s področja načrtovanja biotransformacij
- zmožnost optimiranja ključnih procesnih parametrov

Objectives and competences:

- Deeper knowledges in the field of biotransformations
- Adoption of knowledge in the field of biotransformation design
- Ability to optimise key process parameters

Predvideni študijski rezultati:

Znanje in razumevanje:

- poznavanje nekaterih pomembnih biotransformacij
- razumevanje načrtovanja biotransformacij
- poznavanje vpliva procesnih parametrov na proces biotransformacije

Prenesljive/ključne spretnosti in drugi atributi:

- sposobnost uvajanja trajnostne kemije
- načrtovanje biotransformacij
- načrtovanje in izvajanje zahtevnejših nalog

Intended learning outcomes:

Knowledge and Understanding:

- Knowledge and understanding of some important biotransformations
- Understanding of biotransformation design
- Understanding of the process parameters influence on biotransformation process

Transferable/Key Skills and other attributes:

- Ability to introduce sustainable chemistry
- Design of biotransformations.
- Designing and performing of exacting piece of work

Metode poučevanja in učenja:

- predavanja v učilnici, ki je opremljena z audio-vizualnimi pripomočki
- samostojni študij
- individualna priprava seminarских nalog s predstavitvijo in diskusijo

Learning and teaching methods:

- Lectures in lecture room, equipped with audio-visual equipment
- Independent study
- Individual preparation of seminars and their presentation with discussion

Delež (v %) /
Weight (in %)

Načini ocenjevanja:

Izpit je opravljen, če so pozitivno opravljene vse naslednje obveznosti:

- seminarska naloga

100%

Assessment:

Student has to pass successfully the following obligations:

- Seminar work

Reference nosilca / Lecturer's references:

1. KAVČIČ, Sabina, KNEZ, Željko, LEITGEB, Maja. Antimicrobial activity of n-butyl lactate obtained via enzymatic esterification of lactic acid with n-butanol in supercritical trifluoromethane. *The Journal of supercritical fluids*, ISSN 0896-8446. 2014, 85, 143-150, doi: [10.1016/j.supflu.2013.11.003](https://doi.org/10.1016/j.supflu.2013.11.003). [COBISS.SI-ID [17392406](https://www.cobiss.si/id/17392406)].
2. KNEZ, Željko, KAVČIČ, Sabina, GUBICZA, László, BÉLAFI-BAKÓ, Katalin, NÉMETH, Gergely, PRIMOŽIČ, Mateja, LEITGEB, Maja. Lipase-catalyzed esterification of lactic acid in supercritical carbon dioxide. *The Journal of supercritical fluids*, ISSN 0896-8446. 2012, 66, 192-197, doi: [10.1016/j.supflu.2011.11](https://doi.org/10.1016/j.supflu.2011.11). [COBISS.SI-ID [15598102](https://www.cobiss.si/id/15598102)].
3. ŠALIĆ, Anita, PINDRIĆ, Katarina, HOJNIK PODREPŠEK, Gordana, LEITGEB, Maja, ZELIĆ, Bruno. NADH oxidation in a microreactor catalyzed by ADH immobilized on γ -Fe₂O₃ nanoparticles. V: ŽNIDARŠIČ PLAZL, Polona (ur.). *The 2nd international conference Implementation of microreactor technology in biotechnology (IMTB 2013), May 5-8, 2013, Cavtat, Croatia*, (Green Processing and Synthesis, ISSN 2191-9550, 2 (6), 2013). [S. l.: s. n.], 2013, 2 (6), 569-578,

doi: [10.1515/gps-2013-0084](https://doi.org/10.1515/gps-2013-0084). [COBISS.SI-ID [17312022](#)]

4. THOREY, Paul, KNEZ, Željko, LEITGEB, Maja. Alcohol dehydrogenase in non-aqueous media using high-pressure technologies : reaction set-up and deactivation determination. *Journal of chemical technology and biotechnology*, ISSN 0268-2575. 2010, 85, 1011-1016. [COBISS.SI-ID [14291222](#)]

5. CSANÁDI, Zsófia, BÉLAFI-BAKÓ, Katalin, SZENTGYÖRGYI, Eszter, GUBICZA, László, KNEZ, Željko, LEITGEB, Maja. Enzymatic esterification of glycerol and stearic acid in non-conventional media. *Acta chimica slovenica*, ISSN 1318-0207. 2010, 57 (1), 244-249, [COBISS.SI-ID [14029590](#)]



Univerza v Mariboru

Fakulteta za kemijo
in kemijsko tehnologijo

UČNI NAČRT PREDMETA / COURSE SYLLABUS

Predmet:	Uporaba elektrokemijskih metod v analizni kemiji
Course title:	Application of Electrochemical Methods in Analytical Chemistry

Študijski program in stopnja Study programme and level	Študijska smer Study field	Letnik Academic year	Semester Semester
Kemija in Kemijska tehnika, 3.stopnja	Kemija	1./2.	Poletni/zimski
Chemistry and Chemical Engineering, 3rd level	Chemistry	1./2.	Spring/Autumn

Vrsta predmeta / Course type

Izbirni/Elective

Univerzitetna koda predmeta / University course code:

Predavanja Lectures	Seminar Seminar	Sem. vaje Tutorial	Lab. vaje Laboratory work	Teren. vaje Field work	Samost. delo Individ. work	ECTS
10	10				430	15

Nosilec predmeta / Lecturer:

Mitja Kolar

Jeziki /

Predavanja / Lectures:

Slovenski /Slovene

Languages:

Vaje / Tutorial:

Slovenski /Slovene

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

Potrebno je predhodno znanje analizne kemije, instrumentalnih metod v analizni kemiji in osnovno znanje elektrokemije.

Prerequisites:

Basic knowledge of analytical chemistry, instrumental methods in analytical chemistry and basic electrochemistry.

Vsebina:

Nadgradnja elektrokemijskih procesov v teoriji:

- faradayski in nefaradayski procesi,
- prenos snovi,
- električna dvojna plast,
- elektrokapilarni efekt,
- Butler-Volmerjeva enačba.

Elektrokemijski senzorji (lastnosti, uporabnost, izdelava):

- ionoselektivne elektrode
- biosenzorji
- plinski senzorji
- »solid state« senzorji

Content (Syllabus outline):

Advanced electrochemical processes and their theory:

- faradaic and nonfaradaic processes,
- mass transfer,
- electrical double layer,
- electrocapillary effect,
- Butler-Volmer equation.

Electrochemical sensors (properties, application, fabrication):

- ion-selective electrodes
- biosensors
- gas sensors
- solid state sensors

- vrstni – »array« senzorji.

Pregled novih elektrokemijskih tehnik s poudarkom na uporabnosti elektrokemijskih senzorjev v pretočnih in sklopljenih sistemih.

Študij sodobne merilne opreme, primerjava z drugimi metodami.

- sensor arrays.

Study of new electroanalytical methods in flow and hyphenated systems.

Study of modern instrumentation and trends in electrochemistry, comparison to other analytical methods.

Temeljni literatura in viri / Readings:

- Analytical Electrochemistry, 3rd Edition Joseph Wang June 2006, Wiley
- Modern Aspects of Electrochemistry, B.E. Conway, J.O.M. Bockris, R.E. White, Plenum Press, 2001.
- Electrochemical Methods: Fundamentals and Applications, A.J. Bard, L. R. Faulkner, Marcel Dekker, 2000.
- Electrochemistry, C.H. Hamann, A. Hamnett, W. Vielstich, Wiley-VCH, 2007.
- Znanstveni, strokovni in pregledni članki s področja elektrokemije

Cilji in kompetence:

Cilj predmeta je seznaniti študente s:

- nadgradnja teoretskih osnov v elektrokemiji, s poudarkom na poglobljenem študiju in uporabnosti elektroanaliznih metod,
- samostojno raziskovalno delo na področju elektrokemije.

Objectives and competences:

The aim of the subject is:

- advanced theory of electrochemistry and study of applied electroanalytical methods,
- research work in the field of electrochemistry.

Predvideni študijski rezultati:

Znanje in razumevanje:

- razumevanje kompleksnih elektrokemijskih sistemov,
- uporabnost, modifikacije in razvoj elektrokemijskih metod za poglobljene študije in primerjavo različnih analitskih sistemov.

Intended learning outcomes:

Knowledge and understanding:

- understanding of complex phenomena in electroanalytical systems,
- applicability, modification and research of electroanalytical methods for advanced study and comparison to other analytical systems.

Metode poučevanja in učenja:

Predavanja v učilnici, ki je opremljena z osnovnimi avdio-vizualnimi pripomočki.

Individualna priprava seminarskih nalog s predstavitvijo in diskusijo.

Learning and teaching methods:

Lectures in lecture room, equipped with basic audio-visual equipment

Individual preparation of seminars and their presentation with discussion.

Načini ocenjevanja:

Delež (v %) /
Weight (in %)

Assessment:

Način (pisni izpit, ustno izpraševanje, naloge, projekt):		Type (examination, oral, coursework, project):
- ustni izpit:	50	- oral examination:
- seminarska naloga:	50	- seminar - coursework:

Reference nosilca / Lecturer's references:

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. 2010, vol. 57, no. 4, str. 813-820, [COBISS.SI-ID [14701078](#)]

BRGLEZ, Polonca, HOLOBAR, Andrej, PIVEC, Aleksandra, BELŠAK, Nataša, KOLAR, Mitja. Determination of oxygen by means of a biogas and gas - interference study using an optical tris (4,7-diphenyl-1,10-phenanthroline) ruthenium(II) dichloride complex sensor. *Acta chimica slovenica*, ISSN 1318-0207. 2012, vol. 59, no. 1, str. 50-58, [COBISS.SI-ID [15889686](#)]

BRGLEZ, Polonca, HOLOBAR, Andrej, PIVEC, Aleksandra, KOLAR, Mitja. Spin-coating for optical-oxygen-sensor preparation *Mater and Tehnolog.*, ISSN 1580-2949. 2014, letn. 48, št. 2, str. 181-188. [COBISS.SI-ID [17746454](#)]



Univerza v Mariboru

Fakulteta za kemijo
in kemijsko tehnologijo

UČNI NAČRT PREDMETA / COURSE SYLLABUS

Predmet:	Sonokemijske metode
Course title:	Sonochemical methods

Študijski program in stopnja Study programme and level	Študijska smer Study field	Letnik Academic year	Semester Semester
Kemija in kemijska tehnika, 3.stopnja	Kemija	1. / 2.	Poletni/ zimski
Chemistry and Chemical Engineering, 3rd level	Chemistry	1. / 2.	Spring/ Autumn

Vrsta predmeta / Course type

Izbirni/Elective

Univerzitetna koda predmeta / University course code:

Predavanja Lectures	Seminar Seminar	Sem. vaje Tutorial	Lab. vaje Laboratory work	Teren. vaje Field work	Samost. delo Individ. work	ECTS
10	10				430	15

Nosilec predmeta / Lecturer:

Matjaž Kristl

Jeziki /

Predavanja / Lectures:

slovenski / Slovene

Languages:

Vaje / Tutorial:

slovenski / Slovene

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

- pogojev ni

Prerequisites:

- None

Vsebina:

Predavanja:

- kemijsko delovanje ultrazvoka: sonokemijsko reakcijsko mesto, kavitacija in dinamika nastanka mehurčkov: homogena in heterogena nukleacija, stabilna in nestabilna kavitacija
- klasične industrijske aplikacije ultrazvoka: ultrazvočno čiščenje, rezanje/spajanje kovinskih in polimernih materialov, ekstrakcija naravnih učinkovin, emulgiranje
- pregled delovanja ultrazvoka v homogenih sistemih: sonokemija vodnih sistemov (sonoliza vode,

Content (Syllabus outline):

Lectures:

- Chemical effects of ultrasound: the nature of sonochemical reaction site, cavitation and bubble dynamics: homogeneous and heterogeneous nucleation, stable and transient cavitation
- Classical industrial applications of ultrasound: ultrasonic cleaning, metal and plastic welding, extraction, emulsification
- Effects of ultrasound in homogeneous systems: aqueous sonochemistry (sonolysis of water, sonochemistry of gases in water, sonochemistry of

sonokemija plinov v vodi, sonokemija anorganskih spojin v vodnih raztopinah, sonokemija organskih spojin v vodnih raztopinah), sonokemija nevodnih sistemov (organske tekočine, polimeri, organokovinska sonokemija)

- delovanje ultrazvoka v heterogenih sistemih: akustična kavitacija na fazni meji trdno/tekoče, reakcije s kovinami, reakcije z nekovinami
- razgradnja organskih polutantov v odpadnih vodah: mehanizem, rezultati laboratorijskih poizkusov, aplikacije v praksi

Seminar:

podrobna vsebina seminarja se bo določila na osnovi dogovora z mentorjem in se bo nanašala na tematiko predmeta

inorganic compounds in water, sonochemistry of organic compounds in water), nonaqueous sonochemistry (organic liquids, polymer sonochemistry, organometallic sonochemistry)

- Effects of ultrasound in heterogeneous systems: acoustic cavitation near solid surfaces, reactions with metals, reactions with nonmetals
- Decomposition of organic pollutants in waste water: mechanism, results of laboratory experiments, practical applications

Seminar:

Detailed content of seminar will be determined on the basis of agreement with mentor and will be related to the subject

Temeljni literatura in viri / Readings:

- K. S., Suslick (ed.), *Ultrasound: Its Chemical, Physical, and Biological Effects*, VCH Publishers, New York, 1988.
- T. J., Mason, J. P., Lorimer, *Applied Sonochemistry*, Wiley-VCH, Weinheim, 2002.
- Primarna literatura (npr. članki) s tematiko glede na študentovo področje raziskovanja / Primary literature (e.g. papers) corresponding to the student's research interest.

Cilji in kompetence:

- Pridobivanje poglobljenega znanja o ultrazvoku in spoznavanje teoretskih osnov delovanja ultrazvoka v kemiji
- spoznavanje uporabe ultrazvočnih sistemov v industrijskih in laboratorijskih procesih s poudarkom na sonokemijskih sintezah nanokristaliničnih materialov
- sposobnost razumevanja mehanizma in uporabe ultrazvočnih metod pri razgradnji polutantov v odpadnih vodah

Objectives and competences:

- To obtain advanced knowledge about principles of ultrasound and fundamentals of chemical effects of ultrasound
- To acquire knowledge about use of ultrasonic systems in laboratory and industrial processes with main focus on sonochemical synthesis of nanocrystalline materials
- Ability to understand the mechanism and use of the ultrasonic methods in decomposition of pollutants in waste waters

Predvideni študijski rezultati:

Znanje in razumevanje:

Po zaključku tega predmeta bo študent sposoben:

- izkazati znanje o ultrazvoku in njegovih virih
- izkazati razumevanje kemijskega učinkovanja ultrazvoka preko mehanizma akustične kavitacije
- analizirati reakcijske pogoje med obsevanjem
- uporaba in načrtovanje laboratorijskih postopkov za sonokemijsko sintezo nanodelcev v vodnih in nevodnih topilih

Prenesljive/ključne spretnosti in drugi atributi:

- obvladovanje sodobnih metod za sintezo anorganskih materialov

Intended learning outcomes:

Knowledge and Understanding:

On completion of this course the student will be able to:

- Demonstrate knowledge about ultrasound and its sources
- Demonstrate understanding of the chemical effect of ultrasound via the mechanism of acoustic cavitation
- Analyse reaction conditions occurring during the process
- Use and design laboratory processes for synthesis of nanostructured materials via sonochemical processes in aqueous and nonaqueous solvents

Transferable/Key Skills and other attributes:

- Mastering of modern methods for the synthesis of inorganic materials
- Practical use of ultrasound in the laboratory and

- praktična uporaba ultrazvoka v laboratoriju in pridobitev pregleda nad industrijskimi aplikacijami ultrazvoka
- pridobitev kemijskih znanj potrebnih za individualno raziskovalno delo s študijem primarne literature, razvojem strategije dela v laboratoriju in karakterizacijo produktov s sodobnimi metodami

- gaining a view of industrial applications of ultrasound
- Acquirement of chemical knowledge needed for individual research work including study of literature, developing work strategies and characterization of products using modern methods

Metode poučevanja in učenja:

- predavanja
- seminar
- seminarska naloga

Learning and teaching methods:

- Lectures
- Seminar
- Seminar work

Načini ocenjevanja:

Delež (v %) /
Weight (in %)

Assessment:

Način (pisni izpit, ustno izpraševanje, naloge, projekt)	Delež (v %) / Weight (in %)	Type (examination, oral, coursework, project):
Izpit je opravljen, če so pozitivno opravljene naslednje študijske obveznosti:		The student has to pass successfully the following obligations:
• ustni izpit	50	• Oral examination
• seminarska naloga	50	• Seminar work

Reference nosilca / Lecturer's references:

1. KRISTL, Matjaž, KRISTL, Janja. Sonochemical process for the preparation of nanosized copper selenides with different phases. *Chalcogenide letters*, ISSN 1584-8663. [Online ed.], Feb. 2014, vol. 11, no. 2, str. 59-66. www.chalcogen.ro/59_Kristl.pdf. [COBISS.SI-ID [17586198](#)]
2. KRISTL, Matjaž, HOJNIK, Nuša, GYERGYEK, Sašo, DROFENIK, Mihael. Sonochemical preparation of copper sulfides with different phases in aqueous solutions. *Materials research bulletin*, ISSN 0025-5408. [Print ed.], Mar. 2013, vol. 48, iss. 3, str. 1184-1188, doi: [10.1016/j.materresbull.2012.12.020](https://doi.org/10.1016/j.materresbull.2012.12.020). [COBISS.SI-ID [16676886](#)]
3. DENAC, Boštjan, KRISTL, Matjaž, GYERGYEK, Sašo, DROFENIK, Mihael. Preparation and characterization of ternary cadmium chalcogenides. *Chalcogenide letters*, ISSN 1584-8663. [Online ed.], March 2013, vol. 10, no. 3, str. 87-98. http://www.chalcogen.infim.ro/87_Denac.pdf. [COBISS.SI-ID [16733718](#)]
4. BAN, Irena, KRISTL, Matjaž, DANČ, Valerija, DANČ, Anita, DROFENIK, Mihael. Preparation of cadmium telluride nanoparticles from aqueous solutions by sonochemical method. *Materials letters*, ISSN 0167-577X. [Print ed.], 15. Jan. 2012, vol. 67, iss. 1, str. 56-59, doi: [10.1016/j.matlet.2011.09.001](https://doi.org/10.1016/j.matlet.2011.09.001). [COBISS.SI-ID [15371798](#)]
5. KRISTL, Matjaž, BAN, Irena, DANČ, Anita, DANČ, Valerija, DROFENIK, Mihael. A sonochemical method for the preparation of cadmium sulfide and cadmium selenide nanoparticles in aqueous solutions. *Ultrasonics Sonochemistry*, ISSN 1350-4177, June 2010, vol. 17, iss. 5, str. 916-922, doi: [10.1016/j.ultsonch.2009.12.013](https://doi.org/10.1016/j.ultsonch.2009.12.013). [COBISS.SI-ID [13766422](#)]



Univerza v Mariboru

Fakulteta za kemijo
in kemijsko tehnologijo

UČNI NAČRT PREDMETA / COURSE SYLLABUS

Predmet:	Energetski Management
Course title:	Energy Management

Študijski program in stopnja Study programme and level	Študijska smer Study field	Letnik Academic year	Semester Semester
Kemija in kemijska tehnika, 3.stopnja	Kemijska tehnika	1. / 2.	poletni /zimski
Chemistry and Chemical Engineering, 3rd level	Chemical Engineering	1. / 2.	spring /autumn

Vrsta predmeta / Course type

Izbirni/Elective

Univerzitetna koda predmeta / University course code:

Predavanja Lectures	Seminar Seminar	Sem. vaje Tutorial	Lab. vaje Laboratory work	Teren. vaje Field work	Samost. delo Individ. work	ECTS
10	10				430	15

Nosilec predmeta / Lecturer:

Jurij Krope

Jeziki /

Predavanja / Lectures:

slovenski / Slovene

Languages:

Vaje / Tutorial:

slovenski / Slovene

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

pogojev ni

Prerequisites:

None

Vsebina:

- energetski management in energijske pretvorbe
- pretočna omrežja, rekuperacije, razsvetljava, proizvodnja toplote
- energetska analiza sistemov
- ekonomsko vrednotenje energetskih sistemov
- optimizacija energetskih sistemov
- vzdrževanje energetskih sistemov

Seminar:

podrobna vsebina seminarja se bo določila na osnovi dogovora z mentorjem in se bo nanašala na tematiko predmeta

Content (Syllabus outline):

- Energy management and energy conversions
- Types of energy systems (flow-pressure networks, recuperation, lightening, heat production)
- Energy consumption of systems
- Economical evaluation of energy systems
- Optimisation of energy systems
- Energy systems maintenance

Seminar:

Detailed content of seminar will be determined on the basis of agreement with mentor and will be related to the subject

Temeljni literatura in viri / Readings:

G. J. Levermore, Building Energy Management Systems, 2nd edition, E&FN Spon, 2000
W. C. Turner, Energy management handbook, Other, 5th edition, 2004.

Priporočena dodatna literatura:

Capehart Barney L., Turner Wayne C., Kennedy William J., Guide to energy management, 6th Edition, 2008.
Turner W., Energy management handbook, Fairmont press, Liburn, 2001.

Cilji in kompetence:

- razvoj in osvojitve znanj o učinkovitem in gospodarno uspešnem načrtovanju energetske oskrbe
- poznavanje standardnih metod in možnosti vključevanja postopkov optimizacije pri reševanju aplikativnih projektov

Objectives and competences:

- To develop and acquire the knowledge of efficient and economically successful designing of energy supply
- Knowledge of standard methods and possibilities of integrating the optimization process for solving applicable projects

Predvideni študijski rezultati:**Znanje in razumevanje:**

- Razumevanje soodvisnosti več znanj in postopkov ter pomena uporabe strokovne literature za učinkovito reševanje inženirskih problemov povezanih z učinkovito rabo energije.
- Sposobnost uporabe ustrezne programske opreme in računalniško načrtovanje zahtevnejših energetskih sistemov.

Prenosljive/ključne spretnosti in drugi atributi:

- Z mentorskim reševanjem konkretnih primerov se oblikuje študentova kreativnost, logično razmišljanje in sposobnost ekonomsko učinkovitega načrtovanja.
- Avtonomnost v strokovnem in raziskovalnem delu

Intended learning outcomes:**Knowledge and Understanding:**

- Understanding of relationship between different knowledge and procedures and importance of professional literature for efficient solutions of engineering problems related to the efficient energy consumption.
- The ability to use the appropriate software and computer aided design of more complex energy systems.

Transferable/Key Skills and other attributes:

- Solving concrete examples under supervision and hence developing student's creativity, logical thinking and the ability of economically efficient designing.
- Autonomy in professional and research work

Metode poučevanja in učenja:

- predavanja
- seminar
- seminarska naloga

Learning and teaching methods:

- Lectures
- Seminar
- Seminar work

Delež (v %) /

Weight (in %)

Načini ocenjevanja:**Assessment:**

Izpit je opravljen, če so pozitivno opravljene vse naslednje obveznosti:

- seminarska naloga
- ustni izpit

50

50

Student has to pass successfully the following obligations:

- Seminar work
- Oral examination

Reference nosilca / Lecturer's references:

KULČAR, Bojan, GORIČANEC, Darko, KROPE, Jurij. Economy of replacing a refrigerant in a cooling system for preparing chilled water = Remplacement du frigorigène dans un système utilisé pour préparer de l'eau glacée : impact financier. International journal of refrigeration, ISSN 0140-7007. [Print ed.], Aug. 2010, vol. 33, iss. 5, str. 989-994

ZORKO, Jerneja, GORIČANEC, Darko, KROPE, Jurij. Process of oxygen transfer and power requirements in activated sludge wastewater treatment plant. Res. J. Chem. Environ., 2011, vol. 15, no. 2, str. 1-3, graf. prikazi. [COBISS.SI-ID 15168534], [JCR, Scopus do 28. 9. 2011: št. citatov (TC): 0, čistih citatov (CI): 0, normirano št. čistih citatov (NC): 0]

TORHAČ, Evgen, GORIČANEC, Darko, KROPE, Jurij, TROP, Peter, SALJNIKOV, Aleksandar. *Geothermal gravity heat pipe for exploitation of geothermal energy from unproductive wells : končno poročilo = Geotermalna gravitacijska toplotna cev za izkoriščanje geotermalne energije neproduktivnih vrtin : final report*. Maribor: Fakulteta za kemijo in kemijsko tehnologijo, 2012. 213 str., ilustr. [COBISS.SI-ID [16626966](#)]

KROPE, Jurij, GORIČANEC, Darko, DOBERŠEK, Danijela, TROP, Peter. Preveritev možnosti izrabe odpadne toplote v HE Dravograd : končno poročilo. Maribor: Fakulteta za kemijo in kemijsko tehnologijo, 2012. 119 str., ilustr. [COBISS.SI-ID 16626454]

KROPE, Jurij, GORIČANEC, Darko, DOBERŠEK, Danijela. Optimizacija lokacije deponije, tehnologije transporta in doziranja komunalne biomase v sušilnik premoga TET : končno poročilo. Maribor: Fakulteta za kemijo in kemijsko tehnologijo, 2012. 90 f., ilustr. [COBISS.SI-ID 16563222]



Univerza v Mariboru

Fakulteta za kemijo
in kemijsko tehnologijo

UČNI NAČRT PREDMETA / COURSE SYLLABUS

Predmet:	Tehnologije obdelave odpadnih vod
Course title:	Technologies of wastewater treatment

Študijski program in stopnja Study programme and level	Študijska smer Study field	Letnik Academic year	Semester Semester
Kemija in kemijska tehnika, 3.stopnja	Kemijska tehnika	1. / 2.	poletni / zimski
Chemistry and Chemical Engineering, 3rd level	Chemical Engineering	1. / 2.	Spring /Autumn

Vrsta predmeta / Course type

Izbirni / Elective

Univerzitetna koda predmeta / University course code:

Predavanja Lectures	Seminar Seminar	Sem. vaje Tutorial	Lab. vaje Laboratory work	Teren. vaje Field work	Samost. delo Individ. work	ECTS
10	10				430	15

Nosilec predmeta / Lecturer:

Darko Goričanec

Jeziki /

Predavanja / Lectures:

slovenski / Slovene

Languages:

Vaje / Tutorial:

slovenski / Slovene

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

pogojev ni

Prerequisites:

None

Vsebina:

- analiza odpadnih vod
- določitev pretoka, sestave in koncentracije odpadnih snovi (statistična analiza)
- fizikalne procesne naprave
- kemijske procesne naprave
- biološka obdelava odpadnih vod
- postopki biološke obdelave odpadnih vod v suspenziji
- postopki biološke obdelave odpadnih vod s tvorbo biofilma
- anaerobna biološka obdelava v suspenziji ali s tvorbo biofilma
- naprave za dodatno obdelavo odpadne vode
- dezinfekcija obdelane odpadne vode
- ponovna uporaba obdelane odpadne vode
- obdelava, ponovna uporaba ter odstranjevanje trdih in bioloških snovi

Seminar:

izdelava seminarske naloge vezane na tematiko predmeta

Content (Syllabus outline):

- Analysis of wastewater
- Determination of mass flow, composition and concentration of waste substances (statistical analyse)
- Physical process equipment
- Chemical process equipment
- Biological waste water treatment
- Methods of biological wastewater treatment in suspension
- Methods of biological wastewater treatment with biofilm formation
- Anaerobic biological water treatment in suspension or with biofilm formation
- Devices for additional wastewater treatment
- Re-use of treated wastewater
- Treatment, re-use and removing of hard and biological substances

Seminar

Preparation of seminar work related to the content of the subject

Temeljni literatura in viri / Readings:

- Metcalf & Eddy, Inc: Wastewater Engineering Treatment and Reuse, McGraw - Hill Higher Education, pp. 1819, 2003.
- Morgens Henze, Poul Harremoes, Jes LA Cour Jansen, Eric Arvin: Wastewater Treatment: Biological and Chemical Processes (Environmental Engineering), Springer Verlag, pp. 420, 2001.

Cilji in kompetence:

- sposobnost pravilne izbire fizikalnih in kemijskih postopkov obdelave odpadnih vod
- priprava novih strategij in konceptov za obratovanje naprav za obdelavo odpadnih vod

Objectives and competences:

- Ability of correct choice between physical or chemical waste water treatment processes
- Ability to develop new strategies and concepts for operating the equipment for waste water treatment

Predvideni študijski rezultati:**Znanje in razumevanje:**

- obvladovanje naprednih tehnik obdelave odpadnih vod
- razumevanje postopkov naprednih tehnologij za obdelavo odpadnih vod

Prenesljive/ključne spretnosti in drugi atributi:

- obvladovanje zahtevnejših inženirskih problemov na področju obdelave odpadnih vod
- sposobnost prenosa teorije na reševanje praktičnih primerov

Intended learning outcomes:**Knowledge and Understanding:**

- In-depth knowledge of advanced techniques for waste water treatment
- Knowledge of procedures of advanced technologies for waste water treatment.

Transferable/Key Skills and other attributes:

- In-depth knowledge of complex engineering problems in waste water treatment
- The ability to use the theory to solve practical problems

Metode poučevanja in učenja:

- predavanja
- seminar
- seminarska naloga

Learning and teaching methods:

- Lectures
- Seminar
- Seminar work

Načini ocenjevanja:

Delež (v %) /
Weight (in %)

Assessment:

Izpit je opravljen, če so pozitivno opravljene vse naslednje obveznosti:

- seminarska naloga
- ustni izpit

50

50

Student has to pass successfully the following obligations:

- Seminar work
- Oral examination

Reference nosilca / Lecturer's references:

ZORKO, Jerneja, GORIČANEC, Darko, KROPE, Jurij. Process of oxygen transfer and power requirements in activated sludge wastewater treatment plant. Research Journal of Chemistry and Environment, ISSN 0972-0626, 2011, vol. 15, no. 2, str. 1-3, graf. prikazi. [COBISS.SI-ID 15168534]

DOBERŠEK, Danijela, GORIČANEC, Darko, TROP, Peter. Municipal wastewater treatment plants in Slovenia. International journal of energy and environment, 2012, vol. 6, iss. 6, str. 579-587.
<http://www.naun.org/multimedia/NAUN/energyenvironment/16-688.pdf>. [COBISS.SI-ID 16535318]

DOBERŠEK, Danijela, GORIČANEC, Darko. An experimentally evaluated magnetic device's efficiency for water-scale reduction on electric heaters. Energy, ISSN 0360-5442. [Print ed.], Available online 27 September 2014, str. 1-8

DOBERŠEK, Danijela, GORIČANEC, Darko, KROPE, Jurij. Dryers for sewage sludge dehydration. International journal of energy and environment, 2012, vol. 6, iss. 6, str. 588-596.
<http://www.naun.org/multimedia/NAUN/energyenvironment/16-691.pdf>. [COBISS.SI-ID 16535062]

DOBERŠEK, Danijela, GORIČANEC, Darko. The role of threshold inhibitors on water scale precipitation from tap water. Research Journal of Chemistry and Environment, ISSN 0972-0626, Oct. 2013, vol. 17, no. 10, str. 77-81, ilustr. [COBISS.SI-ID 17192982].



Univerza v Mariboru

Fakulteta za kemijo
in kemijsko tehnologijo

UČNI NAČRT PREDMETA / SUBJECT SPECIFICATION

Predmet:	Kemija keramičnih materialov
Subject Title:	Chemistry of ceramic materials

Študijski program Study programme	Študijska smer Study field	Letnik Year	Semester Semester
Kemija in kemijska tehnika Chemistry and Chemical Engineering	Kemija Chemistry	1. / 2.	zimski / poletni Autumn / Spring

Vrsta predmeta / Course type:

Izbirni Elective

Univerzitetna koda predmeta / University subject code:

Predavanja Lectures	Seminar Seminar	Sem. vaje Tutorial	Lab. vaje Labor work	Teren. vaje Field work	Samost. delo Individ. work	ECTS
10	10				430	15

Nosilec predmeta / Lecturer:

Mihael Drofenik

Jeziki /

Languages:

Predavanja / Lecture:

Vaje / Tutorial:

slovenski / Slovene

slovenski / Slovene

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

- pogojev ni

Prerequisites:

- None

Vsebina:

- struktura keramike: oksidna keramika, neoksidna keramika, stekla
- kemijske reakcije v keramiki: fazna ravnotežja, difuzija in transport snovi, sintranje in zgoščevanje, ostali keramični procesi
- fizikalne lastnosti keramike: termične lastnosti, električne lastnosti, magnetne lastnosti, mehanske lastnosti

Seminar:

- podrobna vsebina seminarja se bo določila na osnovi dogovora z mentorjem in se bo nanašala na tematiko predmeta

Content (Syllabus outline):

- Structure of the ceramics: oxide ceramics, nonoxide ceramics, glasses
- Chemical reactions and ceramics: phase diagrams, diffusion and transport of matter, sintering and densification, miscellaneous
- Physical properties of ceramics: thermal properties, electrical properties, magnetic properties, mechanical properties

Seminar:

- Detailed content of seminar will be determined on the basis of agreement with mentor and will be related to the subject

Temeljni literatura in viri / Textbooks:

- H. Yanagida, K. Koumoto, M. Miyayama, Chemistry of Ceramics, John Wiley & Sons, 1996.
- Primarna literatura (npr. članki) s tematiko glede na študentovo področje raziskovanja / Primary literature (e.g. papers) corresponding to the student's research interest.

Cilji:

- pridobitev kemijskega znanja potrebnega za samostojno načrtovanje in sintezo keramičnih in steklastih materialov
- obvladovanje raziskav povezanih z načrtovanimi keramičnimi materiali

Objectives:

- Acquiring the chemical knowledge needed for the development of targeting ceramic and glass materials
- Mastering of the investigation and /or development activities in the field of ceramics and glass

Predvideni študijski rezultati:Znanje in razumevanje:

- pridobitev znanj potrebnih za načrtovanje in realizacijo keramičnih materialov

Prenesljive/ključne spretnosti in drugi atributi:

- samostojno načrtovanje razvojnih raziskav za izdelavo načrtovanih keramičnih materialov
- pridobitev znanj potrebnih za sodelovanje z ostalimi raziskovalnimi skupinami

Intended learning outcomes:Knowledge and Understanding:

- Acquirement of technological knowledge needed for autonomous planning and/or performing of targeting ceramic materials

Transferable/Key Skills and other attributes:

- Autonomous planning of investigation and material development
- Acquirement of general technological knowledge needed for collaboration with other technological subjects

Metode poučevanja in učenja:

- predavanja
- seminar
- seminarska naloga

Learning and teaching methods:

- Lectures
- Seminar
- Seminar work

Delež (v %) / Weight (in %)		Assessment:
Načini ocenjevanja:		
Izpit je opravljen, če so pozitivno opravljene vse naslednje obveznosti:		Student has to pass successfully the following obligations:
• seminarska naloga	50	• Seminar work
• ustni izpit	50	• Oral examination

Reference nosilca / Lecturer's references:

HOJNIK, Nuša, KRISTL, Matjaž, GOLOBIČ, Amalija, JAGLIČIĆ, Zvonko, DROFENIK, Mihael. Hydrolytic synthesis of novel lanthanide(III) complexes with pyridine-2,6-dicarboxylic acid. *Journal of molecular structure*, 2015, vol. 1079, str. 54-60,

HOJNIK, Nuša, KRISTL, Matjaž, GOLOBIČ, Amalija, JAGLIČIĆ, Zvonko, DROFENIK, Mihael. The synthesis, structure and physical properties of lanthanide(III) complexes with nicotinic acid. *Central European Journal of Chemistry*, 2014, vol. 12, iss. 2, str. 220-226,

KRISTL, Matjaž, HOJNIK, Nuša, GYERGYEK, Sašo, DROFENIK, Mihael. Sonochemical preparation of copper sulfides with different phases in aqueous solutions. *Materials research bulletin*, 2013, vol. 48, iss. 3, str. 1184-1188,

LISJAK, Darja, DROFENIK, Mihael. Chemical substitution - an alternative strategy for controlling the particle size of barium ferrite. *Crystal growth & design*, 2012, vol. 12, no. 11, str. 5174-5179,

DOJER, Brina, PEVEC, Andrej, JAGODIČ, Marko, KRISTL, Matjaž, DROFENIK, Mihael. Three new cobalt(II) carboxylates with 2-, 3- and 4-aminopyridine : syntheses, structures and magnetic properties. *Inorganica Chimica Acta*, 2012, vol. 383, str. 98-104,



Univerza v Mariboru

Fakulteta za kemijo
in kemijsko tehnologijo

UČNI NAČRT PREDMETA / COURSE SYLLABUS

Predmet:	Nanotehnologije
Course title:	Nanotechnologies

Študijski program in stopnja Study programme and level	Študijska smer Study field	Letnik Academic year	Semester Semester
Kemija in kemijska tehnika, 3.stopnja Chemistry and Chemical Engineering, 3rd level	Kemijska tehnika Chemical Engineering	1. / 2.	zimski / poletni Autumn/ Spring

Vrsta predmeta / Course type

Izbirni/Elective

Univerzitetna koda predmeta / University course code:

Predavanja Lectures	Seminar Seminar	Sem. vaje Tutorial	Lab. vaje Laboratory work	Teren. vaje Field work	Samost. delo Individ. work	ECTS
10	10				430	15

Nosilec predmeta / Lecturer:

Zoran Novak

**Jeziki /
Languages:**

Predavanja / Lectures: slovenski / Slovene
Vaje / Tutorial: slovenski / Slovene

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

pogojev ni

Prerequisites:

None

Vsebina:

- uvod v nanotehnologijo
- definicija nanotehnologije
- kemija na nano nivoju
- tehnologije za pridobivanje nanodelcev
- »Top-down« in »bottom up« pristopi za pridobivanje nanodelcev
- področja uporabe nanostrukturnih materialov:
Materiali – zlitine, kompoziti, zaščitne in »pametne« prevleke (optična vlakna, biokompatibilni materiali, izdelki za zaščito pred soncem);
Kataliza – katalizatorji za goriva, polimere, farmacevtske izdelke, zaščito okolja (mineralni nano delci, fullereni, organo-kovinske kompleksne molekule za fotokatalizo, senzorji);
Kemijska nanotehnologija – biočipi, površinsko aktivne in koloidne snovi za hrano in zdravje;
Elektronski in optični izdelki – uporaba nanokemije za proizvodnjo polprevodnikov in drugih elektronskih in optičnih izdelkov;

Content (Syllabus outline):

- Introduction to nanotechnology
- Definition of nanotechnology. Chemistry on nano level
- Technologies for production of nano particles
- Top-down« and »bottom up« approaches for production of nano particles
- Use of nanostructural materials:
Materials – alloys, composites, protective and smart coatings (optical wires, biocompatible materials, sun protect products);
Catalysis – catalysts for fuels, polymers, farmaceuticals products (mineral nano particles, fullerens, organo-metall complex molecules for photocatalysis, senzors...);
Chemical nanotechnology – biochips, surface active substances and colloids for food and health;
Electronics and optics – nanotechnology for productions of subconductors and other electronic and optic products;
Glues and coatings

Lepila in premazi Seminarske vaje: podrobna vsebina seminarja se bo določila na osnovi dogovora z mentorjem in se bo nanašala na tematiko predmeta	Seminar Detailed content of seminar will be determined on the basis of agreement with mentor and will be related to the subject
---	--

Temeljni literatura in viri / Readings:

- R. Edward (ed.), Nano: the emerging science of nanotechnology, Back Bay, Boston, 1995.
- A. S. Edelstein, R. C. Cammarata (eds.), Nanomaterials: synthesis, properties and applications, Institute of Physics, Bristol, 1996.
- T. Sugimoto (ed.), Fine particles: synthesis, characterization and mechanism of growth, Marcel Dekker, New York, 2000.

Cilji in kompetence:

- študentom predstaviti najzahtevnejše vidike nano-znanosti in različne nano-tehnologije za pridobivanje nanostrukturnih materialov

Objectives and competences:

- Postgraduated students will gain advanced knowledge about nano-science and different nano technologies for production of nanostructured materials.

Predvideni študijski rezultati:

- poglobljeno poznavanje nano znanosti
- znanje in razumevanje dveh različnih osnovnih pristopov pri pridobivanju nano delcev: bottom up, top down
- razumevanje različnih nano-tehnoloških postopkov in poznavanje različnih področij uporabe nanostrukturnih materialov

Intended learning outcomes:

- Advanced knowledge of nano science
- Knowledge and understanding two basic different approaches for production of nano materials: bottom up, top down
- Understanding different processes on the field of nanotechnology and different usages of nanostructured material

Metode poučevanja in učenja:

- predavanja
- seminar
- seminarska naloga

Learning and teaching methods:

- Lectures
- Seminar
- Seminar work

Načini ocenjevanja:	Delež (v %) / Weight (in %)	Assessment:
Izpit je opravljen, če so pozitivno opravljene vse naslednje obveznosti: - seminarska naloga - ustni izpit	50 50	Student has to pass successfully the following obligations: - Seminar work - Oral examination

Reference nosilca / Lecturer's references:

NOVAK, Zoran (umetnik), KNEZ, Željko. Sol-gel transition for production of silica aerogels. *Chemische Technik*, ISSN 0045-6519, Mai/Juni 1997, jg. 49, heft 3, str. 106-109. [COBISS.SI-ID [2872086](#)]

JESPERSEN, Henrik Tofte, ŠTANDEKER, Suzana, NOVAK, Zoran, SCHAUMBURG, Kjeld, MADSEN, Jeppe, KNEZ, Željko. Supercritical fluids applied to the sol-gel process for preparation of AEROMOSILS/palladium particle nanocomposite catalyst. *The Journal of supercritical fluids*, ISSN 0896-8446. [Print ed.], Sep. 2008, vol. 46, iss. 2, str. 178-184. doi: [10.1016/j.supflu.2008.04.013](#). [COBISS.SI-ID [12544790](#)]

KNEZ, Željko, NOVAK, Zoran. Adsorption of water vapor on silica, alumina, and their mixed oxide aerogels. *Journal of chemical and engineering data*, ISSN 0021-9568, July/August 2001, vol. 46, no. 4, str. 858-867. [COBISS.SI-ID [6463254](#)]

NOVAK, Zoran, KNEZ, Željko, DROFENIK, Mihael, BAN, Irena. Preparation of BaTiO₃ powders using supercritical CO₂ drying of gels. *Journal of non-crystalline solids*, ISSN 0022-3093. [Print ed.], 2001, 285, str. 44-49. [COBISS.SI-ID [6413590](#)]



Univerza v Mariboru

Fakulteta za kemijo
in kemijsko tehnologijo

UČNI NAČRT PREDMETA / SUBJECT SPECIFICATION

Predmet:	Razvoj naravnih produktov
Subject Title:	Food products development

Študijski program Study programme	Študijska smer Study field	Letnik Year	Semester Semester
Kemija in kemijska tehnika Chemistry and Chemical Engineering	Kemijska tehnika Chemical Engineering	1. / 2.	zimski / poletni Autumn / Spring

Vrsta predmeta / Course type:

Izbirni/ Elective

Univerzitetna koda predmeta / University subject code:

Predavanja Lectures	Seminar Seminar	Sem. vaje Tutorial	Lab. vaje Labor work	Teren. vaje Field work	Samost. delo Individ. work	ECTS
10	10				430	15

Nosilec predmeta / Lecturer:

Mojca Škerget

Jeziki /

Languages:

Predavanja / Lecture:

Vaje / Tutorial:

slovenski / Slovene

slovenski / Slovene

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

- pogojev ni

Prerequisites:

- None

Vsebina:

- kemijske in funkcionalne lastnosti naravnih komponent: ogljikovodiki, lipidi, proteini, antioksidanti, vitamini, barvila, minerali in elementi v sledovih, dišave in arome; konzervansi in aditivi
- naravni viri funkcionalnih komponent in postopki pridobivanja
- postopki izolacije in koncentriranja učinkovin: ekstrakcija, kromatografija itd.
- postopki formuliranja in procesiranja v obliko primerno za aplikacijo
- načrtovanje konvencionalnih in visokotlačnih postopkov in prenos iz laboratorijskega v industrijsko merilo: termodinamske in transportne lastnosti sistemov in uporaba modelov
- kontrola kvalitete končnega produkta

Seminar:

- izdelava študije na izbranem primeru: lastnosti produkta, sestava, aktivne učinkovine, postopki pridobivanja, tehnike izolacije in koncentriranja, oblika produkta za aplikacijo ter možne tehnike procesiranja. Načrtovanje postopkov na osnovi termodinamskih in transportnih lastnosti.

Content (Syllabus outline):

- Chemical and functional properties of natural components: Carbohydrates, lipids, proteins, enzymes, vitamins, minerals, colorants, flavors, preservatives, additives
- Natural sources of functional compounds and production methods
- Isolation and concentration methods (extraction, chromatography etc.)
- Formulating and processing for application
- Design of conventional and high pressure processes and scale up: thermodynamic and transport properties of systems and application of models
- Quality control of finished product.

Seminar:

- Study report on selected case: product properties, composition, active compounds, production methods, isolation and concentration methods, proper form for application and formulation techniques. Design of processes based on thermodynamic and transport properties

Temeljni literatura in viri / Textbooks:

Separation, extraction and concentration processes in the food, beverage and nutraceutical industries, Syed S. H. Rizvi (Ed.), Woodhead Publishing Limited, 2010.

Functional Food Product Development; J. Smith, E. Charter (Eds.); Blackwell Publishing Ltd, 2010.

Priporočena dodatna literatura:

Handbook of Nutraceuticals and Functional Foods, R. E. C. WILDMAN (Ed.), 2nd Ed., CRC Press, Taylor & Francis Group, Boca Raton 2007.

A. Y. Leung, S. Foster: *Encyclopedia of common natural ingredients used in food, drugs and cosmetics*. 2nd ed., Wiley, New York, 1996.

J. Buttriss, M. Saltmarsh, eds.: *Functional foods II: claims and evidence*, Cambridge: Royal Society of Chemistry, 2000.

Cilji:

- razvoj naravnih produktih z visoko dodano vrednostjo, ki so zaradi farmakoloških oz tehnoloških vrednot zanimivi za uporabo v prehrabi, kozmetični in farmacevtski industriji

Objectives:

- Development of natural products with high added value, which are due to pharmacological or technological values interesting for application in food, cosmetic and pharmaceutical industry

Predvideni študijski rezultati:Znanje in razumevanje:

- kemijske sestave in lastnosti prehrabnih artiklov in aditivov ter kemijskih sprememb komponent med procesiranjem in skladiščenjem
- postopkov izolacije naravnih aktivnih komponent
- postopkov formulacije v produkt s specifičnimi lastnostmi za aplikacijo
- načrtovanje in optimiranje procesov na osnovi termodinamskih in snovnih transportnih zakonitostih

Prenesljive/ključne spretnosti in drugi atributi:

- razvoj naravnih produktih z visoko dodano vrednostjo

Intended learning outcomes:Knowledge and Understanding:

- of chemical composition and properties of food products and additives and chemical changes during processing and storage
- of isolation and purification processes of active compounds from natural sources
- of formulation processes in products with specific properties for application
- Design and optimization of processes based on thermodynamic and mass transport principles

Transferable/Key Skills and other attributes:

- Development of natural products with high added value

Metode poučevanja in učenja:

- predavanja
- seminar
- seminarska naloga

Learning and teaching methods:

- Lectures
- Seminar
- Seminar work

Načini ocenjevanja:

Izpit je opravljen, če so pozitivno opravljene vse naslednje obveznosti:

- seminarska naloga
- ustni izpit

Delež (v %) /

Weight (in %)

Assessment:

Student has to pass successfully the following obligations:

- Seminar work
- Oral examination

70

30

Reference nosilca / Lecturer's references:

RAVBER, Matej, KNEZ, Željko, ŠKERGET, Mojca. Simultaneous extraction of oil- and water-soluble phase from sunflower seeds with subcritical water. Food chemistry, ISSN 0308-8146. [Print ed.], Jan. 2015, vol. 166, str. 316-323, [COBISS.SI-ID 17908502].

PAVLOVIČ, Irena, KNEZ, Željko, ŠKERGET, Mojca. Hydrothermal reactions of agricultural and food processing wastes in sub- and supercritical water : a review of fundamentals, mechanisms, and state of research. Journal of agricultural and food chemistry, ISSN 0021-8561, 2013, vol. 61, no. 34, str. 8003-8025, [COBISS.SI-ID 17077526].

RUŽIČ, Iva, ŠKERGET, Mojca, KNEZ, Željko, RUNJE, Mislav. Phenolic content and antioxidant potential of macerated white wines. European Food Research and Technology. A, Zeitschrift für Lebensmittel-Untersuchung und -Forschung,

ISSN 1438-2377. [Print ed.], 2011, vol. 233, no. 3, str. 465-472, [COBISS.SI-ID 15174422].

MAKOVŠEK, Katja, KNEZ, Željko, ŠKERGET, Mojca. Influence of process parameters on the extraction of flavanones from mandarin peel. *Acta chimica slovenica*, ISSN 1318-0207. [Tiskana izd.], 2012, vol. 59, no. 4, str. 879-887. [COBISS.SI-ID 16555542].

ŠKERGET, Mojca, BEZJAK, Miran, MAKOVŠEK, Katja, KNEZ, Željko. Extraction of lutein diesters from *tagetes erecta* using supercritical CO₂ and liquid propane. *Acta chimica slovenica*, ISSN 1318-0207. [Tiskana izd.], 2010, vol. 57, št. 1, str. 60-65, ilustr. [COBISS.SI-ID 14011158].

KOTNIK, Petra, ŠKERGET, Mojca, KNEZ, Željko. Phase equilibria of free fatty acids enriched vegetable oils and carbon dioxide : experimental data, distribution coefficients and separation factors. *The Journal of supercritical fluids*, 2014, vol. 87, str. 65-72. [COBISS.SI-ID 17574678]



Univerza v Mariboru

Fakulteta za kemijo
in kemijsko tehnologijo

UČNI NAČRT PREDMETA / COURSE SYLLABUS

Predmet:	Uporabna elektrokemija
Course title:	Applied electrochemistry

Študijski program in stopnja Study programme and level	Študijska smer Study field	Letnik Academic year	Semester Semester
Kemija in kemijska tehnika, 3. stopnja	Kemija	1./2.	poletni / zimski
Chemistry and Chemical Engineering, 3rd level	Chemistry	1./2.	Spring / Autumn

Vrsta predmeta / Course type

Izbirni/Elective

Univerzitetna koda predmeta / University course code:

Predavanja Lectures	Seminar Seminar	Sem. vaje Tutorial	Lab. vaje Laboratory work	Teren. vaje Field work	Samost. delo Individ. work	ECTS
10	10	/	/	/	430	15

Nosilec predmeta / Lecturer:

Matjaž Finšgar

Jeziki /

Predavanja / Lectures: slovensko/Slovene

Languages:

Vaje / Tutorial: slovenski/Slovene

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

Pogojev ni

Prerequisites:

None

Vsebina:

Principi delovanja in uporaba elektrokemijskih analiznih metod, omejenost teh metod in pogoste napake meritev:
- Elektrokemijska kremenova mikrotehnika ali nanotehnika (EQCM ali EQCN), ciklična voltametrika (CV), elektrokemijska impedančna spektroskopija (EIS), elektrokemijski šum (EN), kronopotenciometrija, kronokulometrija, kronoamperometrija, ciklična polarizacija (CP), tehnike EFM, SECM, SVET, SKP in LEIS, tehnike za merjenje permeabilnosti vodika. Simulacija elektrodnih procesov z uporabo računalniških programov.
Spektroelektrokemija:

Content (Syllabus outline):

Operating principles and applications of electrochemical analytical methods, limitations of these methods and common experimental errors:
- Electrochemical quartz crystal microbalance or nanobalance (EQCM or EQCN), cyclic voltammetry (CV), electrochemical impedance spectroscopy (EIS), electrochemical noise (EN), chronopotentiometry, chronocoulometry, chronoamperometry, cyclic polarization (CP), EFM, SECM, SVET, SKP, and LEIS techniques, techniques for measuring the permeability of hydrogen.
Simulation of electrode processes using computer programs.

- EC-AFM, EC-STM, EC-IR, EC-UV-Vis, zadnji trendi in tehnike razvoja spektroelektrokemije
Pregled različnih konfiguracij elektrokemijskih celic.

Spectroelectrochemistry:
- EC-AFM, STM-EC, EC-IR, EC-UV-Vis, the latest trends and techniques in the development of spectroelectrochemistry
Overview of the different electrochemical cell configurations.

Temeljni literatura in viri / Readings:

Joseph Wang, Analytical Electrochemistry, 3rd Edition, Toronto 2006

Mark E. Orazem & Bernard Tribollet, Electrochemical Impedance Spectroscopy, ECS, John Wiley & Sons, New Jersey, 2008

Primarna literatura (npr. članki) s tematiko glede na študentovo področje raziskovanja / Primary literature (e.g. papers) corresponding to the student's research interest.

Cilji in kompetence:

Poglobljen študij elektrokemijskih zakonitosti bo podal kritičen pogled glede omejitev in prednosti uporabe sodobnih elektroanaliznih metod za raziskave materialov in elektrokemijskih senzorjev. Z uporabo tega znanja bodo študenti sposobni izbrati primerno metodo za reševanje problemov na več raziskovalnih področjih.

Objectives and competences:

A detail study of electrochemical operations will give a critical view regarding the limitations and advantages of using modern electroanalytical methods for materials research and electrochemical sensors. Using this knowledge, students will be able to choose an appropriate method for solving problems in many research areas.

Predvideni študijski rezultati:

Znanje in razumevanje:
Študenti bodo pridobili znanja za raziskovalno delo na področjih raziskav, kjer se uporabljajo sodobne elektrokemijske tehnike. Obvladali bodo sodobno instrumentacijo in razumeli principe naprednih elektrokemijskih tehnik. Pridobili bodo kritičen pogled na izbiro različnih tehnik glede na definiran problem. Pridobljeno znanje je namenjeno preiskavam novih materialov, elektrokemijskim sintezam, študiju omejitvam in prednostim elektroanaliznih metod, razvoju novih metod za določen problem, itd. Študenti se v tem procesu usposobijo za individualno raziskovalno delo.

Intended learning outcomes:

Knowledge and understanding:
Students will obtain knowledge for research in the fields, where the use of modern electrochemical techniques are needed. They will acquire knowledge about modern instrumentation and understand the principles of advanced electrochemical techniques. They will gain a critical view on the choice of different techniques according to the certain problem. The knowledge acquired is intended for investigations of new materials, electrochemical synthesis, study limitations and advantages of electroanalytical methods, development of new methods for a given problem, etc. Students are trained in this process for individual research work.

Metode poučevanja in učenja:

Learning and teaching methods:

• predavanja • seminar • seminarska naloga	• Lectures • Seminar • Coursework
--	---

Delež (v %) / Weight (in %)		Assessment:
Načini ocenjevanja:		
Izpit je opravljen, če so pozitivno opravljene vse naslednje obveznosti:		Student has to pass successfully the following obligations:
• seminarska naloga • ustni izpit	50% 50%	• Coursework • Oral examination

Reference nosilca / Lecturer's references:

FINŠGAR, Matjaž. EQCM and XPS analysis of 1,2,4-triazole and 3-amino-1,2,4-triazole as Copper corrosion inhibitors in chloride solution. Corrosion science, 2013, vol. 77, str. 350-359

FINŠGAR, Matjaž. 2-mercaptobenzimidazole as a copper corrosion inhibitor : Part I. : long-term immersion, 3D-profilometry, and electrochemistry. Corrosion science, 2013, vol. 72, str. 82-89

FINŠGAR, Matjaž. Galvanic series of different stainless steels and copper- and aluminium-based materials in acid solutions. Corrosion science, 2013, vol. 68, str. 51-56

FINŠGAR, Matjaž, KEK-MERL, Darja. 2-mercaptobenzoxazole as a copper corrosion inhibitor in chloride solution : electrochemistry, 3D-profilometry, and XPS surface analysis. Corrosion science, 2014, vol. 80, str. 82-95

FINŠGAR, Matjaž, KEK-MERL, Darja. An electrochemical, long-term immersion, and XPS study of 2-mercaptobenzothiazole as a copper corrosion inhibitor in chloride solution. Corrosion science, 2014, vol. 83, str. 164-175



Univerza v Mariboru

Fakulteta za kemijo
in kemijsko tehnologijo

UČNI NAČRT PREDMETA / SUBJECT SPECIFICATION

Predmet:	Kakovost: evropski pristop
Subject Title:	Quality: the European way

Študijski program Study programme	Študijska smer Study field	Letnik Year	Semester Semester
Kemija in kemijska tehnika Chemistry and Chemical Engineering	Kemija Chemistry	1. / 2.	zimski / poletni Autumn / Spring

Vrsta predmeta / Course type:

Izbirni/Elective

Univerzitetna koda predmeta / University subject code:

Predavanja Lectures	Seminar Seminar	Sem. vaje Tutorial	Lab. vaje Labor work	Teren. vaje Field work	Samost. delo Individ. work	ECTS
10	10				430	15

Nosilec predmeta / Lecturer:

Philip Taylor

Jeziki /

Languages:

Predavanja / Lecture:

Vaje / Tutorial:

slovenski / Slovene

slovenski / Slovene

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

- pogojev ni

Prerequisites:

- None

Vsebina:

- pregled tehniške infrastrukture na evropskem nivoju (meroslovje, akreditacija, standardizacija)
- pregled evropske tehniške zakonodaje, ki vsebuje zahteve glede rezultatov meritev
- ključni procesi v meroslovju, akreditaciji in standardizaciji
- razlaga vloge in posledic evropske tehniške zakonodaje
- opis medsebojnih soodvisnih povezav med vsemi akterji evropske in nacionalne tehniške infrastrukture

Seminar:

- identifikacija subjektov kakovostne infrastrukture, ki so vključeni v izvajanje določene evropske zakonodaje (varstvo potrošnikov, hrana, okolje) ter opis njihovih aktivnosti
- identifikacija potrebnih uslug kakovostne infrastrukture pri proizvodnji določenega proizvoda ali usluge

Content (Syllabus outline):

- Overview of quality infrastructure at the European level (metrology, accreditation, standardisation)
- Overview of the European Technical legislation, including requirements concerning measurements
- Basic processes of metrology, accreditation and standardization
- Explanation of the role and consequences of European technical legislation
- Describing the network and interrelations between all the stakeholders

Seminar:

- Identify inside a European legislative text (e.g. consumer protection, food, environment) which quality infrastructure organizations are involved and describe their activity
- Identify quality infrastructure services that are needed when producing a certain product or service

Temeljni literatura in viri / Textbooks:

- Blue guide of DG enterprise
- ISO standardi serije 9000 in 17000
- Metrology in short, EUROMET, 2004
- Primarna literatura (npr. članki) s tematiko glede na študentovo področje raziskovanja / Primary literature (e.g.

papers) corresponding to the student's research interest.

Cilji:

- naučiti slušatelja o tehniški infrastrukturi na evropskem nivoju (meroslovje, akreditacija, standardizacija)
- naučiti slušatelja o ključnih procesih meroslovja, akreditacije in standardizacije
- razumevanje pomena in vpliva tehniške infrastrukture na življenje državljanov
- naučiti slušatelja o potencialnih težavah delovanje sistema tehniške infrastrukture in načinih njihovega reševanja

Objectives:

- To learn about the quality infrastructure in Europe, namely accreditation, metrology, standardization
- To learn about basic processes of each of the above mentioned activities
- To learn how such the infrastructure helps and how it affects the citizens
- To learn about the potential problems and ways of solving

Predvideni študijski rezultati:Znanje in razumevanje:

- vseh inštitucij tehniške infrastrukture (meroslovja, akreditacije, standardizacije)
- povezav med inštitucijami in ključnimi procesi
- evropske tehniške zakonodaje
- vpeljave ključnih procesov povezanih s tehniško infrastrukturo v delovno okolje

Prenesljive/ključne spretnosti in drugi atributi:

- analiziranje kompleksnih sistemov z vidika analize procesov
- pridobivanje informacij s kombiniranjem podatkov pridobljenih z intervjuji s strokovnjaki ter s spletnih strani
- prenašanje teoretičnega znanja v prakso v delovnem okolju

Intended learning outcomes:Knowledge and Understanding:

- Deeper understanding of each of the actors (e.g. metrology, accreditation, standardization, market surveillance)
- Understanding of linking (networking) between them
- Understanding of technical legislation in Europe
- Understanding of how to apply processes in a working environment

Transferable/Key Skills and other attributes:

- Analysing complex systems by means of process analysis
- Retrieving relevant pieces of information by means of combined use of interview of experts and via internet
- Translating their theoretical knowledge into real life organisation

Metode poučevanja in učenja:

- predavanja
- seminar
- seminarska naloga

Learning and teaching methods:

- Lectures
- Seminar
- Seminar work

Načini ocenjevanja:

Delež (v %) /
Weight (in %)

Assessment:

Izpit je opravljen, če so pozitivno opravljene vse naslednje obveznosti:

- seminarska naloga
- ustni izpit

40
60

Student has to pass successfully the following obligations:

- Seminar work
- Oral examination

Reference nosilca / Lecturer's references:

Inkret, M., Valkiers, S., Berglund, M., Majcen, N., Taylor, P., & Zupan, J. (2008). Optimization of the sample preparation procedure for the conversion of enriched²⁸Si single crystal to enriched gaseous²⁸SiF₄. *Acta Chimica Slovenica*, 55(2), 294-301. Retrieved from www.scopus.com

Suchánek, M., Robouch, P., Aregbe, Y., Herrero, A., & Taylor, P. (2007). The use of multiple correspondence analysis for the evaluation of inter-laboratory comparisons. *Accreditation and Quality Assurance*, 12(8), 399-403. Retrieved from www.scopus.com

Papadakis, I., Van Nevel, L., Harper, C., Aregbe, Y., & Taylor, P. D. P. (2007). IMEP-12: Trace elements in water; objective evaluation of the performance of the laboratories when measuring quality parameters prescribed in the european directive 98/83/EC. *Accreditation and Quality Assurance*, 12(2), 105-111. Retrieved from www.scopus.com

Prohaska, T., Bulska, E., Duta, S., Leito, I., Magnusson, B., Majcen, N., et al. (2006). Report of the 1st AcadeMiC summer school for 'metrology in chemistry', held in Rogaška slatina, slovenia (6-9 july 2005). *Analytical and Bioanalytical Chemistry*, 385(6), 1031-1032. Retrieved from www.scopus.com

Bednarova, M., Aregbe, Y., Harper, C., & Taylor, P. D. P. (2006). Evaluation of laboratory performance in IMEP water interlaboratory comparisons. *Accreditation and Quality Assurance*, 10(11), 617-626. Retrieved from www.scopus.com



Fakulteta za kemijo
in kemijsko tehnologijo

UČNI NAČRT PREDMETA / SUBJECT SPECIFICATION

Predmet:	Trajnostni razvoj
Subject Title:	Sustainable development

Študijski program Study programme	Študijska smer Study field	Letnik Year	Semester Semester
Kemija in kemijska tehnika Chemistry and Chemical Engineering	Kemijska tehnika Chemical Engineering	1. / 2.	zimski / poletni Autumn / Spring

Vrsta predmeta / Course type:

Izbirni/ Elective

Univerzitetna koda predmeta / University subject code:

Predavanja Lectures	Seminar Seminar	Sem. vaje Tutorial	Lab. vaje Labor work	Teren. vaje Field work	Samost. delo Individ. work	ECTS
10	10				430	15

Nosilec predmeta / Lecturer:

Peter Glavič

**Jeziki /
Languages:**

Predavanja / Lecture: slovenski / Slovene
Vaje / Tutorial: slovenski / Slovene

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

- pogojev ni

Prerequisites:

- None

Vsebina:

<u>Predavanja:</u> • Svetovni trendi (izkoriščanje naravnih virov, vplivi onesnaževanja, rast prebivalstva itd.) • Osnove okoljevarstva (ekološka organizacija in procesi v ekosistemih, prenos onesnaževal) • Razvoj koncepta trajnostnega razvoja (deklaracije, podobnosti definicij) • Koncepti in načela trajnostnega razvoja (obveze inštitucij, sistemski pristop, strategije) • Trajnost v kemijski tehniki (vplivi industrijskih aktivnosti na okolje, strategije načrtovanja, analiza okoljskih vplivov, snovne bilance, dematerializacija; okolje, zdravje in varnost; eko-učinkovitost, čistejša proizvodnja, ničelni odpadki, upravljanje dobavnih verig) • Trajnostna raba energije (viri energije, energetska učinkovitost, energetska politika) • Upravljanje z okoljem (ISO 14000, EMAS, IPPC, GRI) • Tehnološke inovacije • Merjenje trajnostnega razvoja in metodologije ocenjevanja (kazalci, cilji, okoljsko računovodstvo in ocenjevanje, ekološki odtis, trajnostne lestvice, orodja za odločanje, poročanje (o trajnosti, okolju,

Content (Syllabus outline):

<u>Lectures:</u> • Current global issues (resource depletion, pollution impacts, population growth etc.) • Fundamentals of environmental engineering (ecological organization and ecosystem processes, pollutant pathways) • Evolution of sustainable development thinking (declarations, commonality in definitions) • Sustainable development concepts and principles (commitment of institutions, systems approach, strategies) • Sustainability in Chemical Engineering (impact to environment, design strategies, environmental impact and input-output analysis, Environment, health, safety, Eco-efficiency, Cleaner production, Zero waste, Supply chain management) • Sustainable energy use (energy sources, energy efficiency, energy policy) • Environmental management (ISO 14000 series, EMAS, IPPC, GRI). • Technological innovation • Sustainability metrics and assessment (Indicators, targets, Environmental accounting and assessment,

učinkovitosti) • Trajnostna potrošnja • Perspektiva kemijske tehnike <u>Seminar:</u> • Seminar obsega detajlni študij enega poglavja s praktičnim primerom uporabe pridobljenega znanja.	Ecological Footprint, Environmental rankings, Decision Making Tools, Reporting (sustainability, environmental, efficiency) • Sustainable consumption • Perspectives in chemical engineering <u>Seminar:</u> • Seminar comprises detailed study of one chapter using a practical example of the knowledge acquired.
--	--

Temeljni literatura in viri / Textbooks:

- Azapagic, R. Clift, S. Perdan, Sustainable Development in Practice: Case Studies for Engineers and Scientists. John Wiley & Sons, 2004.
- B. Wallace, Becoming Part of the Solution: The Engineer's Guide to Sustainable Development, American, 2005.
- K. Mulder, Sustainable Development for Engineers, Greenleaf Publishing, 2006.
- D. C. Esty, A. S. Winston, Green to Gold: How Smart Companies Use Environmental Strategy to Innovate, Create Value, and Build Competitive Advantage. Yale University Press, 2006.
- C. Vezzoli, E. Manzini, Design for Environmental Sustainability. Springer, 2008.
- J. Fresner et al., Promoting resource efficiency in small and medium sized enterprises, UNEP, 2010
- Towards Green Growth: monitoring Progress, OECD Green Growth Studies, 2011.
- Ad hoc Working Group, Report on critical raw materials for the EU, European Commission, 2014.

Cilji:

- seznanitev s sodobnimi koncepti in orodji za doseganje trajnostnega (vzdržnega) razvoja v kemijski in procesnih industrijah

Objectives:

- introduction to modern concepts and tools for achievement of sustainable development in chemical and process industries

Predvideni študijski rezultati:

Znanje in razumevanje:

- celovito razumevanje koncepta in načel trajnostnega razvoja
- obvladovanje naprednih pristopov k doseganju trajnostnega razvoja v kemijski in procesnih industrijah
- sposobnost razvoja načrtov, strategij in ukrepov za trajnostni razvoj

Prenesljive/ključne spretnosti in drugi atributi:

- sposobnost razvoja novega znanja na podlagi pridobljenih poglobljenih osnov trajnostnega razvoja
- sposobnost delovanja v multidisciplinarnih skupinah, ugotavljanje/opredeljevanje/reševanje tehniške probleme, učinkovito komunicirati, razumeti poklicne/etične odgovornosti in učinke tehniških rešitev na trajnostni razvoj

Intended learning outcomes:

Knowledge and Understanding:

- Integral understanding of sustainable development concepts and principles
- Mastering the advanced approaches towards sustainable development in chemical and process industries
- Development of plans, strategies and measures for sustainable development

Transferable/Key Skills and other attributes:

- Ability to develop new knowledge on the basis of obtained advanced knowledge on sustainable development
- Ability to function in multi-disciplinary teams, identify/formulate/solve engineering problems, communicate effectively, understand professional/ethical responsibilities and impact of engineering solutions to sustainable development

Metode poučevanja in učenja:

- predavanja
- seminar
- seminarska naloga

Learning and teaching methods:

- Lectures
- Seminar
- Seminar work

Delež (v %) / Weight (in %)		
Načini ocenjevanja:		Assessment:
Izpit je opravljen, če so pozitivno opravljene vse naslednje obveznosti:		Student has to pass successfully the following obligations:
• seminarska naloga	70	• Seminar work
• ustni izpit	30	• Oral exam

Reference nosilca / Lecturer's references:

M. Bogataj, P. Glavič, A. Stergaršek and M. Horvat, Mercury Chemistry in Wet Flue Gas Desulphurisation Process, 17th European Roundtable on Sustainable Consumption and Production, ERSCP 2014, Nigrad, Portorož, 14.–16. 10. 2014, *Conference Proceedings*, 1063–1071, ISBN 978-961-93738-1-1, ISBN 978-961-93738-1-1.

Glavič P., Bogataj M., *Water Networks – Theory and Practice*, September 13–15, 2010. In: A. T. Atimtay and S. K. Sikdar (eds.), *Security of Industrial Water Supply and Management*, NATO science for Peace and Security Series C: Environmental Security, Springer, Dordrecht, 2011, ISBN 978-007-1867-8, pp. 13–30.

H. Tokos, Z. Novak Pintarič, P. Glavič, Energy saving opportunities in heat integrated beverage plant retrofit, *Applied Thermal Engineering* **30**, 36–44 (2010), ISSN 1359-4311.

P. Glavič, Natural laws dominate the human society, *Clean Tech. Environ Policy* **12/6** (2010) 591–599, ISSN 1618-954X.

Glavič P., Lukman R., Lesjak M. *A comparative analysis of universities using sustainability indicators*, 3rd International Symposium on Environmental Management, October 26–28, 2011, Zagreb, Croatia, Book of Abstracts, p. 61.



Univerza v Mariboru

Fakulteta za kemijo
in kemijsko tehnologijo

UČNI NAČRT PREDMETA / COURSE SYLLABUS

Predmet:	Kemija nanomaterialov
Course title:	Chemistry of nanomaterials

Študijski program in stopnja Study programme and level	Študijska smer Study field	Letnik Academic year	Semester Semester
Kemija in Kemijska tehnika, 3.stopnja	Kemija	1./2.	Poletni/Zimski
Chemistry and Chemical Engineering, 3 rd level	Chemistry	1./2.	Spring /Autumn

Vrsta predmeta / Course type

Izbirni/Elective

Univerzitetna koda predmeta / University course code:

Predavanja Lectures	Seminar Seminar	Sem. vaje Tutorial	Lab. vaje Laboratory work	Teren. vaje Field work	Samost. delo Individ. work	ECTS
10	10				430	15

Nosilec predmeta / Lecturer:

Darko Makovec

Jeziki /

Predavanja / Lectures:

Slovenski/Slovene

Languages:

Vaje / Tutorial:

Slovenski/Slovene

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

Pogojev ni

Prerequisites:

None

Vsebina:

- fizikalno-kemijske lastnosti nanodelcev in tankih plasti
- sodobni postopki, ki omogočajo kontrolirano sintezo nanodelcev in tankih plasti
- priprava suspenzij nanodelcev
- funkcionalizacija površin nanodelcev
- sintranje nanodelcev
- sinteza nanokompozitov s posebnimi mehanskimi, magnetnimi, in električnimi lastnostmi
- uporaba nanomaterialov v tehniki in medicini

Content (Syllabus outline):

- Physical and chemical properties of nanoparticles and thin films
- Advanced methods for controlled synthesis of nanoparticles and thin films
- Nanoparticles suspensions
- Functionalization of nanoparticles' surfaces
- Sintering of nanoparticles
- Synthesis of nanocomposites displaying special mechanical, magnetic and electric properties
- Applications of nanomaterials in technology and medicine

Temeljni literatura in viri / Readings:

T. Sugimoto, "Monodispersed Particles", Elsevier, 2001.

J-P. Jolivet, Metal Oxide Chemistry and Synthesis, From Solution to Solid State, John Wiley & Sons, LTD, 2000.

G. Cao, Nanostructures & Nanomaterials, Imperial College Press, 2004.

Izbrani znanstveni in pregledni članki s tematiko glede na študentovo področje raziskovanja / Chosen scientific and review articles corresponding to the student's research interest.

Cilji in kompetence:

- osvojitev osnov pomembnih pri razvoju in raziskavah sodobnih nanomaterialov za uporabo v tehniki in medicini
- razumevanje vzrokov za posebne fizikalne in kemijske lastnosti nanodelcev
- razumevanje principov, ki omogočajo kontrolirano sintezo nanomaterialov
- razumevanje principov, ki omogočajo funkcionalizacijo površin nanodelcev

Objectives and competences:

- To gain basic knowledge important for development and research of advanced nanomaterials for technological and medical applications.
- Understanding the origin of the specifics in physical and chemical properties of nanoparticles
- Understanding of the principles that enable controlled synthesis of nanomaterials
- Understanding of the principles that enable functionalization of nanoparticles' surfaces

Predvideni študijski rezultati:

Znanje in razumevanje:

- razumevanje posebnosti v fizikalno-kemijskih lastnostih nanomaterialov
- razumevanje mehanizmov, ki omogočajo kontrolo kemičnih, fizikalnih in stereoloških lastnosti nanomaterialov med njihovo sintezo
- poznavanje modernih metod za kontrolirano sintezo nanodelcev
- poznavanje načinov uravnavanja površinskih lastnosti nanodelcev s funkcionalizacijo njihovih površin
- razumevanje procesov, ki omogočajo pripravo stabilnih suspenzij nanodelcev

Intended learning outcomes:

Knowledge and understanding:

- Understanding of the specifics in physical and chemical properties of nanoparticles
- Understanding of mechanisms, which can be employed for the control of chemical, physical and stereological properties of nanomaterials during their synthesis
- Review of methods for the controlled synthesis of the nanoparticles
- Review of basic methods used for functionalization of the nanoparticle surfaces.
- Understanding of the processes involved during preparation of stable nanoparticles suspensions

Metode poučevanja in učenja:

- Študij ustrezne literature (izbrana poglavja iz knjig s področja tematike)
- Študij znanstvenih člankov s tematiko iz področja raziskav
- Izdelava seminarja s področja tematike v povezavi z raziskovalnim delom
- Vključevanje v tekoče raziskovalno delo

Learning and teaching methods:

- Study selected chapters from adequate textbooks
- Study of selected scientific literature
- Seminar on selected topic
- Taking part in research work

Načini ocenjevanja:

Ocena seminarske naloge (70 %)

Ustni zagovor (30 %)

Delež (v %) /

Weight (in %)

Assessment:

Assessment of the seminar work (70 %)

Oral examination (30 %)

70 30

Reference nosilca / Lecturer's references:

PRIMC, Darinka, MAKOVEC, Darko. Composite nanoplatelets combining soft-magnetic iron oxide with hard-magnetic barium hexaferrite. *Nanoscale*, 2015, 7, 2688-2697.

DUŠAK, Peter, MERTELJ, Alenka, KRALJ, Slavko, MAKOVEC, Darko. Controlled heteroaggregation of two types of nanoparticles in an aqueous suspension. *J. Coll. Interface Sci.*, 2015, 438, 235-243.

MAKOVEC, Darko, PRIMC, Darinka, ŠTURM, Sašo, KODRE, Alojz, HANŽEL, Darko, DROFENIK, Mihael. Structural properties of ultrafine Ba-hexaferrite nanoparticles. *J. Sol. State Chem.*, 2012, 196, 63-71.

MAKOVEC, Darko, SAJKO, Marjan, SELIŠNIK, Aljaž, DROFENIK, Mihael. Low-temperature synthesis of magnetically recoverable, superparamagnetic, photocatalytic, nanocomposite particles. *Mat. Chem. Phys.*, 2012, 136, 230-240.

MAKOVEC, Darko, KODRE, Alojz, ARČON, Iztok, DROFENIK, Mihael. The structure of compositionally constrained zinc-ferrite spinel nanoparticles. *J. Nanopart. Res.*, 2011, 13, 1781-1790.

KRALJ, Slavko, DROFENIK, Mihael, MAKOVEC, Darko. Controlled surface functionalization of silica-coated magnetic nanoparticles with terminal amino and carboxyl groups. *J. Nanopart. Res.*, 2011, 13, 2829-2841.



Univerza v Mariboru

Fakulteta za kemijo
in kemijsko tehnologijo

UČNI NAČRT PREDMETA / SUBJECT SPECIFICATION

Predmet:	Sinteza nanomaterialov
Subject Title:	Synthesis of nanomaterials

Študijski program Study programme	Študijska smer Study field	Letnik Year	Semester Semester
Kemija in kemijska tehnika Chemistry and Chemical Engineering	Kemija Chemistry	1. / 2.	zimski / poletni Autumn / Spring

Univerzitetna koda predmeta / University subject code:

Predavanja Lectures	Seminar Seminar	Sem. vaje Tutorial	Lab. vaje Labor work	Teren. vaje Field work	Samost. delo Individ. work	ECTS
10	10				430	15

Vrsta predmeta / Course type:

Izbirni/Elective

Nosilec predmeta / Lecturer:

Mihael Drofenik

Jeziki /
Languages:

Predavanja / Lecture: slovenski / Slovene
Vaje / Tutorial: slovenski / Slovene

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

- pogojev ni

Prerequisites:

- None

Vsebina:

Sintezni postopki:

- sinteza s postopkom soobarjanja
- sol-gel sinteza
- mehanokemijska sinteza
- sonokemijska sinteza
- hidrotermalna sinteza
- kristalizacija iz steklastih talin
- sinteza iz mikroemulzij
- manj uporabljeni postopki sinteze

Seminar:

- podrobna vsebina seminarja se bo določila na osnovi dogovora z mentorjem in se bo nanašala na tematiko predmeta

Content (Syllabus outline):

Synthesis procedures:

- Coprecipitation assisted synthesis
- Sol-gel synthesis
- Mechanochemical synthesis
- Sonochemical synthesis
- Hydrothermal synthesis
- Crystallization from glass melts
- Micro emulsion assisted synthesis
- Less common synthesis methods

Seminar:

- Detailed content of seminar will be determined on the basis of agreement with mentor and will be related to the subject

Temeljni literatura in viri / Textbooks:

- Nanomaterials: synthesis, properties and applications, Ed. A.S. Edelstain, R.C. Cammarata, Institute of Physics, Publishing Bristol and Philadelphia, 2002.
- E. Avvakumov, M. Senna, N. Kosova, "Soft Mechanochemical Synthesis", Kluwer Academic Publishing, 2000.
- Primarna literatura (npr. članki) s tematiko glede na študentovo področje raziskovanja / Primary literature (e.g. papers) corresponding to the student's research interest.

Cilji:

- pridobitev znanja za sintezo sodobnih nanomaterialov
- obvladovanje fizikalno-kemijskega znanja o postopkih sinteze nanomaterialov
- obvladovanje različnih postopkov za kontrolirano sintezo nanomaterialov
- obvladovanje zgoščevanja/sintranja konsolidiranih nanodelcev pri visokih temperaturah

Objectives:

- Acquiring the knowledge for the synthesis of contemporary nano materials
- Acquiring physical-chemical properties of synthesis of nano material
- Mastering of controlled synthesis of nanomaterials with different methods
- Mastering of sintering/densification of consolidated nanoparticles

Predvideni študijski rezultati:Znanje in razumevanje:

- razumevanje fizikalno-kemijskih učinkov raznih sinteznih postopkov
- razumevanje mehanizmov, ki vodijo do sinteze nanodelcev z določenimi lastnostmi

Prenesljive/ključne spretnosti in drugi atributi:

- obvladanje nekaterih najpogostejše uporabljenih metod za kontrolirano sintezo nanodelcev
- obvladovanje načinov uravnavanja površinskih lastnosti nanodelcev s funkcionalizacijo njihovih površin
- obvladovanje procesov, ki omogočajo pripravo gostih keramičnih materialov s pomočjo sintranja

Intended learning outcomes:Knowledge and Understanding:

- Understanding of the physical and chemical effects of various synthesis methods
- Understanding of mechanisms, which lead to the synthesis of nanoparticles with defined properties

Transferable/Key Skills and other attributes:

- Mastering of the most used methods for the controlled synthesis of nanoparticles
- Mastering of the basic methods used for the functionalization of the nanoparticle surfaces
- Mastering of the processes involved during the preparation of ceramic materials with sintering

Metode poučevanja in učenja:

- predavanja
- seminar
- seminarska naloga

Learning and teaching methods:

- Lectures
- Seminar
- Seminar work

Načini ocenjevanja:

Delež (v %) /
Weight (in %)

Assessment:

Izpit je opravljen, če so pozitivno opravljene vse naslednje obveznosti:

- seminarska naloga
- ustni izpit

50
50

Student has to pass successfully the following obligations:

- Seminar work
- Oral examination

Reference nosilca / Lecturer's references:

HOJNIK, Nuša, KRISTL, Matjaž, GOLOBIČ, Amalija, JAGLIČIČ, Zvonko, DROFENIK, Mihael. Hydrolytic synthesis of novel lanthanide(III) complexes with pyridine-2,6-dicarboxylic acid. *Journal of molecular structure*, 2015, vol. 1079, str. 54-60,

HOJNIK, Nuša, KRISTL, Matjaž, GOLOBIČ, Amalija, JAGLIČIČ, Zvonko, DROFENIK, Mihael. The synthesis, structure and physical properties of lanthanide(III) complexes with nicotinic acid. *Central European Journal of Chemistry*, 2014, vol. 12, iss. 2, str. 220-226,

KRISTL, Matjaž, HOJNIK, Nuša, GYERGYEK, Sašo, DROFENIK, Mihael. Sonochemical preparation of copper sulfides with different phases in aqueous solutions. *Materials research bulletin*, 2013, vol. 48, iss. 3, str. 1184-1188,

LISJAK, Darja, DROFENIK, Mihael. Chemical substitution - an alternative strategy for controlling the particle size of barium ferrite. *Crystal growth & design*, 2012, vol. 12, no. 11, str. 5174-5179,

DOJER, Brina, PEVEC, Andrej, JAGODIČ, Marko, KRISTL, Matjaž, DROFENIK, Mihael. Three new cobalt(II) carboxylates with 2-, 3- and 4-aminopyridine : syntheses, structures and magnetic properties. *Inorganica Chimica Acta*, 2012, vol. 383, str. 98-104,



Univerza v Mariboru

Fakulteta za kemijo
in kemijsko tehnologijo

UČNI NAČRT PREDMETA / COURSE SYLLABUS

Predmet:	Kemometrične in statistične metode v kemiji
Course title:	Chemometric and statistic methods in chemistry

Študijski program in stopnja Study programme and level	Študijska smer Study field	Letnik Academic year	Semester Semester
Kemija in kemijska tehnika, 3.stopnja	Kemija	1. / 2.	Poletni/ zimski
Chemistry and Chemical Engineering, 3rd level	Chemistry	1. / 2.	Spring /Autumn

Vrsta predmeta / Course type

Izbirni / Elective

Univerzitetna koda predmeta / University course code:

Predavanja Lectures	Seminar Seminar	Sem. vaje Tutorial	Lab. vaje Laboratory work	Teren. vaje Field work	Samost. delo Individ. work	ECTS
10	10				430	15

Nosilec predmeta / Lecturer:

Matjaž Finšgar

**Jeziki /
Languages:**

Predavanja / Lectures: slovenski /
Slovene

Vaje / Tutorial: slovenski / Slovene

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

pogojev ni

Prerequisites:

none

Vsebina:

Content (Syllabus outline):

- opis eksperimentov z več spremenljivkami in priprava podatkov
- načrtovanje in priprava eksperimentalnega načrta in vrednotenje rezultatov meritev dobljenih z merjenjem večih spremenljivk
- metode za izdelavo modelov za napovedovanje kompleksnih lastnosti

Seminar:

- seminarska naloga obsega uporabo računalniških programov za ovrednotenje večdimenzionalnih podatkov in meritev

- Description of experiments with multivariate variables and preparation of data
- Planning and preparing of experimental design and evaluation of measuring results obtained by multivariate variables
- Methods for preparing models for predicting of complex properties

Coursework:

Coursework contains use of software for evaluation of multivariate data and measurements

Temeljni literatura in viri / Readings:

- D. L. Massart, B. G. M. Vandeginste, L. M. C. Buydens, S. De Jong, P. J. Lewi, J. Smeyers-Verbeke: Handbook of Chemometrics and Qualimetrics: Part A, Elsevier, Amsterdam, 1998.
- B. G. M. Vandeginste, D. L. Massart, L. M. C. Buydens, S. De Jong, P. J. Lewi, J. Smeyers-Verbeke: Handbook of Chemometrics and Qualimetrics: Part B, Elsevier, Amsterdam, 1998.
- J. C. Miller, J. N. Miller, Statistics and Chemometrics for Analytical Chemistry, Ellis Horwood, New York, 5th edition, 2005.
- Primarna literatura (npr. članki) s tematiko glede na študentovo področje raziskovanja / Primary literature (e.g. papers) corresponding to the student's research interest.

Cilji in kompetence:

- spoznavanje statističnih metod za pravilno vrednotenje rezultatov
- spoznavanje teorije sodobnih numeričnih metod za obdelavo podatkov in za vrednotenje meritev

Objectives and competences:

- Acquiring of statistical methods for accurate evaluation of results
- Acquiring knowledge of modern numerical methods for data processing and evaluation of measurements

Predvideni študijski rezultati:

Znanje in razumevanje:

- celovito razumevanje obdelave podatkov in ocenjevanja meritev
- zagotavljanje kakovosti in kontrola kakovosti (QA/QC) analiznih rezultatov

Prenesljive/ključne spretnosti in drugi atributi:

- spretnosti in znanja pri analizi različnih podatkov in meritev

Intended learning outcomes:

Knowledge and Understanding:

- Integral understanding of data processing and assessments of measurements
- Quality assurance and quality control (QA and QC) of analytical results

Transferable/Key Skills and other attributes:

- Main skills and knowledge in the analysis of different data and measurements

Metode poučevanja in učenja:

- predavanja
- seminarska naloga

Learning and teaching methods:

- Lectures
- Coursework

Načini ocenjevanja:

Izpit je opravljen, če so pozitivno opravljene vse naslednje obveznosti:

- ustni izpit
- seminarska naloga

Delež (v %) /
Weight (in %)

60
40

Assessment:

Student has to pass successfully the following obligations:

- Oral examination
- Coursework

Reference nosilca / Lecturer's references:

Matjaž Finšgar, Sebastijan Peljhan, Anton Kokalj, Janez Kovač, Ingrid Milošev, Determination of the Cu₂O Thickness on BTAH-Inhibited Copper by Reconstruction of Auger Electron Spectra, Journal of The Electrochemical Society, 157 (2010) C295-C301.

FINŠGAR, Matjaž, LESAR, Antonija, KOKALJ, Anton, MILOŠEV, Ingrid. A comparative electrochemical and quantum chemical calculation study of BTAH and BTAOH as copper corrosion inhibitors in near neutral chloride solution. Electrochimica Acta, 2008, vol. 53, str. 8287-8297.

Matjaž Finšgar, Ingrid Milošev, Corrosion behaviour of stainless steels in aqueous solutions of methanesulfonic acid, Corrosion Science, 52 (2010) 2430–2438



Univerza v Mariboru

Fakulteta za kemijo
in kemijsko tehnologijo

UČNI NAČRT PREDMETA / SUBJECT SPECIFICATION

Predmet:	Analitika nevarnih snovi v okolju
Subject Title:	Analysis of hazardous substances in environment

Študijski program Study programme	Študijska smer Study field	Letnik Year	Semester Semester
Kemija in kemijska tehnika Chemistry and Chemical Engineering	Kemija Chemistry	1. / 2.	zimski / poletni Autumn / Spring

Vrsta predmeta / Course type:

Izbirni/ Elective

Univerzitetna koda predmeta / University subject code:

Predavanja Lectures	Seminar Seminar	Sem. vaje Tutorial	Lab. vaje Labor work	Teren. vaje Field work	Samost. delo Individ. work	ECTS
10	10				430	15

Nosilec predmeta / Lecturer:

Ernest Vončina

Jeziki /

Languages:

Predavanja / Lecture:

Vaje / Tutorial:

slovenski / Slovene

slovenski / Slovene

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

- pogojev ni

Prerequisites:

- None

Vsebina:

Content (Syllabus outline):

- analize metode plinske in tekočinske kromatografije v povezavi z masno spektrometrijo za določanje nevarnih snovi v okolju
- analitika obstojnih halogeniranih organskih spojin (POPs) kot so dioksini, poliklorirani bifenili, polibromirane in perfluorirane organske spojine
- spoznavanje in analitski pristopi določanja spojin, ki motijo normalno ravnotežje človeka (estrogene spojine)
- separacijske metode za ločevanje organskih onesnaževal iz okoljskih vzorcev
- priprava vzorcev za identifikacijo in kvantitativno določanje organskih onesnaževal v različnih matricah okolja kot so voda, zrak, tla in hrana.

Seminar:

- podrobna vsebina seminarja se bo določila na osnovi dogovora z mentorjem in se bo nanašala na tematiko predmeta

- Analytical methods such as gas chromatography and liquid chromatography coupled with mass spectrometry for determination of hazardous substances in environment
- Analytics of persistent halogenated organic compounds (POPs) such as dioxins, polychlorinated biphenyls, polybrominated and perfluorinated organic compounds.
- Knowledge and analytical procedures for determination of hormonal disruptors /estrogenic compounds
- Separation methods for separation of organic pollutants from environmental samples
- Sample preparation for identification and quantitative determination of organic pollutants in different matrices such as water, air, soil and food

Seminar:

- Detailed content of seminar will be determined on the basis of agreement with mentor and will be related to the subject

Temeljni literatura in viri / Textbooks:

- G. Fellenberg, *The Chemistry of Pollution*, John Wiley and Sons, 2000.
- I. Williams, *Environmental Chemistry: A modular approach*, John Wiley and Sons, 2001.
- E. Vončina, *Analitika nevarnih snovi v okolju*, Zapiski predavanj, Maribor, 2013
- M. Guardia in S. Garrigues, *Handbook of Green Analytical Chemistry*, Chichester, West Sussex, Wiley, 2012.
- M. Koel in M. R. Kaljurand, *Green Analytical Chemistry*, Cambridge, UK, Royal Society of Chemistry, 2010.

Cilji:

- spoznavanje in razumevanje analiznih metod kot je plinska in tekočinska kromatografija v povezavi z masno spektrometrijo, ki se uporabljajo v moderni okoljski kemiji za določanje vsebnosti nevarnih snovi in njihovih razgradnih produktov v okolju

Objectives:

- Knowledge and understanding of analytical methods, such as gas chromatography and liquid chromatography coupled with mass spectrometry, used in modern environmental chemistry for quantitative determination of hazardous substances and their degradation products

Predvideni študijski rezultati:

Znanje in razumevanje:

- razumevanje principov merjenja v plinski in tekočinski kromatografiji
- razumevanje principov masne spektrometrije

Prenesljive/ključne spretnosti in drugi atributi:

- laboratorijske spretnosti in pridobivanje izkušenj pri delu z masnim spektrometrom
- sposobnost razumevanja znanstvene prispevkov in zahtevnejše študijske literature

Intended learning outcomes:

Knowledge and Understanding:

- Understanding of principles for measurements using gas chromatography and liquid chromatography
- Understanding of mass spectrometry principles

Transferable/Key Skills and other attributes:

- Laboratory skills and acquiring experience with mass spectrometer
- Ability to understand articles in basic scientific journals and more advanced text-books

Metode poučevanja in učenja:

Learning and teaching methods:

- predavanja
- seminar
- seminarska naloga

- Lectures
- Seminar
- Seminar work

Delež (v %) /
Weight (in %)

Načini ocenjevanja:

Assessment:

Izpit je opravljen, če so pozitivno opravljene vse naslednje obveznosti:		Student has to pass successfully the following obligations:
• pisni izpit	50	• Written examination
• seminarska naloga	50	• Seminar work

Reference nosilca / Lecturer's references:

KRANVOGL, Roman, KNEZ, Jure, MIUC, Alen, VONČINA, Ernest, BRODNJAK-VONČINA, Darinka, VLAISAVLJEVIĆ, Veljko. Simultaneous determination of phthalates, their metabolites, alkylphenols and bisphenol A using GC-MS in urine of men with fertility problems. *Acta chimica slovenica*, ISSN 1318-0207. [Tiskana izd.], 2014, vol. 61, no. 1, str. 110-120. <http://acta.chem-soc.si/61/61-1-110.pdf>. [COBISS.SI-ID [17710102](#)]

KNEZ, Jure, KRANVOGL, Roman, BREZNIK, Barbara, VONČINA, Ernest, VLAISAVLJEVIĆ, Veljko. Are urinary bisphenol A levels in men related to semen quality and embryo development after medically assisted reproduction?. *Fertility and sterility*, ISSN 0015-0282. [Print ed.], Jan. 2014, vol. 101, no. 1, str. 215-221. <http://www.sciencedirect.com/science/article/pii/S0015028213031026#>, doi: [10.1016/j.fertnstert.2013.09.030](https://doi.org/10.1016/j.fertnstert.2013.09.030). [COBISS.SI-ID [4809023](#)]

PAVŠIČ, Primož, MLADENOVIC, Ana, MAUKO, Alenka, KRAMAR, Sabina, DOLENEC, Matej, VONČINA, Ernest, PAVŠIČ VRTAČ, Katarina, BUKOVEC, Peter. Sewage sludge / biomass ash based products for sustainable construction. *Journal of cleaner production*, ISSN 0959-6526. [Print ed.], 2013. <http://www.sciencedirect.com/science/article/pii/S0959652613008883>, doi: [10.1016/j.jclepro.2013.12.034](https://doi.org/10.1016/j.jclepro.2013.12.034). [COBISS.SI-ID [1998695](#)]

ALFIREVIĆ, Marjetka, KRIŽANEC, Boštjan, VONČINA, Ernest, BRODNJAK-VONČINA, Darinka. Presence of nonylphenols in plastic films and their migration into food simulants. *Acta chimica slovenica*, ISSN 1318-0207. [Tiskana izd.], 2011, vol. 58, no. 1, str. 127-133. <http://acta.chem-soc.si/58/58-1-127.pdf>. [COBISS.SI-ID [14880790](#)]

KAIŠAREVIĆ, Sonja N., HILSCHEROVA, Klara, WEBER, Roland, SUNDQVIST, Kristina L., TYSKLIND, Mats, VONČINA, Ernest, BOBIC, Stanka, ANDRIĆ, Nebojša, POGRMIC-MAJKIC, Kristina, VOJINOVIĆ-MILORADOV, Mirjana, GIESY, John Paul, KOVAČEVIĆ, Radmila. Characterization of dioxin-like contamination in soil and sediments from the "hot spot" area of petrochemical plant in Pancevo (Serbia). *Environmental science and pollution research international*, ISSN 0944-1344. [Print ed.], 2011, vol. 18, no. 4, str. 677-686, doi: [10.1007/s11356-010-0418-8](https://doi.org/10.1007/s11356-010-0418-8). [COBISS.SI-ID [15555606](#)]



Univerza v Mariboru

Fakulteta za kemijo
in kemijsko tehnologijo

UČNI NAČRT PREDMETA / COURSE SYLLABUS

Predmet:	Ocena življenjskega cikla
Subject Title:	Life cycle assessment

Študijski program Study programme	Študijska smer Study field	Letnik Academic year	Semester Semester
Kemija in kemijska tehnika, 3. stopnja Chemistry and Chemical Engineering, 3rd level	Kemijska tehnika Chemical Engineering	1. / 2.	poletni / zimski Spring / Autumn

Vrsta predmeta / Course type

Izbirni/Elective

Univerzitetna koda predmeta / University course code:

Predavanja Lectures	Seminar Seminar	Sem. vaje Tutorial	Lab. vaje Laboratory work	Teren. vaje Field work	Samost. delo Individ. work	ECTS
10	10				430	15

Nosilec predmeta / Lecturer:

Damjan Krajnc

Jeziki /

Predavanja / Lectures: slovenski / Slovene

Languages:

Vaje / Tutorial: slovenski / Slovene

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

Ni pogojev

Prerequisites:

None

Vsebina:

- Ključne opredelitve ocene življenjskega cikla (LCA)
- Iterativni pristop LCA
- Določanje ciljev - opredelitev namena in ciljne uporabnike (ozadje študije, zahteve modeliranja, načrtovanje študije LCA)
- Opredelitev področja uporabe - kaj analizirati in kako
- Inventarizacija analize življenjskega cikla - zbiranje podatkov, modeliranje sistema, izračun rezultatov, alokacija
- Ocena vpliva življenjskega cikla - izračun rezultatov LCIA (različne faze ocene vpliva življenjskega cikla, metode karakterizacije)

Content (Syllabus outline):

- Key definitions of Life Cycle Assessment (LCA)
- Iterative approach to LCA
- Goal definition – identifying purpose and target audience (context of the study, modelling requirements, planning of an LCA study)
- Scope definition – what to analyze and how
- Life cycle inventory analysis – collecting data, modelling the system, calculating results, allocation
- Life cycle impact assessment – calculating LCIA results (different phases of life cycle impact assessment, characterization methods)
- Life cycle interpretation and presentation of results

- Interpretacija življenjskega cikla in predstavitev rezultatov
- Kritični pregled LCA

Seminarske vaje:

Študent bo s pridobljenim znanjem o metodologiji, orodji in programsko opremo LCA obravnaval dani problem okoljskega modeliranja in sistemske analize.

- Critical review of LCA

Seminar work:

Based on acquired knowledge on methodology, tools and LCA software, student will work on given problem of environmental modeling and systems analysis.

Temeljni literatura in viri / Readings:

- Bauman H., Tillman A.M. 2004. The Hitch Hiker's Guide to LCA. Studentlitteratur AB.
- European Commission - Joint Research Centre - Institute for Environment and Sustainability: International Reference Life Cycle Data System (ILCD) Handbook - General guide for Life Cycle Assessment - Detailed guidance. First edition March 2010. EUR 24708 EN. Luxembourg. Publications Office of the European Union; 2010
- Krajnc D. 2014. Eko-dizajn - Okoljsko načrtovanje, razvoj in analiziranje proizvodov in procesov. Univerza v Mariboru, Fakulteta za kemijo in kemijsko tehnologijo.
- Zbiciński I., Stavenuiter J., Kozłowska B., van de Coevering H.P.M. 2006. Product Design and Life Cycle Assessment. The Baltic University Press.

Cilji in kompetence:

Razviti sposobnosti sistemskega razmišljanja glede okoljskih vprašanj in pridobiti osnovne analitične kompetence pri ocenjevanju življenjskega cikla (LCA).

Objectives and competences:

Develop skills of systems thinking in environmental issues and get a basic analyst's competence in Life Cycle Assessment (LCA).

Predvideni študijski rezultati:

Znanje in razumevanje:

Študent mora biti sposoben:

- razložiti splošni namen in načela LCA,
- razpravljati o možnih aplikacijah in omejitvah LCA,
- opisati vsebino in pojasniti namen analitičnih korakov LCA,
- izvesti celovito analizo LCA sistema proizvoda ali storitve,
- napisati poročilo o opravljeni analizi LCA,
- izvesti kritičen pregled podobne študije LCA.

Prenesljive/ključne spretnosti in drugi atributi:

- celostni pristop k analizi LCA proizvodov ali storitev.
- poznavanje metodologij ocenjevanja okoljskih vplivov, LCA in eko-dizajna,
- uporaba osnovnih metod in okoljsko izboljšanje obstoječih in novih procesov in proizvodov.

Intended learning outcomes:

Knowledge and Understanding:

Student should be able to:

- Explain the overall purpose and principles of LCA.
- Discuss possible applications and limitations of LCA.
- Describe the content and explain the purpose of the analytical steps of LCA.
- Carry out a complete LCA of a product or service system.
- Write a report of the performed LCA.
- Make a critical review of another LCA study.

Transferable/Key Skills and other attributes:

- Integral approach to the LCA of products or services.
- Knowledge of the methodologies to be used in environmental impact assessment, LCA and eco-design.
- Application of the basic methods and environmental improvements of the existing and new processes and products.

Metode poučevanja in učenja:

Learning and teaching methods:

- predavanja
- seminar
- seminarska naloga

- Lectures
- Seminar
- Seminar work

Delež (v %) /
Weight (in %)

Načini ocenjevanja:

Assessment:

Izpit je opravljen, če so pozitivno opravljene vse naslednje obveznosti:		Student has to pass successfully the following obligations:
- pisni izpit,	50	- written examination
- seminarska naloga	40	- seminar work
- predstavitev seminarske naloge	10	- seminar work presentation

Reference nosilca / Lecturer's references:

KRAJNC, Damjan. Okoljski vplivi različnih nagrobnih sveč in metoda LCA. *Embalaža, okolje, logistika*, ISSN 1855-4849, nov. 2010, št. 54.

KRAJNC, Damjan. Vzpostavljanje ekoindustrijskih sistemov z načeli industrijske simbioze = The establishment of eco-industrial systems including the principles of industrial symbiosis. V: VOLFAND, Jože (ur.), ČERNUTA, Uroš. *Odpadki v Sloveniji = Waste in Slovenia*, (Zbirka Zelena Slovenija). Celje: Fit media, 2010.

RADONJIČ, Gregor, PISNIK KORDA, Aleksandra, KRAJNC, Damjan. Product ecodesign approaches in ISO 14001 certified companies. V: VII. International Conference on Environmental Sciences and Engineering, Phuket, Thailand, December 21-23 2011. *World Academy of Science, Engineering and Technology, WASET, December 2011, Thailand. [Part 5]*, (World Academy of Science, Engineering and Technology, ISSN 2010-376X, Iss. 60 (Dec. 2011)). [S. l.]: World Academy of Science, Engineering and Technology, 2011, str. 644-648.

TOKOS, Hella, NOVAK-PINTARIČ, Zorka, KRAJNC, Damjan. An integrated sustainability performance assessment and benchmarking of breweries. *Clean technologies and environmental policy*, 2012, vol. 14, no. 2, str. 173-193.

ZHOU, Li, TOKOS, Hella, KRAJNC, Damjan, YANG, Yongrong. Sustainability performance evaluation in industry by composite sustainability index. *Clean technologies and environmental policy*, Oct. 2012, vol. 14, iss. 5, str. 789-803.



Univerza v Mariboru

Fakulteta za kemijo
in kemijsko tehnologijo

UČNI NAČRT PREDMETA / COURSE SYLLABUS

Predmet:	Bionanotehnologija
Course title:	Bionanotechnology

Študijski program in stopnja Study programme and level	Študijska smer Study field	Letnik Academic year	Semester Semester
Kemija in kemijska tehnika, 3.stopnja	Kemija	1./2.	Poletni/zimski
Chemistry and Chemical Engineering, 3rd level	Chemistry	1./2.	Spring/ Autumn

Vrsta predmeta / Course type

Izbirni/ Elective

Univerzitetna koda predmeta / University course code:

Predavanja Lectures	Seminar Seminar	Sem. vaje Tutorial	Lab. vaje Laboratory work	Teren. vaje Field work	Samost. delo Individ. work	ECTS
10	10				430	15

Nosilec predmeta / Lecturer:

Maja Leitgeb

Jeziki /

Languages:

Predavanja / Lectures:

Vaje / Tutorial:

slovenski / Slovene

slovenski / Slovene

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

Pogojev ni

Prerequisites:

None

Vsebina:

Content (Syllabus outline):

- Uvod v bionanotehnologijo
- Generične metodologije za bionanotehnologijo
- Nanotehnologija v prehrani in medicini
- Bionanomateriali
- Biološke aplikacije magnetnih nanodelcev
- Nanodelci v medicini
- Nanotoksikologija

- Introduction into bionanotechnology
- Generic methodologies for bionanotechnology
- Nanotechnology in nutrition and medicine
- Bionanomaterials
- Biological applications of magnetic nanoparticles
- Nanoparticles in medicine
- Nanotoxicology

Temeljni literatura in viri / Readings:

- V. Labhasetwar, D.L. Leslie-Pelecky, Biomedical Applications of Nanotechnology, Wiley-Interscience, New Jersey, 2007.
- B. Bharat, Springer handbook of nanotechnology, 3rd ed., Springer-Verlag, Berlin Heidelberg, 2010.
- D. Bagchi, M. Bagchi, H. Moriyama, F. Shahidi, Bio-Nanotechnology: A Revolution in Food, Biomedical and Health Sciences, Wiley-Blackwell, 2013.
- Primarna literatura (npr. članki) s tematiko glede na študentovo področje raziskovanja / Primary literature (e.g. papers) corresponding to the student's research interest.

Cilji in kompetence:

Študenti se bodo spoznali z bionanotehnologijo, bionanomateriali, njihovo izdelavo, karakterizacijo, modifikacijo ter uporabo na različnih področjih, kot npr. prehrani in medicini.

Interdisciplinarno področje bionanotehnologije bo od študenta zahtevalo povezovanje že usvojenih znanj.

Objectives and competences:

Students will learn about bionanotechnology, bionanomaterials, design, characterization, modification and use of biomaterials in different fields, such as nutrition and medicine.

Because of the interdisciplinary field of bionanotechnology students shall integrate their current knowledge.

Predvideni študijski rezultati:

Znanje in razumevanje:

Študenti bodo dobili vpogled v področje bionanotehnologije, načrtovanja in izdelave bionanomaterialov za določeno področje uporabe. Znalci bodo modificirati določene tipe bionanomaterialov ter jih okarakterizirati. Razumeli bodo delovanje bionanomaterialov v nekaterih aplikacijah.

Intended learning outcomes:

Knowledge and understanding:

Students will get insight into the field of bionanotechnology, design and synthesis of bionanomaterials for a specific area of use. They will be able to modify and characterize some types of bionanomaterials. They will understand the operation of bionanomaterials in some applications.

Metode poučevanja in učenja:

Learning and teaching methods:

• predavanja v učilnici, ki je opremljena z audio-vizualnimi pripomočki • samostojni študij • individualna priprava seminarских nalog s predstavitvijo in diskusijo	• Lectures in a lecture room, equipped with audio-visual equipment • Independent study • Individual preparation of seminars and their presentation with discussion
---	--

Načini ocenjevanja:		Delež (v %) / Weight (in %)	Assessment:
Izpit je opravljen, če so pozitivno opravljene vse naslednje obveznosti:			Student has to pass successfully the following obligations:
• pisni izpit • seminarska naloga		50%	• Written examination
		50%	• Seminar work

Reference nosilca / Lecturer's references:

ŠULEK, Franja, KNEZ, Željko, LEITGEB, Maja. Immobilization of cholesterol oxidase to finely dispersed silica-coated maghemite nanoparticles based magnetic fluid. *Applied Surface Science*, ISSN 0169-4332. 2010, 256 (14), 4596-4600. [COBISS.SI-ID [14055446](#)]

LEITGEB, Maja, HERŽIČ, Katja, HOJNIK PODREPŠEK, Gordana, HOJSKI, Aljaž, CRNJAC, Anton, KNEZ, Željko. Toxicity of magnetic chitosan micro and nanoparticles as carriers for biologically active substances. *Acta chimica slovenica*, ISSN 1318-0207. 2014, 61 (1), 145-152, <http://acta.chem-soc.si/61/61-1-145.pdf>. [COBISS.SI-ID [4955199](#)]

ŠALIĆ, Anita, PINDRIĆ, Katarina, HOJNIK PODREPŠEK, Gordana, LEITGEB, Maja, ZELIĆ, Bruno. NADH oxidation in a microreactor catalyzed by ADH immobilized on γ -Fe₂O₃ nanoparticles. V: ŽNIDARŠIČ PLAZL, Polona (ur.). *Green Processing and Synthesis*, ISSN 2191-9550, 2 (6), 2013, 569-578, doi:[10.1515/gps-2013-0084](https://doi.org/10.1515/gps-2013-0084). [COBISS.SI-ID [17312022](#)]

LEITGEB, Maja, HOJNIK PODREPŠEK, Gordana, KNEZ, Željko. Magnetic nanocarriers for targeted drug delivery. V: SABBAS, Nora P. (ur.). *Magnetic nanoparticles : synthesis, physicochemical properties and role in biomedicine*, (Nanotechnology science and technology). New York: Nova Science Publishers, 2014, 201-230, [COBISS.SI-ID [17988374](#)]

LEITGEB, Maja, PRIMOŽIČ, Mateja, KNEZ, Željko. Biocompatible nanomaterials : synthesis, characterization and applications. V: ACKLIN, Beate (ur.), LAUTENS, Edon (ur.). *Magnetic nanoparticles : properties, synthesis and applications*, (Physics research and technology), (Nanotechnology science and technology). New York: Nova Science Publishers, cop. 2012, 135-156. https://www.novapublishers.com/catalog/product_info.php?products_id=34293. [COBISS.SI-ID [16159766](#)]



Univerza v Mariboru

Fakulteta za kemijo
in kemijsko tehnologijo

UČNI NAČRT PREDMETA / COURSE SYLLABUS

Predmet:	Procesna hladilna tehnika
Course title:	Refrigeration process technology

Študijski program in stopnja Study programme and level	Študijska smer Study field	Letnik Academic year	Semester Semester
Kemija in kemijska tehnika, 3.stopnja	Kemijska tehnika	1. / 2.	poletni/zimski
Chemistry and Chemical Engineering, 3rd level	Chemical Engineering	1. / 2.	Spring /Autumn

Vrsta predmeta / Course type:

Izbirni / Elective

Univerzitetna koda predmeta / University course code:

Predavanja Lectures	Seminar Seminar	Sem. vaje Tutorial	Lab. vaje Laboratory work	Teren. vaje Field work	Samost. delo Individ. work	ECTS
10	10				430	15

Nosilec predmeta / Lecturer:

Darko Goričanec

Jeziki /

Languages:

Predavanja / Lectures:

Vaje / Tutorial:

slovenski /Slovene

slovenski /Slovene

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

Pogojev ni

Prerequisites:

None

Vsebina:

Predavanja:

- Hladilne naprave.
- Nizkotemperaturne hladilne naprave.
- Hlajenje v industriji.
- Naprave za hlajenje in shranjevanje prehrabnih proizvodov.
- Postopki hlajenja in zamrzovanja prehrabnih proizvodov.

Seminarske vaje:

- Uporaba računalniških programov za preračun hladilnih naprav.

Content (Syllabus outline):

Lectures:

- Cooling devices.
- Low-temperature cooling devices.
- Refrigeration in industry.
- Devices for cooling and storing of food products.
- Processes for cooling and freezing of food products.

Seminar work:

- Use of software for the calculation of cooling devices.
- Preparation of reports related to the content of the

- Izdelava poročila vezanega na tematiko predmeta.

subject.

Temeljni literatura in viri / Readings:

Ibrahim Dincer, Mehmet Kanoglu: Refrigeration Systems and Applications, Wiley; 2 edition, pp. 482, 2010.
Roj J. Dossat, Thomas J. Horan: Principles of Refrigeration, Prentice Hall, pp. 454, 2001.

Priporočena dodatna literatura:

Chris Langley: Refrigeration Principles, Practices, and Performance, Cengage Learning; 1 edition, pp. 440, 2007.
ASHRAE Handbook Refrigeration SI (Systems-International), American Society of Heating, Refrigerating and Air-Conditioning Engineers; pp.758, 2010.

Cilji in kompetence:

- Celovito obvladovanje naprednih hladilnih sistemov.
- Poglobitev znanja v cilju načrtovanja naprednejših hladilnih sistemov.

Objectives and competences:

- Comprehensive understanding of advanced cooling systems.
- Deepening of the knowledge with the aim to design advanced cooling systems

Predvideni študijski rezultati:

Znanje in razumevanje:

- Znanje in razumevanje učinkovitih hladilnih postopkov.
- Teoretično razumevanje in poznavanje postopkov in naprav za hlajenje in shranjevanje prehranskih izdelkov.

Prenosljive/ključne spretnosti in drugi atributi:

- Sposobnost operativnega razmišljanja, načrtovanja in odločanja.
- Razumevanje vpliva tehniških rešitev na okolje in socialne odnose.

Intended learning outcomes:

Knowledge and Understanding:

- Knowledge and understanding of efficient cooling processes .
- Theoretical understanding and knowledge of processes and equipment for cooling and storing of food products.

Transferable/Key Skills and other attributes:

- The ability of operational thinking, planning and decision-making.
- Understanding the influence of technical solutions on the environment and social relationships.

Metode poučevanja in učenja:

- predavanja
- seminar
- seminarska naloga

Learning and teaching methods:

- Lectures
- Seminar
- Seminar work

Načini ocenjevanja:

Delež (v %) /
Weight (in %)

Assessment:

Izpit je opravljen, če so pozitivno opravljene vse naslednje obveznosti:

- seminarska naloga
- ustni izpit

50
50

Student has to pass successfully the following obligations:

- Seminar work
- Oral examination

Reference nosilca / Lecturer's references:

GORIČANEC, Darko, POZEB, Viljem, TOMŠIČ, Ladislav, TROP, Peter. Exploitation of the waste-heat from hydro power plants. Energy, ISSN 0360-5442. [Print ed.], Available online 22 July 2014, str. 1-6.

GORIČANEC, Darko, POZEB, Viljem, TOMŠIČ, Ladislav, TROP, Peter. Exploitation of the waste-heat from hydro power plants. Energy, ISSN 0360-5442. [Print ed.], Available online 22 July 2014, str. 1-6, doi: 10.1016/j.energy.2014.06.106. [COBISS.SI-ID 17986326]

KULČAR, Bojan, GORIČANEC, Darko, KROPE, Jurij. Economy of replacing a refrigerant in a cooling system for preparing chilled water = Remplacement du frigorigene dans un systeme utilisé pour préparer de l'eau glacée : impact financier. International journal of refrigeration, ISSN 0140-7007. [Print ed.], Aug. 2010, vol. 33, iss. 5, str. 989-994, doi: 10.1016/j.ijrefrig.2010.02.003. [COBISS.SI-ID 14472470]

TORHAČ, Evgen, GORIČANEC, Darko, ANDREJEVIČ, Srđan, SALJNIKOV, Saša, KROPE, Jurij. New high temperature heat pumps for exploiting low-temperature sources. Research Journal of Chemistry and Environment, ISSN 0972-0626, 2011, vol. 15, no. 2, str. 1-6, graf. prikazi. [COBISS.SI-ID 15093782]

JOTANOVIĆ, Milovan, TADIĆ, G., KROPE, Jurij, GORIČANEC, Darko. Analysis of two-stage high- temperature heat pump efficiency. International journal of systems applications, engineering & development, ISSN 2074-1308. [Online ed.], 2012, vol. 6, iss. 5, str. 350-363. <http://www.naun.org/multimedia/UPress/saed/16-564.pdf>. [COBISS.SI-ID 16535574]



Univerza v Mariboru

Fakulteta za kemijo
in kemijsko tehnologijo

UČNI NAČRT PREDMETA / COURSE SYLLABUS

Predmet:	Napredne metode za proučevanje korozije
Coursetitle:	Advanced methods for study of corrosion

Študijski program in stopnja Study programme and level	Študijska smer Study field	Letnik Academic year	Semester Semester
Kemija in kemijska tehnika/3.stopnja	Kemijska tehnika/Kemija	1./2.	Poletni/zimski
Chemistry and Chemical Engineering/3 rd level	Chemical Engineering/Chemistry	1./2.	Spring/Autumn

Vrsta predmeta / Course type

Izbirni/Elective

Univerzitetna koda predmeta / University course code:

Predavanja Lectures	Seminar Seminar	Sem. vaje Tutorial	Lab. vaje Laboratory work	Teren. vaje Field work	Samost. delo Individ. work	ECTS
10	10				430	15

Nosilec predmeta / Lecturer:

MOJCA SLEMNİK

**Jeziki /
Languages:**

Predavanja /Lectures: Slovenščina /Slovene

Vaje / Tutorial: Slovenščina /Slovene

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

Potrebno je predhodno znanje fizikalne kemije, gradiv in osnovno znanje elektrokemije.

Prerequisites:

Basic knowledge of physical chemistry, materials science and basic electrochemistry.

Vsebina:

Content (Syllabus outline):

Pregled naprednih metod za znižanje hitrosti korozije in izboljšanja kakovosti materialov:

- toplotna obdelava
- ionska implantacija
- nitiranje v plazmi
- lasersko površinsko utrjevanje
- ciklična termometrija
- EIS

Poglobljen študij teorije korozijskih procesov:

Review of advanced methods for reducing corrosion rates and improving the quality of materials:

- heat treatment
- ion implantation
- plasma nitriding
- laser surface hardening
- cyclic thermammetry
- EIS

Further study of corrosion processes theory:

- pregled hitrih tehnik za proučevanje korozije na izbranih materialih.
- študij sodobne merilne opreme, primerjava z drugimi metodami.
- procesi na površinah izbranih materialov,
- korozija specifičnih izbranih materialov.

Metode v koroziji (značilnosti, uporaba, merjenje, primerjava med metodami): gravimetrija, potenciodinamske meritve, frekvenčna analiza, elektrokemijska impedančna spektroskopija (EIS).

Konstrukcija korozijskih sistemov (celic) glede na izbrani material in medij.

Poglobljen študij EIS in kinetike procesov:

- diagrami odvisnosti impedance in admittance od frekvence,
- proučevanje diagramov glede na korozijski proces na materialih: raztapljanje, adsorpcija, pasiviranje, pitting, porušitev zaščitnih plasti,
- konstrukcija nadomestnih vezij: uporaba C, R, L, CPE, Warburgove impedance, in njihove kombinacije v zaporedna in/ali vzporedna vezja glede na izbrani korozijski sistem,
- določanje kinetike procesov na osnovi EIS.

- study of rapid techniques in corrosion of different materials.
- study of modern instrumentation, comparison to other analytical methods.
- processes at chosen material's surfaces,
- corrosion of specific chosen materials.

Methods in corrosion (properties, application, measurements, comparison between methods): gravimetry, potentiodynamics, frequency analysis, electrochemical impedance spectroscopy (EIS).

Construction of corrosion systems (cells) according to chosen material and media.

Advanced study of EIS and process's kinetics

- dependency diagrams of impedance and admittance from frequency,
- studying the diagrams of the corrosion processes with regard to the process on materials: dissolution, adsorption, passivation, pitting, disruption of protective layers,
- electrochemical circuits construction: the use of C, R, L, CPE, Warbourg impedance, their combinations into serial and/or parallel circuits with regard to chosen corrosion system,
- determining the kinetics of processes on base of EIS.
-

Temeljni literatura in viri / Readings:

Electrochemistry, Principles, methods and applications, C.M.A. Brett and A.M.O. Brett, Oxford university press, Oxford, New York, Tokyo, 1993.

Electrochemical Impedance and Noise, R. Cottis, S. Turgoose, Nace international, 1999.

Electrochemical techniques in corrosion science and engineering, R.G. Kelly, J.R. Scully, D. W. Shoesmith, R.G. Bichheit; Marcel Dekker, INC, New York Basel, 2003.

Corrosion engineering – Principles and practice, P.R. Roberge, McGraw-Hill, ZDA, 2008.

Impedance spectroscopy Theory, Experiment, and Applications, Evgenij Barsoukov, J. Ross Macdonald, Wiley-Interscience, 2005.

Electrochemical Impedance Spectroscopy and its Application, Andrzej Lasia, Springer, 2014.

Najnovejši znanstveni, strokovni in pregledni članki s področja korozije /*Newest scientific, professional and review articles from fields of corrosion.*

Cilji in kompetence:

Cilj predmeta so:

- poglobljen študij korozije, razumevanje in konstrukcija korozijskih celic in uporabnosti metod za proučevanje korozije s poudarkom na EIS
- samostojno raziskovalno delo na področju korozije

Objectives and competences:

The aim of the subject is:

- *advanced study of corrosion, understanding and construction of corrosion cells and applied methods for corrosion study with focus on EIS*
- *research work in the field of corrosion.*

Predvideni študijski rezultati:

Znanje in razumevanje:

- razumevanje korozijskega procesa
- uporabnost metod za merjenje korozije in poglobljene študije na izbranih materialih in medijih

Intended learning outcomes:

Knowledge and understanding:

- *understanding of corrosion process*
- *applicability of methods in corrosion, and advanced study of chosen materials and media*

Metode poučevanja in učenja:

- Predavanja v učilnici, ki je opremljena z osnovnimi avdio-vizualnimi pripomočki.
- Praktično usposabljanje v laboratoriju na merilnih aparaturah.
- Individualna priprava seminarskih nalog s predstavitvijo in diskusijo.

Learning and teaching methods:

- *Lectures in lecture room, equipped with basic audio-visual equipment.*
- *Practical training in laboratory on apparatus.*
- *Individual preparation of seminars and their presentation with discussion.*

Načini ocenjevanja:**Delež (v %) /Weight (in %)****Assessment:**

Način (pisni izpit, ustno izpraševanje, naloge, projekt)

- ustni izpit:
- seminarska naloga:

50
50

Type (examination, oral, course work, project):

- *oral examination:*
- *seminar - coursework:*

Reference nosilca / Lecturer's references:

PEČAR, Darja, SLEMNIK, Mojca, GORŠEK, Andreja. Testing the corrosion resistance of stainless steels during the fermentation of probiotic drink. *Journal of the Science of Food and Agriculture*, ISSN 0022-5142, May 2011, vol. 91, iss. 7, str. 1293-1297, doi:[10.1002/jsfa.4315](https://doi.org/10.1002/jsfa.4315). [COBISS.SI-ID [14809622](#)], [JCR, SNIP, WoS]

SLEMNIK, Mojca. Effect of testing temperature on corrosion behaviour of different heat treated stainless steels in the active-passive region. *Anti-Corrosion Methods and Materials*, ISSN 0003-5599, 2008, vol. 55, iss. 1, str. 20-26. <http://dx.doi.org/10.1108/00035590810842799>. [COBISS.SI-ID [12012310](#)], [JCR, SNIP, WoS]

SKALE, Saša, DOLEČEK, Valter, SLEMNIK, Mojca. Electrochemical impedance studies of corrosion protected surfaces covered by epoxy polyamide coating systems. *Progress in organic coatings*, ISSN 0300-9440. [Print ed.], June 2008,

vol. 62, iss. 4, str. 387-

SKALE, Saša, DOLEČEK, Valter, SLEMNIK, Mojca. Substitution of the constant phase element by Warburg impedance for protective coatings. *Corrosion science*, ISSN 0010-938X. [Print ed.], Mar. 2007, vol. 49, iss. 3, str. 1045-1055. <http://dx.doi.org/10.1016/j.corsci.2006.06.027>. [COBISS.SI-ID [10666518](#)], [JCR, SNIP, WoS]

SLEMNIK, Mojca, MILOŠEV, Ingrid. An impedance study of two types of stainless steel in Ringer physiological solution containing complexing agents. *Journal of materials science. Materials in medicine*, ISSN 0957-4530, Oct. 2006, vol. 17, no 10, str. 911-918. <http://dx.doi.org/10.1007/s10856-006-0180-0>. [COBISS.SI-ID [10666262](#)], [JCR, SNIP, WoS]



Univerza v Mariboru

Fakulteta za kemijo
in kemijsko tehnologijo

UČNI NAČRT PREDMETA / COURSE SYLLABUS

Predmet:	Kontrola varne in kakovostne hrane
Course title:	Food safety and quality control

Študijski program in stopnja Study programme and level	Študijska smer Study field	Letnik Academic year	Semester Semester
Kemija in kemijska tehnika, 3.stopnja	kemija	1./2.	poletni /zimski
Chemistry and chemical engineering, 3rd level	Chemistry	1./2.	Spring /Autumn

Vrsta predmeta / Course type

Izbirni/Elective

Univerzitetna koda predmeta / University course code:

Predavanja Lectures	Seminar Seminar	Sem. vaje Tutorial	Lab. vaje Laboratory work	Teren. vaje Field work	Samost. delo Individ. work	ECTS
10	10				430	15

Nosilec predmeta / Lecturer:

Iztok Jože Košir

Jeziki /

Languages:

Predavanja / Lectures:

Vaje / Tutorial:

slovenski/Slovene

slovenski/Slovene

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

Potrebno je predhodno osnovno znanje analize kemije, instrumentalnih metod v analizi kemije in statistične obdelave podatkov.

Prerequisites:

Basic knowledge of analytical chemistry, instrumental methods in analytical chemistry and statistical treatment of data.

Vsebina:**Predavanja:**

- Uvod v osnovno sestavo agroživilskih izdelkov.
- Določanje osnovnih kakovostnih parametrov agroživilskih izdelkov.
- Uporaba različnih analiznih metodologij za preverjanje kakovostnih parametrov in določanje dodatkov v živilskih izdelkih.
- Prisotnost zdravju škodljivih snovi zunanjega izvora v agroživilskih izdelkih
- Prisotnost dodatkov v agroživilskih izdelkih in njihovo določanje
- Pristnosti agroživilskih izdelkov.
- Uporaba različnih analiznih metodologij za preverjanje pristnosti agroživilskih proizvodov v povezavi s kemometričnimi metodami.
- Uporabnost razmerij stabilnih izotopov za spremljanje izvora surovin.
- Osnovni zakonski predpisi, ki urejajo področje varne in kakovostne hrane na nivoju R Slovenije in EU.
- Codex Alimentarius.

Content (Syllabus outline):**Lectures:**

- Introduction to basic composition of agricultural and food products.
- Determination of basic quality parameters of agrifood products.
- Application of different analytical methodologies for checking quality parameters and determination of additives in agrifood products.
- Presence of harmful compounds in agrifood products, originated from external origins.
- Presence of additives in agrifood products and their determination.
- Authenticity of agri food products.
- Application of analytical methodologies for checking the authenticity of agricultural and food products in connection with chemometrics.
- Aplicability of stable isotope ratios for tracking the source of raw materials.
- Basic regulations covering food safety and quality in R Slovenia and EU.
- Codex Alimentarius.

Temeljni literatura in viri / Readings:**Osnovni/temeljni:**

1. Food Chemistry, H.D. Belitz, W. Grosch, P. Schieberle, Springer-Verlag, Heidelberg, 2009.
2. Chemical analysis of food: techniques and applications, ed. Yolanda Picó, Waltham: Elsevier/Academic Press, 2012.
3. Case studies in food safety and authenticity : lessons from real-life situations; J. Hoorfar, Oxford, Woodhead Publishing, 2012.

Dodatna priporočena literatura:

4. Food authenticity and traceability, M. Lees, CRC Press, Cambridge, Woodhead Publishing, 2003.
5. Znanstveni, strokovni in pregledni članki s področja agrokemije.

Cilji in kompetence:**Objectives and competences:**

Cilj predmeta je seznaniti študente s:

- teoretskimi osnovami pomembnimi za vrednotenje kakovosti in varnosti agroživilskih izdelkov,
- uporabnostjo različnih analiznokemijskih metodoloških pristopov za ugotavljanje pristnosti agroživilskih izdelkov,
- možnostmi prisotnosti zdravju škodljivih snovi v agroživilskih izdelkih in njihovoega določanja.
- možnostih prisotnosti aditivov v agroživilskih izdelkih
- zakonskimi podlagami, ki urejajo varnost in kakovost hrane v R Sloveniji in EU

The aim of the subject is:

- theory and principles important for evaluation of quality and safety of food and agricultural products,
- application of different analytical chemical methodologies for determination of the authenticity of agricultural and food products,
- possibilities of presence of harmful compounds in agricultural and food products and their determination.
- possibilities of presence of additives in agricultural and food products.
- regulations in Slovenia and EU covering safety and quality of agricultural food products

Predvideni študijski rezultati:

Znanje in razumevanje:

Znanje in razumevanje:

- razumevanje pomembnosti varnosti in kakovosti agroživilskih izdelkov,
- razumevanje problematike povezane s pristnostjo agroživilskih izdelkov,
- kompleksnosti uporabe različnih analiznih metodologij za ugotavljanje varnosti in kakovosti agroživilskih izdelkov.
- poznavanje osnovnih zakonskih ureditev področja varne in kakovostne hrane

Intended learning outcomes:

Knowledge and Understanding:

Knowledge and understanding:

- understanding of the importance of quality and safety of agricultural and food products,
- understanding of problems connected with the authenticity of agricultural and food products,
- complexity of the use of different analytical methodologies for determination of safety and quality of agricultural and food products.
- basic knowledge about the law regulations of food safety and quality

Metode poučevanja in učenja:

Predavanja v učilnici, ki je opremljena z osnovnimi avdio-vizualnimi pripomočki.

Individualna priprava seminarskih nalog s predstavitvijo in diskusijo.

Learning and teaching methods:

Lectures in lecture room, equipped with basic audio-visual equipment

Individual preparation of seminars and their presentation with discussion.

Načini ocenjevanja:

Način ocenjevanja (izpraševanje - ustni izpit, seminarska naloga):

- ustni izpit:
- seminarska naloga:

Delež (v %) /

Weight (in %)

Assessment:

Type (examination, oral, coursework, project):

- oral examination:
- seminar - coursework:

Reference nosilca / Lecturer's references:

DEŽELAK, Matjaž, GEBREMARIAM, Mekonnen M., ČADEŽ, Neža, ZUPAN, Jure, RASPOR, Peter, ZARNKOW, Martin, BECKER, Thomas, KOŠIR, Iztok Jože. The influence of serial repitching of *Saccharomyces pastorianus* on its karyotype and protein profile during the fermentation of gluten-free buckwheat and quinoa wort. *International journal of food microbiology*, ISSN 0168-1605. [Print ed.], 2014, vol. 185, str. 93-102, doi: [10.1016/j.ijfoodmicro.2014.05.023](https://doi.org/10.1016/j.ijfoodmicro.2014.05.023). [COBISS.SI-ID [650380](#)]

KREMER, Dario, KOŠIR, Iztok Jože, KOSALEC, Ivan, ZOVKO KONČIĆ, Marijana, POTOČNIK, Tanja, ČERENAK, Andreja, BEZIĆ, Nada, SREČEC, Siniša, DUNKIĆ, Valerija. Investigation of chemical compounds, antioxidant and antimicrobial properties of *Teucrium arduini* L. (Lamiaceae). *Current drug targets*, ISSN 1389-4501, 2013, vol. 14, issue 9, str. [1-9], doi: [10.2174/1389450111314090009](https://doi.org/10.2174/1389450111314090009). [COBISS.SI-ID [620940](#)]

HRASTAR, Robert, TERPINC, Petra, KOŠIR, Iztok Jože, ABRAMOVIČ, Helena. Effect of deodorization of camelina (*Camelina sativa*) oil on its phenolic content and the radical scavenging effectiveness of its extracts. *Journal of agricultural and food chemistry*, ISSN 0021-8561, 2013, vol. 61, str. 8098-8103, doi: [10.1021/jf400309j](https://doi.org/10.1021/jf400309j). [COBISS.SI-ID [4278136](#)]

HRASTAR, Robert, ABRAMOVIČ, Helena, KOŠIR, Iztok Jože. In situ quality evaluation of *Camelina sativa* landrace. *European journal of lipid science and technology*, ISSN 1438-7697. [Print ed.], 2012, vol. 114, issue 3, str. 343-351, doi: [10.1002/ejlt.201100003](https://doi.org/10.1002/ejlt.201100003). [COBISS.SI-ID [563596](#)]

HRASTAR, Robert, KOŠIR, Iztok Jože, et al. Camelina sativa oil deodorization: balance between free fatty acids and color reduction and isomerized byproducts formation. *Journal of the American Oil Chemists' Society*, ISSN 0003-021X, 2011, vol. 88, no. 4, str. 581-588, doi: [10.1007/s11746-010-1692-9](https://doi.org/10.1007/s11746-010-1692-9). [COBISS.SI-ID [530572](#)]



Univerza v Mariboru

Fakulteta za kemijo
in kemijsko tehnologijo

UČNI NAČRT PREDMETA / COURSE SYLLABUS

Predmet:	Izbrana poglavja iz koloidne kemije
Course title:	Selected topics of the Colloid Chemistry

Študijski program in stopnja Study programme and level	Študijska smer Study field	Letnik Academic year	Semester Semester
Kemija in kemijska tehnika, 3.stopnja Chemistry and Chemical Engineering, 3rd level	Kemija Chemistry	1./2.	Poletni/zimski Spring/Autumn

Vrsta predmeta / Course type

Izbirni/Elective

Univerzitetna koda predmeta / University course code:

Predavanja Lectures	Seminar Seminar	Sem. vaje Tutorial	Lab. vaje Laboratory work	Teren. vaje Field work	Samost. delo Individ. work	ECTS
10	10				430	15

Nosilec predmeta / Lecturer:

Regina Fuchs-Godec

Jeziki /

Languages:

Predavanja / Lectures:

slovenski

Slovene

Vaje / Tutorial:

slovenski / Slovene

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

Znanje splošne, organske in fizikalne kemije. Znanje osnovne analize kemije.

Prerequisites:

Knowledge of general, organic and physical chemistry. Basics of analytical chemistry.

Vsebina:

Content (Syllabus outline):

Koloidni sistemi-razvrstitev (liefobni, liefilni) Samourejene strukture-agregati Poglobljeno znanje o pojavih ob površini in suspenzijah koloidov • Girifalco-Good –Fowkesova enačba • Razlika tlakov na ukrivljeni površini • Medmolekulske sile; van der Waalove sile; Elektrostatske in solvacijske sile Adsorpcija in orientacija na površini Podrobnejša obravnav posebne vrste amfifilov-<i>'surfaktanti'</i> • splošne značilnosti Lastnosti : • topnost • Kraftova točka • točka motnosti • kritična micelna koncentracija (CMC) Micelizacija • termodinamika micelizacije • parametri, ki vplivajo na CMC • oblike in lastnosti micelij • metode določanja CMC • Agregacija/Lastna asociacija površinsko aktivnih snovi • strukture agregatov v raztopinah površinsko aktivnih snovi	Classification of colloids Self-Assembly Amphiphiles Extended knowledge of the surface phenomena and of the colloidal suspensions • Girifalco-Good –Fowkesova equation • Pressure differences across curved surfaces • Intermolecular forces; van der Waals forces; Electrostatic and solvation forces Adsorption and orientation on the surface Detailed consideration of the special group of the Amphiphiles –<i>'Surfactants'</i> • general features Properties: • solubility • Kraft's point • turbidity • critical micelle concentration (CMC) Micellization • thermodynamics of micellization • factors affecting the CMC • micellar structures and shapes • methods of the CMC determination • Aggregation/ Self-Assembly processes of the surfactants • The structure of aggregates in the solutions of surfactants
--	--

Temeljni literatura in viri / Readings:

D.F.Evans, H.Wennerström, The colloidal domain, Wiley-VCH, Canada, 1999.

R.J.Hunter, Foundations of Colloid Science, Oxford, University press, 2001.

Dodatna priporočena literatura:

J.N. Israelachvili, Intermolecular and surface forces, 3rd Ed, 2011 Elsevier

Cilji in kompetence:

Objectives and competences:

Spoznati

- lastnosti in uporabnost surfaktantov v tehnologiji in živilski ter farmacevtski industriji (npr. kot inhibitorjev korozijskih procesov, kot stabilizatorjev mikroemulzij, itd.)
- kemijske in elektrokemijske metode za določanje inhibicijske učinkovitosti surfaktantov
- metode za določanje površinske napetosti in CMC, ter faktorji ki vplivajo na te količine

Na osnovi eksperimentalnih podatkov določitev adsorpcijske izoterme in spoznavanje procesov adsorpcije (kemisorpcija, fizikalna adsorpcija)

To know:

- properties of surfactants and their use in technology and food and pharmaceutical industry (for example, corrosion processes inhibitors or stabilizers of emulsions, etc.)
- classical chemical and electrochemical methods for determination of inhibition efficiency of surfactants
- methods for determination of surface tension and CMC, and factors which affecting on these quantities

Determination of adsorption isotherm on the basis of experimental data and understanding of the adsorption processes (chemisorption, physisorption)

Predvideni študijski rezultati:

Znanje in razumevanje:

Spoznati zakonitosti, ki veljajo za koloidne sisteme, tako raztopine kot suspenzije.

Študent spozna klasične in spektroskopske metode za določanje fizikalnih lastnosti surfaktantov.

Intended learning outcomes:

Knowledge and understanding:

To grasp the most important features of colloidal systems (suspensions and solutions).

Student obtains the knowledge of classical and spectroscopic methods to determine the physical properties of surfactants

Metode poučevanja in učenja:

Predavanja, seminarsko delo

Individualna priprava seminarских nalog s predstavitvijo in diskusijo.

Learning and teaching methods:

Lectures, seminars

Individual preparation of seminars and their presentation with discussion.

Načini ocenjevanja:

Način ocenjevanja (izpraševanje - ustni izpit, seminarska naloga):

- ustni izpit:
- seminarska naloga:

Delež (v %) /
Weight (in %)

60
40

Assessment:

Type (examination, oral, coursework, project):

- oral examination:
- seminar - coursework:

Reference nosilca / Lecturer's references:

FUCHS-GODEC, Regina, PAVLOVIĆ, Miomir, TOMIĆ, Milorad V. The inhibitive effect of vitamin-C on the corrosive performance of steel in HCl solutions. *International Journal of Electrochemical Science*, ISSN 1452-3981, 2013, vol. 8, str. 1551-1519. <http://www.electrochemsci.org/papers/vol8/80101511.pdf>. [COBISS.SI-ID [16562966](#)], [JCR, SNIP, WoS do 24. 3. 2014: št. citatov (TC): 0, čistih citatov (CI): 0, normirano št. čistih citatov (NC): 0, Scopus do 27. 2. 2013: št. citatov (TC): 0, čistih citatov (CI): 0, normirano št. čistih citatov (NC): 0]

FUCHS-GODEC, Regina, PAVLOVIĆ, Miomir. Synergistic effect between non-ionic surfactant and halide ions in the forms of inorganic or organic salts for the corrosion inhibition of stainless-steel X4Cr13 in sulphuric acid. *Corrosion science*, ISSN 0010-938X. [Print ed.], May 2012, vol. 58, str. 192-201, doi: [10.1016/j.corsci.2012.01.027](https://doi.org/10.1016/j.corsci.2012.01.027). [COBISS.SI-ID [15809558](#)], [JCR, SNIP, WoS do 4. 4. 2015: št. citatov (TC): 18, čistih citatov (CI): 18, normirano št. čistih citatov (NC): 23, Scopus do 4. 2. 2015: št. citatov (TC): 19, čistih citatov (CI): 19, normirano št. čistih citatov (NC): 24]

FUCHS-GODEC, Regina, PAVLOVIĆ, Miomir, TOMIĆ, Milorad V. Effect of temperature on the corrosion inhibition of nonionic surfactant TRITON-X-405 on ferritic stainless steel in 1.0 M H₂SO₄. *Industrial & engineering chemistry research*, ISSN 0888-5885. [Print ed.], 2012, vol. 51, iss. 1, str. 274-284, doi: [10.1021/ie2015697](https://doi.org/10.1021/ie2015697). [COBISS.SI-ID [15674134](#)], [JCR, SNIP, WoS do 4. 6. 2014: št. citatov (TC): 3, čistih citatov (CI): 2, normirano št. čistih citatov (NC): 1, Scopus do 12. 3. 2014: št. citatov (TC): 3, čistih citatov (CI): 2, normirano št. čistih citatov (NC): 1]

FUCHS-GODEC, Regina, ŽERJAV, Gregor. Inhibition properties of TRITON-X-100 on ferritic stainless steel in sulphuric acid at increasing temperature. *Acta chimica slovenica*, ISSN 1318-0207. [Tiskana izd.], 2009, vol. 56, no. 1, str. 78-85. <http://acta.chem-soc.si/56/56-1-78.pdf>. [COBISS.SI-ID [13053718](#)], [JCR, SNIP, WoS do 15. 2. 2013: št. citatov (TC): 2, čistih citatov (CI): 1, normirano št. čistih citatov (NC): 0, Scopus do 5. 3. 2013: št. citatov (TC): 2, čistih citatov (CI): 1, normirano št. čistih citatov (NC): 0]

FUCHS-GODEC, Regina. Effects of surfactants and their mixtures on inhibition of the corrosion process of ferritic stainless steel. *Electrochimica Acta*, ISSN 0013-4686. [Print ed.], Mar. 2009, vol. 54, iss. 8, str. 2171-2179. <http://dx.doi.org/10.1016/j.electacta.2008.10.014>, doi: [10.1016/j.electacta.2008.10.014](https://doi.org/10.1016/j.electacta.2008.10.014). [COBISS.SI-ID [12746262](#)], [JCR, SNIP, WoS do 13. 10. 2014: št. citatov (TC): 16, čistih citatov (CI): 12, normirano št. čistih citatov (NC): 6, Scopus do 20. 5. 2014: št. citatov (TC): 17, čistih citatov (CI): 13, normirano št. čistih citatov (NC): 6]



Univerza v Mariboru

Fakulteta za kemijo
in kemijsko tehnologijo

UČNI NAČRT PREDMETA / COURSE SYLLABUS

Predmet:	Rekonstrukcije obstoječih procesov
Course title:	Retrofit of existing processes

Študijski program in stopnja Study programme and level	Študijska smer Study field	Letnik Academic year	Semester Semester
Kemija in kemijska tehnika	Kemijska tehnika	1	zimski
Chemistry and Chemical Engineering	Chemical Engineering/Chemistry	1	Autumn

Vrsta predmeta / Course type

Izbirni/Elective

Univerzitetna koda predmeta / University course code:

Predavanja Lectures	Seminar Seminar	Sem. vaje Tutorial	Lab. vaje Laboratory work	Teren. vaje Field work	Samost. delo Individ. work	ECTS
10		10			430	15

Nosilec predmeta / Lecturer:

Anita Kovač Kralj

Jeziki /

Languages:

Predavanja / Lectures:

Vaje / Tutorial:

Slovenski /Slovenian

Slovenski /Slovenian

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

pogojev ni

Prerequisites:

None

Vsebina:

Content (Syllabus outline):

- Uvod v problematiko rekonstrukcij
- Pregled metod za izvedbo rekonstrukcij
- Učinkovitejšo energetska načrtovanje obstoječih procesov
- Učinkovitejša poraba surovin v obstoječih procesih
- Uporaba stranskih produktov
- Učinkovitejšo načrtovanje vodnih sistemov v obstoječih procesih
- Načrtovanje parnih turbin v obstoječih procesih
- Načrtovanje plinskih turbin v obstoječih procesih

Seminarska naloga:

aplikacije rekonstruiranja obstoječih procesov.

- Introduction of retrofit problem
- Overview of methods for the retrofit implementation
- More efficient energy planning of the existing processes
- More efficient use of raw materials within the existing processes
- Use of the by-products
- More efficient water systems planning of the existing processes
- Planning of steam turbine within the existing processes
- Planning of gas turbine within the existing processes

Seminar work:

applications retrofit of existing processes.

Temeljni literatura in viri / Readings:

- A. Brooke, D. Kendrick, A. Meeraus, R. Raman, GAMS - A user Guide, Scientific Press, GAMS Development Corporation, 2005.
- Bagajewicz M.J, A review of recent design procedures for water networks in refineries and process plants, *Computers and Chemical Engineering* **24** (2000), pp. 2093–2113.
- R. Smith. Chemical Process Design and Integration. John Wiley, West Sussex, (2005).
- I.C. Kemp (authors of the first edition Linnhoff B, Townsend DW, Boland D, Hewitt GF, Thomas BEA, Guy AR, Marsland R): *Pinch analysis and process integration. A user guide on process integration for efficient use of energy*. Amsterdam, the Netherlands: Elsevier, (2007).
- Primarna literatura (npr. članki) / Primary literature (e.g. papers).

Cilji in kompetence:

- posodobiti obstoječe delovanje procesov
- podati sodobno znanje študentom.

Objectives and competences:

- update the existing operation processes
- to provide students with modern knowledge.

Predvideni študijski rezultati:

Znanje in razumevanje:

Znanje in razumevanje:

sposobnost reševanja in posodabljanja obstoječih procesov, da bi delovali učinkoviteje.

Prenesljive/ključne spretnosti in drugi atributi:

- sposobnost pridobitve najnovejšega znanja s področja rekonstrukcij in sposobnost reševanja praktičnih problemov

Intended learning outcomes:

Knowledge and understanding:

Knowledge and Understanding:

- ability to solve and update existing processes in order to operate efficiently.

Transferable/Key Skills and other attributes:

- the ability of obtaining the latest knowledge in the field of retrofit and the ability to solve practical problems

Metode poučevanja in učenja:

- predavanja
- seminar
- seminarska naloga

Learning and teaching methods:

- lectures
- seminar
- seminar work

Načini ocenjevanja:

Način (pisni izpit, ustno izpraševanje, naloge, projekt)
Izpit je opravljen, če so pozitivno opravljene vse naslednje obveznosti:

- seminarska naloga

Delež (v %) /
Weight (in %)

100

Assessment:

Type (examination, oral, coursework, project):
Student has to pass successfully the following obligations:

- Seminar work

Reference nosilca / Lecturer's references:

KOVAČ KRALJ, Anita. Electricity cogeneration in an exothermic reactor circuit system using an open gas turbine. *Fuel*, ISSN 0016-2361. [Print ed.], 2014, vol. 118, str. 220-226, doi: [10.1016/j.fuel.2013.10.076](https://doi.org/10.1016/j.fuel.2013.10.076). [COBISS.SI-ID [17548822](#)], [JCR, SNIP]

KOVAČ KRALJ, Anita. Energy-efficient hexamine production process. *Advanced chemical engineering research*, ISSN 2326-5647. [Print ed.], 2013, vol. 2, issue 3, str. 51-54. [COBISS.SI-ID [17124630](#)]

KOVAČ KRALJ, Anita. A simple graphical utilities targeting method for heat integration between processes. *Industrial & engineering chemistry research*, ISSN 0888-5885. [Print ed.], 2012, vol. 51, iss. 43, str. 14171-14177, doi: [10.1021/ie301769e](https://doi.org/10.1021/ie301769e). [COBISS.SI-ID [16556566](#)], [JCR, SNIP, WoS do 5. 1. 2013: št. citatov (TC): 0, čistih citatov (CI): 0, normirano št. čistih citatov (NC): 0, Scopus do 25. 12. 2013: št. citatov (TC): 2, čistih citatov (CI): 2, normirano št. čistih citatov (NC): 1]

KOVAČ KRALJ, Anita. Industrial wastewater collection using a separation technique. *Journal of industrial and engineering chemistry*, ISSN 1226-086X, 2012, vol. 18, iss. 4, str. 1320-1325, doi: [10.1016/j.jiec.2012.01.033](https://doi.org/10.1016/j.jiec.2012.01.033). [COBISS.SI-ID [16124438](#)], [JCR, SNIP, WoS do 5. 8. 2012: št. citatov (TC): 0, čistih citatov (CI): 0, normirano št. čistih citatov (NC): 0, Scopus do 21. 7. 2012: št. citatov (TC): 0, čistih citatov (CI): 0, normirano št. čistih citatov (NC): 0]



Univerza v Mariboru

Fakulteta za kemijo
in kemijsko tehnologijo

UČNI NAČRT PREDMETA / SUBJECT SPECIFICATION

Predmet:	Individualno raziskovalno delo I
Subject Title:	Individual research work I

Študijski program Study programme	Študijska smer Study field	Letnik Year	Semester Semester
Kemija in kemijska tehnika Chemistry and Chemical Engineering	Kemijska tehnika / Kemija Chemical Engineering / Chemistry	1.	poletni Spring

Univerzitetna koda predmeta / University subject code:

Predavanja Lectures	Seminar Seminar	Sem. vaje Tutorial	Lab. vaje Labor work	Teren. vaje Field work	Samost. delo Individ. work	ECTS
	10				440	15

Nosilec predmeta / Lecturer:

Vsi nosilci / All lecturers

Jeziki /

Languages:

Predavanja / Lecture:

Vaje / Tutorial:

slovenski / Slovene

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

- pogojev ni

Prerequisites:

- None

Vsebina:

Individualno raziskovalno delo I je namenjeno:

- tehničnim predpripravam
- organizaciji delovnega mesta in drugih pogojev za začetek in nemoteno nadaljevanje raziskovalnega dela
- pripravi časovnega načrta izvedbe projekta
- pripravi dispozicije
- eventualnemu preverjanju in preizkušanju predvidenih metod
- pregledu in analizi dosedanjih raziskav in relevantne literature na izbrano raziskovalno temo
- postavitvi raziskovalnih hipotez

Content (Syllabus outline):

Individual research work I is intended for:

- Technical pre-preparations
- Organisation of working place and other conditions required for start and continuation of the research work
- Preparation of time plan for project realization
- Preparation of disposition
- Eventual checking and testing of the foreseen methods
- State-of-the-art in the proposed field of research and survey of the relevant literature
- Definition of research hypotheses

Temeljni literatura in viri / Textbooks:

- specifična strokovna in tekoča znanstvena periodika iz predvidenega področja doktorata, ki jo študent poišče individualno po navodilih mentorja

Cilji:

- identificirati splošno problematiko na izbranem področju
- samostojna določiti namen raziskave
- opredeliti metode dela
- samostojna postaviti hipoteze
- izvesti približno 1/4 raziskovalnega dela za doktorsko disertacijo

Objectives:

- Identification of problem from the selected field
- Independent determination of the research goal
- Definition of the methods
- Independent definition of hypothesis
- To perform approximately 1/4 of the research work for doctoral thesis

Predvideni študijski rezultati:Znanje in razumevanje:

- poglobljeno obvladanje znanj in izrazoslovja s področja doktorske disertacije
- poznavanje sistematike, najzahtevnejših metod in pristopov raziskovalno-razvojnega dela

Prenesljive/ključne spretnosti in drugi atributi:

- sposobnost identifikacije, formulacije in pristopa k reševanju najzahtevnejših problemov
- sposobnost samostojnega raziskovalnega dela, reševanja strokovnih problemov

Intended learning outcomes:Knowledge and Understanding:

- Mastery of knowledge and terminology in the specific field of Doctoral Thesis
- Knowledge of systematics, the most pretentious methods and approaches of research and development work

Transferable/Key Skills and other attributes:

- Ability of identification, formulation and approach to solving of the most pretentious problems
- Ability of individual research work, solving of scientific problems

Metode poučevanja in učenja:

- konzultacije in diskusije študenta z mentorjem o vsebinskem poteku dela
- priprava polletnega poročila o poteku IRD I

Learning and teaching methods:

- Consultations and discussions between student and mentor about the content and progress of the work
- Preparation of half-year report about IRW I

Načini ocenjevanja:

Delež (v %) /
Weight (in %)

Assessment:

Individualno raziskovalno delo je opravljeno, če so pozitivno opravljene vse naslednje obveznosti:		Student has to pass successfully the following obligations:
• individualno raziskovalno delo	50	• Individual research work
• poročilo o delu	50	• Report



Univerza v Mariboru

Fakulteta za kemijo
in kemijsko tehnologijo

UČNI NAČRT PREDMETA / SUBJECT SPECIFICATION

Predmet:	Individualno raziskovalno delo II
Subject Title:	Individual research work II

Študijski program Study programme	Študijska smer Study field	Letnik Year	Semester Semester
Kemija in kemijska tehnika Chemistry and Chemical Engineering	Kemijska tehnika / Kemija Chemical Engineering / Chemistry	2.	zimski Autumn

Univerzitetna koda predmeta / University subject code:

Predavanja Lectures	Seminar Seminar	Sem. vaje Tutorial	Lab. vaje Labor work	Teren. vaje Field work	Samost. delo Individ. work	ECTS
	10				440	15

Nosilec predmeta / Lecturer:

Vsi nosilci / All lecturers

Jeziki /

Languages:

Predavanja / Lecture:

Vaje / Tutorial:

slovenski / Slovene

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

- pogojev ni

Prerequisites:

- None

Vsebina:

- Individualno raziskovalno delo II je namenjeno:
- samostojnemu izvajanju znanstveno-raziskovalnega dela na izbrano temo doktorata
 - znanstvenemu izobraževanju kandidata v smislu aktivne udeležbe na domačih in tujih simpozijih
 - pripravi dispozicije prvega članka
 - uvajanju v timsko delo

Content (Syllabus outline):

- Individual research work II is intended for:
- Independent scientific and research work in the specific field of doctoral thesis
 - Scientific education as active participation at national and international conferences
 - Preparation of first paper disposition
 - Introduction to team work

Temeljni literatura in viri / Textbooks:

- Specifična strokovna in tekoča znanstvena periodika iz predvidenega področja doktorata, ki jo študent po predhodnih navodilih mentorja poišče individualno.
- Z. Svobodova idr., Writing in English, A Practical Handbook for Scientific and Technical Writers, Leonardo da Vinci Programme, European Commission, 2000, http://atom.uni-mb.si/Stud/files/Writing_in_English.pdf

Cilji:

Objectives:

- usposobiti kandidata za samostojno raziskovalno delo
- spoznati večšine priprave in izvedbe javnih predstavitev
- pridobiti tehniko pisanja znanstvenih članov in drugih elaboratov
- izvesti približno 1/4 raziskovalnega dela za doktorsko disertacijo

- To qualify the candidate for individual research work
- To understand the skills of preparation and realization of public presentations
- To gain the technique of writing scientific papers and other expert's detailed reports
- To perform approximately 1/4 of the research work for doctoral thesis

Predvideni študijski rezultati:

Znanje in razumevanje:

- usposobljenost uporabe pridobljenih znanj pri reševanju najzahtevnejših kvalitativnih in kvantitativnih nalog na področju kemije, kemijske in biokemijske tehnike
- razvijanje povsem novih znanj, konceptov in metod na osnovi konkretnih problemov
-

Prenesljive/ključne spretnosti in drugi atributi:

- samostojnost pri izvajanju raziskovalnega dela
- sposobnost razvijanja novih znanj
- pridobitev tehnike pisanja člankov in priprave prezentacij

Intended learning outcomes:

Knowledge and Understanding:

- Mastery of using the acquired knowledge for solving the most pretentious qualitative and quantitative tasks in the field of chemistry and (bio)chemical technology
- Developing of entirely new knowledge, concepts and methods based on specific problems

Transferable/Key Skills and other attributes:

- Independence at performing of research work
- Ability for developing of new knowledge
- Acquisition of techniques for writing the papers and preparing the presentations

Metode poučevanja in učenja:

- konzultacije in diskusije študenta z mentorjem o vsebinskem poteku dela
- priprava polletnega poročila o poteku IRD II

Learning and teaching methods:

- Consultations and discussions between student and mentor about the content and progress of the work
- Preparation of half-year report about IRW II

Načini ocenjevanja:

Delež (v %) /
Weight (in %)

Assessment:

Individualno raziskovalno delo je opravljeno, če so pozitivno opravljene vse naslednje obveznosti:		Student has to pass successfully the following obligations:
• individualno raziskovalno delo	50	• Individual research work
• poročilo o delu	50	• Report



Univerza v Mariboru

Fakulteta za kemijo
in kemijsko tehnologijo

UČNI NAČRT PREDMETA / SUBJECT SPECIFICATION

Predmet:	Individualno raziskovalno delo III
Subject Title:	Individual research work III

Študijski program Study programme	Študijska smer Study field	Letnik Year	Semester Semester
Kemija in kemijska tehnika Chemistry and Chemical Engineering	Kemijska tehnika / Kemija Chemical Engineering / Chemistry	2.	poletni Spring

Univerzitetna koda predmeta / University subject code:

Predavanja Lectures	Seminar Seminar	Sem. vaje Tutorial	Lab. vaje Labor work	Teren. vaje Field work	Samost. delo Individ. work	ECTS
	30				870	30

Nosilec predmeta / Lecturer:

Vsi nosilci / All lecturers

Jeziki /

Languages:

Predavanja / Lecture:

Vaje / Tutorial:

slovenski / Slovene

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

- ni pogojev

Prerequisites:

- None

Vsebina:

Individualno raziskovalno delo III je namenjeno:

- nadaljevanju samostojnega izvajanja znanstveno-raziskovalnega dela na izbrano temo doktorata
- znanstvenemu izobraževanju kandidata v smislu aktivne udeležbe na domačih in tujih simpozijih
- pripravi prvega članka za znanstveno revijo (JCR)

Content (Syllabus outline):

Individual research work I is intended for:

- Continuation of independent scientific and research work in the specific field of doctoral thesis
- Scientific education as active participation at national and international conferences
- Preparation of the first paper for the scientific journal (JCR)

Temeljni literatura in viri / Textbooks:

- Specifična strokovna in tekoča znanstvena periodika iz predvidenega področja doktorata, ki jo študent po predhodnih navodilih mentorja poišče individualno.
- Z. Svobodova idr., Writing in English, A Practical Handbook for Scientific and Technical Writers, Leonardo da Vinci Programme, European Commission, 2000, http://atom.uni-mb.si/Stud/files/Writing_in_English.pdf

Cilji:

Objectives:

- izvesti približno 1/4 raziskovalnega dela za doktorsko disertacijo
- pripraviti prvi članek za znanstveno revijo (JCR)
- aktivna udeležba na znanstvenem simpoziju

- To perform approximately 1/4 of the research work for doctoral thesis
- To prepare the first paper for the scientific journal (JCR)
- Active participation at the scientific symposium

Predvideni študijski rezultati:

Znanje in razumevanje:

- razvijanje dodatnih znanj, konceptov in metod v okviru izbrane teme doktorata

Prenesljive/ključne spretnosti in drugi atributi:

- sposobnost izvirnega inoviranja
- sposobnost samostojnega reševanja problemov, integracije teorije in prakse
- sposobnost objavljanja člankov

Intended learning outcomes:

Knowledge and Understanding:

- Additional developing of knowledge, concepts and methods within the doctoral thesis

Transferable/Key Skills and other attributes:

- Ability for original innovation
- Ability for independent problem solving, integration between theory and practice
- Ability for publishing.

Metode poučevanja in učenja:

- konzultacije in diskusije študenta z mentorjem o vsebinskem poteku dela
- priprava polletnega poročila o poteku IRD III

Learning and teaching methods:

- Consultations and discussions between student and mentor about the content and progress of the work
- Preparation of half-year report about IRW III

Načini ocenjevanja:

Delež (v %) /
Weight (in %)

Assessment:

Individualno raziskovalno delo je opravljeno, če so pozitivno opravljene vse naslednje obveznosti:

- individualno raziskovalno delo
- poročilo o delu

50
50

Student has to pass successfully the following obligations:

- Individual research work
- Report



Univerza v Mariboru

Fakulteta za kemijo
in kemijsko tehnologijo

UČNI NAČRT PREDMETA / SUBJECT SPECIFICATION

Predmet:	Individualno raziskovalno delo IV
Subject Title:	Individual research work IV

Študijski program Study programme	Študijska smer Study field	Letnik Year	Semester Semester
Kemija in kemijska tehnika Chemistry and Chemical Engineering	Kemijska tehnika / Kemija Chemical Engineering / Chemistry	3.	zimski Autumn

Univerzitetna koda predmeta / University subject code:

Predavanja Lectures	Seminar Seminar	Sem. vaje Tutorial	Lab. vaje Labor work	Teren. vaje Field work	Samost. delo Individ. work	ECTS
	30				870	30

Nosilec predmeta / Lecturer:

Vsi nosilci / All lecturers

Jeziki /

Languages:

Predavanja / Lecture:

Vaje / Tutorial:

slovenski / Slovene

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

- ni pogojev

Prerequisites:

- None

Vsebina:

Individualno raziskovalno delo IV je namenjeno:

- nadaljevanju in dokončanju raziskovalnega dela
- znanstvenemu izobraževanju kandidata v smislu aktivne udeležbe na domačih in tujih simpozijih
- oddaji prvega članka v znanstveno revijo (JCR)
- pripravi drugega članka za znanstveno revijo (JCR)

Content (Syllabus outline):

Individual research work I is intended for:

- Continuation and completion of research work
- Scientific education as active participation at national and international conferences
- Submission of the first paper to the scientific journal (JCR)
- Preparation of the second paper for the scientific journal (JCR)

Temeljni literatura in viri / Textbooks:

- Specifična strokovna in tekoča znanstvena periodika iz predvidenega področja doktorata, ki jo študent po predhodnih navodilih mentorja. poišče individualno.
- Z. Svobodova idr., Writing in English, A Practical Handbook for Scientific and Technical Writers, Leonardo da Vinci Programme, European Commission, 2000, http://atom.uni-mb.si/Stud/files/Writing_in_English.pdf

Cilji:

Objectives:

- izvesti približno 1/4 raziskovalnega dela za doktorsko disertacijo
- aktivna udeležba na znanstvenem simpoziju
- oddaja prvega članka v znanstveno revijo (JCR)
- priprava drugega članka za znanstveno revijo (JCR)

- To perform 1/4 of the research work for doctoral thesis
- Active participation at the scientific symposium
- To submit the first paper to the scientific journal (JCR)
- To prepare the second paper for the scientific journal (JCR)

Predvideni študijski rezultati:

Znanje in razumevanje:

- razvijanje dodatnih znanj, konceptov in metod v okviru izbrane teme doktorata
- drugii članek poslan v znanstveno revijo (JCR)

Prenesljive/ključne spretnosti in drugi atributi:

- sposobnost izvirnega inoviranja
- sposobnost samostojnega reševanja problemov, integracije teorije in prakse
- sposobnost objavljjanja člankov
- razumevanje poklicne in etične odgovornosti

Intended learning outcomes:

Knowledge and Understanding:

- Additional developing of knowledge, concepts and methods within the doctoral thesis
- Second paper submitted to the scientific journal (JCR)

Transferable/Key Skills and other attributes:

- Ability for original innovation
- Ability for independent problem solving, integration between theory and practice
- Ability for publishing
- Understanding of professional and ethical responsibility

Metode poučevanja in učenja:

- konzultacije in diskusije študenta z mentorjem o vsebinskem poteku dela
- priprava polletnega poročila o poteku IRD IV

Learning and teaching methods:

- Consultations and discussions between student and mentor about the content and progress of the work
- Preparation of half-year report about IRW IV

Načini ocenjevanja:

Delež (v %) /
Weight (in %)

Assessment:

Individualno raziskovalno delo je opravljeno, če so pozitivno opravljene vse naslednje obveznosti:		Student has to pass successfully the following obligations:
• individualno raziskovalno delo	50	• Individual research work
• poročilo o delu	50	• Report



Univerza v Mariboru

Fakulteta za kemijo
in kemijsko tehnologijo

UČNI NAČRT PREDMETA / SUBJECT SPECIFICATION

Predmet:	Doktorska disertacija
Subject Title:	Doctoral thesis

Študijski program Study programme	Študijska smer Study field	Letnik Year	Semester Semester
Kemija in kemijska tehnika Chemistry and Chemical Engineering	Kemijska tehnika / Kemija Chemical Engineering / Chemistry	3.	poletni Spring

Univerzitetna koda predmeta / University subject code:

Predavanja Lectures	Seminar Seminar	Sem. vaje Tutorial	Lab. vaje Labor work	Teren. vaje Field work	Samost. delo Individ. work	ECTS
	45				855	30

Nosilec predmeta / Lecturer:

Vsi nosilci / All lecturers

Jeziki /

Languages:

Predavanja / Lecture:

Vaje / Tutorial:

slovenski / Slovene

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

- opravljeni izpiti študijskega programa

Prerequisites:

- Exams of study programme

Vsebina:

Priprava doktorske disertacije poteka kot samostojno delo študenta. Na začetku doktorskega študija se kandidat z mentorjem dogovori o okvirni temi disertacije in izbere predmete iz področja, v okviru katerega je predvidena disertacija. Teme lahko predhodno razpišejo mentorji v okviru raziskovalnih laboratorijev Fakultete za kemijo in kemijsko tehnologijo ali jih predlagajo študentje. Mentor študenta usmerja in mu svetuje pri izvedbi doktorske disertacije. Formalni postopek priprave in zagovora doktorske disertacije poteka v skladu s Pravilnikom o pripravi in zagovoru doktorske disertacije na Univerzi v Mariboru. Predvidene aktivnosti študenta pri pripravi in zagovoru doktorske disertacije so naslednje:

- formulacija problema
- pregled in analiza dosedanjih raziskav in relevantne literature
- postavitev raziskovalnih hipotez

Content (Syllabus outline):

The student has to work independently on a doctoral thesis. At the beginning of the study, the candidate together with mentor chooses the research topic and selects the courses from the proposed research field. Topics are issued by the mentors in the research laboratories of the Faculty of Chemistry and Chemical Engineering or could be initiated by students. Mentor guides the student through the research work of Doctoral Thesis. The formal procedure for Doctoral Thesis preparation and defence is regulated by the "Pravilnik o pripravi in zagovoru doktorske disertacije" of the University of Maribor. The preparation and defence of Doctoral Thesis usually include the following activities of student:

- Problem formulation
- State-of-the-art in the proposed field of research and survey of the relevant literature

- definiranje metod dela
- časovni načrt izvedbe projekta
- praktično delo v enem od raziskovalnih laboratorijev fakultete
- interpretacija in kritična presoja rezultatov
- priprava pisnega izdelka
- ustna predstavitev

- Definition of research hypotheses
- Definition of research methods
- Time plan of project
- Practical work in one of the Faculty research laboratories
- Interpretation and evaluation of the results
- Written presentation of the work
- Oral presentation of the work

Temeljni literatura in viri / Textbooks:

- Predloga za pisanje doktorske disertacije:
http://www.fkkt.um.si/sites/default/files/Predloga_DR_KEKT-2015.docx
- Pravilnik o postopku priprave in zagovora doktorske disertacije
<http://www.um.si/univerza/dokumentni-center/akti/Strani/podrobnosti.aspx?iddok=38>

Dodatna priporočena literatura:

- Peter Glavič: Navodila za izdelavo diplomskega dela. Univerza v Mariboru, Fakulteta za kemijo in kemijsko tehnologijo, Maribor, 2008.
- Specifična strokovna in tekoča znanstvena periodika iz predvidenega področja doktorata, ki jo študent po predhodnih navodilih mentorja poišče individualno.

Cilji:

- usposobljenost doktoranda za vrhunsko znanstveno-raziskovalno delo s samostojnim razvijanjem novega znanja
- usposobljenost za vodenje znanstveno-raziskovalnih projektov
- usposobljenost za samostojno ter skupinsko reševanje najzahtevnejših znanstvenih problemov ter odkrivanje novih rešitev
- usposobljenost za samostojno komuniciranje v domačem in mednarodnem znanstvenem okolju
- sposobnost publiciranja izsledkov lastnega raziskovalnega dela

Objectives:

- Ability of student for high quality scientific and research work with independent developing of new knowledge
- Ability for leading the scientific and research projects
- Ability for independent and team solving of most pretentious scientific problems and discovering new solutions
- Ability of independent communication in the national and international scientific environment
- Ability of publishing the results of proper research work

Predvideni študijski rezultati:

Znanje in razumevanje:

- poglobljeno obvladanje znanj in izrazoslovja s področja doktorske disertacije
- poznavanje sistematike, najzahtevnejših metod in pristopov raziskovalno-razvojnega dela
- sposobnost identifikacije, formulacije in reševanja najzahtevnejših problemov s področja kemije, kemijske in biokemijske tehnike

Intended learning outcomes:

Knowledge and Understanding:

- Mastery of knowledge and terminology in the specific field of Doctoral Thesis
- Knowledge of systematics, the most pretentious methods and approaches of research and development work,
- Ability of identification, formulation and solution of the most pretentious problems in the field of Chemistry, Chemical and Biochemical Engineering

<u>Prenesljive/ključne spretnosti in drugi atributi:</u> • sposobnost samostojnega raziskovalnega dela, reševanja strokovnih problemov • sposobnost vodenja in organiziranja skupinskega dela • sposobnost učinkovite predstavitve in interpretacije rezultatov dela • sposobnost razvijanja novih znanstvenih metod		<u>Transferable/Key Skills and other attributes:</u> • Ability to independently accomplish the research work, solve the professional problems • Ability to lead and organize the team work • Ability to efficiently present and interpret the results of work • Ability to develop new scientific methods	
Metode poučevanja in učenja: • konzultacije in diskusije študenta z mentorjem o vsebinskem poteku dela • priprava doktorske disertacije in ustne predstavitve		Learning and teaching methods: • Consultations and discussions between student and mentor about the content and progress of the work • Preparation of doctoral thesis and oral presentation	
Načini ocenjevanja: Doktorsko delo je zaključeno, če so pozitivno opravljene naslednje obveznosti: • doktorska disertacija • ustni zagovor doktorske disertacije		Delež (v %) / Weight (in %) 50 50	Assessment: Student has to pass successfully the following obligations: • doctoral thesis work • doctoral thesis oral presentation