

UČNI NAČRT PREDMETA / COURSE SYLLABUS

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| Predmet: | KEMIJA IN OKOLJE |
| Course title: | CHEMISTRY AND THE ENVIRONMENT |

| Študijski program in stopnja Study programme and level | Študijska smer Study field | Letnik Academic year | Semester Semester |
|---|-------------------------------|-------------------------|----------------------|
| Varstvo okolja in ekotehnologije, 1. stopnja | | 1. | |
| Environmental Protection and Eco-technologies, 1st level | | 1rd | |

Vrsta predmeta / Course type Obvezni predmet / Obligatory subject

Univerzitetna koda predmeta / University course code: KO

| Predavanja Lectures | Seminar Seminar | Sem. Vaje Tutorial | Lab. vaje Laboratory work | Teren. vaje Field work | Samost. delo Individ. work | ECTS |
|------------------------|--------------------|-----------------------|---------------------------------|---------------------------|-------------------------------|------|
| 45 | | 15 | 30 | | 100 | 8 |

Nosilec predmeta / Lecturer: pred. dr. Pipuš Goran / Asist. pred. dr. Bubik Anja

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|--------------------------------|-------------------------------|-----------------------|
| Jeziki / Languages: | Predavanja / Lectures: | Slovenski / Slovenian |
| | Vaje / Tutorial: | Slovenski / Slovenian |

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

Pogojev ni

Prerequisites:

no prerequisites

Vsebina:

1. Uvod v kemijo: (lastnosti snovi, spremembe snovi, čiste snovi in zmesi, agregatna stanja, osnove in izpeljane enote, elementi in spojine, mol, molska masa,

2. Kemijske enačbe: (zapis, urejanje, reaktanti/produkti, empirična formula, molekulska formula).

3. Atomi in zgradba atomov: (Modeli atoma, , Elektron, Proton, Nevtron, Elektronska zgradba atomov, Atomske orbitale, Valenčni elektroni teorija)

4. Periodni sistem elementov, (skupine, vrste, relativna atomska masa, kovine/nekovine, izotopi, premer atomov, ionizacijska energija, elektronegativnost)

5. Kemijske vezi: (ionske vezi, kovalentne vezi,

Content (Syllabus outline):

1. Introduction to the Chemistry: (properties of the matter, changes of the matter, astnosti snovi, spremembe snovi, pure matter and mixtures, aggregate states, basics and derived units, elements and compounds, mol, molar mass,

2. Chemical equations: (writing, editing, reactants/products, empirical formula, molecular formula).

3. Atoms and the structure of atoms: (Models of atoms, Electron, Proton, Neutron, Electronic structure of atoms Structure, Atomic orbitals, Valence electrons)

4. Periodic system of elements, (groups, Periods, relative atomic mass, metals/non-metals, isotopes, atomic diameter, ionization energy,

medmolekulske vezi, vodikove vezi, kristali, fazni diagram)

6. Lastnosti plinov (plinski zakoni, zmesi plinov, parcialni plinski tlak).

7. Kemijske reakcije in kemijsko ravnotežje (energija kemijskih reakcij, hitrost kemijskih reakcij, kataliza, ravnotežna konstanta, homogeno/heterogeno ravnotežje, Le Chatelierov princip, ravnotežje med fazami,)

8. Raztopine: (koncentracijske enote, kisline in baze ter njihova jakost, hidroliza, pH, pufri, nevtralizacija, koligativne lastnosti raztopin, trdota vode, alkalnost vode)

9. Reakcije oksidacije in redukcije: (definicije, urejanje enačb, določevanje oksidacijskih števil, galvanski členi, baterije, elektroliza)

10. Uvod v organsko kemijo: (ogljikov atom in narava kemijske vez v ogljikovih spojinah, vrste ogljikovodikov, poimenovanje ogljikovodikov, izomeri, funkcionalne skupine).

11. Polimeri: (monomeri, naravni in sintetični polimeri, vrste in lastnosti polimerov, kompoziti)

12. Molekule, povezane z življenjem: (peptidi, proteini, DNK, lipidi, maščobne kisline, ogljikovi hidrati, kiralnost)

13. Kemikalije doma in v okolju (mila, detergenti, spreji, laki in barve, umetna gnojila, pesticidi, fosilna goriva)

13. Laboratorijske vaje: (osnove laboratorijskega dela, ločevanje zmesi, določevanje pH vrednosti in motnosti, titracija, sprektrofotometrija, vzorčevanje na terenu)

14. Kemijsko računanje - seminar (urejanje kemijskih enačb, preračunavanje koncentracij, izračun pH vrednosti, titracije, molekulske in empirične formule, plinska enačba)

electronegativity)

5. Chemical bonds: (ionic bonds, covalent bonds, intermolecular bonds, hydrogen bonds, crystals, phase diagram)

6. Gas properties (gas laws, gas mixtures, partial gas pressure).

7. Chemical reactions and chemical equilibria (energy of chemical reactions, rate of chemical reactions, catalysis, equilibrium constant, homogeneous/heterogeneous equilibrium, Le Chatelier's principle, phase equilibrium)

8. Solutions: (concentration units, acids and bases, and their strength, hydrolysis, pH, buffers, neutralization, colligative properties of solutions, hardness of water, alkalinity of water)

9. Oxidation and Reduction Reactions: (Definitions, Editing of Equations, Determination of Oxidation Numbers, Galvanic Cell, Batteries, Electrolysis)

10. Introduction to Organic Chemistry: (carbon atom and nature of a chemical bond in carbon compounds, types of hydrocarbons, nomenclature of hydrocarbons, isomers, functional groups).

11. Polymers: (monomers, natural and synthetic polymers, types and properties of polymers, composites)

12. Life-related molecules: (peptides, proteins, DNA, lipids, fatty acids, carbohydrates, chirality)

13. Chemicals at home and in the environment (soaps, detergents, sprays, varnishes and paints, artificial fertilizers, pesticides, fossil fuels)

13. Laboratory work: (basics of laboratory work, separation of the mixtures, determination of pH and turbidity, titration, spectrophotometry, sampling on the field)

14. Chemical Computation - Seminar (Editing of Chemical Equations, Concentration Calculation, pH Value, Titration, Molecular and Empirical Formula, Gas Equation)

Temeljni literatura in viri / Textbooks:

P. Buell, J. Girard: 2002, **Chemistry Fundamentals – An Environmental perspective**, Jones and Bartlett Publishers, Inc..

P.W. Atkins, M.J. Clugston, M.J. Frazer, R.A.Y. Jones; 1997 - **KEMIJA, zakonitosti in uporaba**, Tehniška založba Slovenije, ,

F. Lazarini, J. Brenčič, 2011 **Splošna in Anorganska kemija**, FKKT,

Kovačič N. in Bubik A., 2015, **NAVODILA ZA LABORATORIJSKE VAJE**, Velenje

Cilji in kompetence:

Predmetno specifični cilji in kompetence:

- Obnoviti in dopolniti osnovno znanje splošne, anorganske in organske kemije.
- Študente usposobiti za razumevanje pojavov v okolju ter seznaniti z vrstami in lastnostmi kemijskih spojin, ki so pomembne v okolju in za življenje kot podloga za študij pri bolj specializiranih predmetih v višjih letnikih..
- Študente usposobiti za osnovno delo v laboratoriju in za izvajanje osnovnih analiznih postopkov.
- Študente usposobiti za reševanje kemijskih nalog v povezavi s problematiko okolja.

Splošne kompetence:

- sposobnost razumevanja in analize pojavov v okolju ter njihovih posledic,
- sposobnost opravljanja osnovnih laboratorijskih in raziskovalnih del

Objectives and competences:

Specific competences:

- Renew and supplement the basic knowledge of general, inorganic and organic chemistry.
- Students get acquainted with the phenomena in the environment and to familiarize themselves with the types and properties of chemical compounds that are important in the environment and for life as a basis for studying in more specialized subjects at higher level of education.
- To train students for basic work in the laboratory and for performing basic analytical procedures.
- Qualify students for solving chemical tasks in connection with environmental issues

General competences:

- Ability to understand and analyze environmental issues and their` s consequences,
- Ability to perform basic laboratory and research works.

Predvideni študijski rezultati:

Znanje in razumevanje:

Študent bo ob zaključku tega predmeta sposoben:

- razložiti kemijske pojave,
- prepoznavanje pomembnih kemijskih spojin in njihovih lastnosti
- načrtovanje, izvedba ter ovrednotiti kemijske analize postopke

Prenesljive/ključne spretnosti in drugi atributi:

- Uporaba domače in tuje literature
- Varno delo v laboratorijih
- Identifikacija in reševanja kompleksnih računskih nalog
- Načrtovanje in vrednotenje eksperimentalnega dela
- Pisno poročanje o izvedenem eksperimentalnem

Intended learning outcomes:

Knowledge and Understanding:

- explain chemical phenomena,
- identification of important chemical compounds and their properties
- design, implement and evaluate chemical analytical procedures

Transferable/Key Skills and other attributes:

- Use of domestic and foreign literature,
- Safe work in laboratories,
- Identifying and solving complex computational tasks,
- Planning and evaluation of experimental work
- Written reporting on the performed experimental work
- Teamwork

- Timsko delo

Metode poučevanja in učenja:

Oblike dela:

- predavanja
- laboratorijske vaje
- samostojno delo študentov/tk
- domače naloge

Metode dela:

- razlaga
- dialog, diskusija
- reševanje kemijskih nalog
- praktično delo v laboratoriju
- izdelava poročil o opravljenih laboratorijskih vajah
- aktivno skupinsko delo

Learning and teaching methods:

Forms of teaching:

- In-class lectures
- Laboratory courses
- Individual work of students
- homework assignments

Teaching methods:

- Explanation
- Discussion, debate
- solving of chemical
- Practical work in laboratory
- Producing Report on performed laboratory experiments
- Teamwork

Načini ocenjevanja:

Delež (v %) /

Weight (in %)

Assessment:

- uspešno opravljene laboratorijske vaje in potrjeni dnevniki
- pisni kolokvij iz kemijskega računanja
- pisni izpit

30 %

20 %

50 %

- **successful completed laboratory work with confirmed diary of laboratory work**
- **written colloquiums on solving chemical equations and problems**
- **written exam**

Na vajah je obvezna vsaj 90-odstotna prisotnost. Študent mora imeti vsaj 5 od 9 pozitivno potrjenih dnevnikov. Potem lahko pristopi k pisnemu kolokviju iz kemijskega računanja in h končnemu pisnemu izpitu

At least 90% attendance at lab work is required. Students must have at least 5 from 9 positive confirmed diaries of laboratory works, which is a prerequisite for written colloquiums and final written examination.

Ocenjevalna lestvica:

- zadostno 6: 60-67%
- dobro 7: 68-75%
- prav dobro 8: 76-83%
- prav dobro 9: 84-90%
- odlično 10: 91-100%

Grading system:

- Sufficient D (6): 60-67%
- Good C (7): 68-75%
- Very good B (8): 76-83%
- Very good B+ (9): 84-90%
- Excellent A (10): 91-100%

Materialni pogoji za izvedbo predmeta :

- Predavalnica z multimedijsko opremo, (projektor,...)
- kemijski laboratorij (pH meter, merilnik motnosti, analitska tehtnica, avtomatski titrator, spektrofotometer, steklovina,...

Material conditions for subject realization:

- Classroom with the multimedia equipment (head-up projector,...)
- Chemical laboratory (pH probe, turbidity meter, analytical scale, automatic titration, spectrophotometer, glassware,...

Obveznosti študentov:

Student's commitments:

- obvezna udeležba na vajah
- izdelava pisnih laboratorijskih dnevnikov
- obvezna udeležba na seminarjih

- obligatory participation at the laboratory experiments
- Written report on Laboratory experiments
- Obligatory participation at the seminars

Reference nosilca predmeta:

(1) Pedagoško delo:

- nosilec in izvajalec predmetov na dodiplomskem študiju (Kemija in okolje – VŠVO velenje, Kemija Onesnaževal, - VŠVO,
- mentor diplomantom na dodiplomskem študiju

(2) Raziskovalno delo:

- potek kemijskih reakcij v mikrovalovnih reaktorjih
- modeliranje biološkega čiščenja odpadnih vod

Pomembnejša raziskovalna dela:

PLAZL, Igor, **PIPUŠ, Goran**, KOLOINI, Tine. Microwave heating of the continuous flow catalytic reactor in a nonuniform electric field. *AIChE journal*, ISSN 0001-1541. [Print ed.], 1997, vol. 43, no. 3, str. 754-760

PIPUŠ, Goran, PLAZL, Igor, KOLOINI, Tine. Esterification of benzoic acid with 2-ethylhexanol in a microwave stirred-tank reactor. *Industrial & engineering chemistry research*, ISSN 0888-5885. [Print ed.], 2002, vol. 41, no. 5,

PIPUŠ, Goran, PLAZL, Igor, KOLOINI, Tine. Esterification of benzoic acid in microwave tubular flow reactor. *The chemical engineering journal*, ISSN 1385-8947. [Print ed.], 2000, vol. 76, no. 3,

PLAZL, Igor, **PIPUŠ, Goran**, DROLKA, Maja, KOLOINI, Tine. Parametric sensitivity and evaluation of a dynamic model for single-stage wastewater treatment plant = Parametrična občutljivost in določitev parametrov dinamičnega modela enostopenjske čistilne naprave. *Acta chimica slovenica*, ISSN 1318-0207. [Tiskana izd.], 1999, vol. 46, št. 2,

PLAZL, Igor, **PIPUŠ, Goran**, KOLOINI, Tine. Parametric sensitivity of a dynamic model for single-stage wastewater treatment plant. V: AGATHOS, Spyridon Nicholas (ur.), REINEKE, Walter (ur.). *Biotechnology for the environment: wastewater treatment and modeling, waste gas handling*, (Focus on biotechnology, Vol. 3C). Dordrecht; Boston; London: Kluwer Academic, cop. 2003.

PIPUŠ Goran, Applying new technologies in wastewater treatment to meet strict demands for effluent discharge in sensitive areas EREF-2006,

Lecturer's references:

(1) Teaching:

- Lecturer of subjects at undergraduate level (Chemistry and Environment VŠVO Velenje, Chemistry of pollutants, VŠVO)
- Mentor to graduate students

(2) Research work:

- chemical reactions in microwave reactors
- mathematical model of biological treatment of wastewaters

Selected research publications:

PLAZL, Igor, **PIPUŠ, Goran**, KOLOINI, Tine. Microwave heating of the continuous flow catalytic reactor in a nonuniform electric field. *AIChE journal*, ISSN 0001-1541. [Print ed.], 1997, vol. 43, no. 3, str. 754-760

PIPUŠ, Goran, PLAZL, Igor, KOLOINI, Tine. Esterification of benzoic acid with 2-ethylhexanol in a microwave stirred-tank reactor. *Industrial & engineering chemistry research*, ISSN 0888-5885. [Print ed.], 2002, vol. 41, no. 5,

PIPUŠ, Goran, PLAZL, Igor, KOLOINI, Tine. Esterification of benzoic acid in microwave tubular flow reactor. *The chemical engineering journal*, ISSN 1385-8947. [Print ed.], 2000, vol. 76, no. 3, PLAZL, Igor, **PIPUŠ, Goran**, DROLKA, Maja, KOLOINI, Tine. Parametric sensitivity and evaluation of a dynamic model for single-stage wastewater treatment plant *Acta chimica slovenica*, ISSN 1318-0207. [Tiskana izd.], 1999, vol. 46, št. 2,

PLAZL, Igor, **PIPUŠ, Goran**, KOLOINI, Tine. Parametric sensitivity of a dynamic model for single-stage wastewater treatment plant. V: AGATHOS, Spyridon Nicholas (ur.), REINEKE, Walter (ur.). *Biotechnology for the environment: wastewater treatment and modeling, waste gas handling*, (Focus on biotechnology, Vol. 3C). Dordrecht; Boston; London: Kluwer Academic, cop. 2003

PIPUŠ Goran, Applying new technologies in wastewater treatment to meet strict demands for effluent discharge in sensitive areas EREF-2006, Building Knowledge Society through Regional Innovation Support, Nova Gorica 2006.,

Building Knowledge Society through Regional Innovation Support, Nova Gorica 2006., zbornik referatov

PIPUŠ Goran, Problematika končne oskrbe odpadkov, iz komunalnih čistilnih naprav, ZTI, 2008 zbornik referatov,

PIPUŠ Goran, Sanacija vodnih virov Segovci in Podgrad, Vodni dnevi 2017, Slovensko društvo za zaščito voda, simpozij z mednarodno udeležbo.

(3) Strokovno delo:

-vodja laboratorija za odpadne vode in odgovorni projektant za tehnološke načrte s področja priprave pitne vode, čiščenja odpadnih vod in obdelave odpadkov.

- izdelal več kot 50 tehnoloških načrtov in sanacijskih programov s področja priprave pitne vode, čiščenja odpadnih vod in obdelave odpadkov.

PIPUŠ Goran, Problems with final disposal of wastes from municipal wastewater treatment plants, ZTI, 2008,

PIPUŠ Goran, Rehabilitation of water sources Segovci and Podgrad, Vodni dnevi 2017, Slovensko društvo za zaščito voda,

(3) Professional work:

– head of laboratory for wastewater analysis and senior process designer for drinking water treatment plants, wastewater treatment plant and waste treatment facilities.

- more than 50 process designs and rehabilitation programs for design for drinking water treatment plants, wastewater treatment plant and waste treatment facilities.