

**UČNI NAČRT PREDMETA / COURSE SYLLABUS**

<b>Predmet:</b>	KEMIJA IN OKOLJE
<b>Course title:</b>	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.	1.
Environmental Protection and Eco-technologies, 1 <sup>st</sup> level	/	1 <sup>st</sup>	1 <sup>st</sup>

**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	7

**Nosilec predmeta / Lecturer:** viš. pred. dr. Goran Pipuš, Katrin Školnik Škrabe, mag./ Goran Pipuš, Ph.D., Lecturer, Katrin Školnik Škrabe, M.sc.

**Jeziki / Predavanja / Lectures:** Slovenski / Slovenian  
**Languages: 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, medmolekulske vezi, vodikove vezi, kristali, fazni diagram)

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

**Content (Syllabus outline):**

**1. Introduction to the Chemistry:** (properties of the matter, changes of the matter, 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, electronegativity)

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

**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 vezi 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, spektrofotometrija, vzorčevanje na terenu)

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

**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:**

##### **Obvezna literatura:**

B. Cigić, L. Pogačnik, N. Šegatin, 2017, Kemija z Biokemijo, BTF

##### **Priporočena literatura:**

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

### **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 analizne 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
- Timsko delo

### **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

**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:**

<ul style="list-style-type: none"> <li>- uspešno opravljene laboratorijske vaje in potrjeni dnevniki</li> <li>- pisni kolokvij iz kemijskega računanja</li> <li>- pisni izpit</li> </ul> <p>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</p> <p>Ocenjevalna lestvica:</p> <ul style="list-style-type: none"> <li>▪ zadostno 6: 60-67%</li> <li>▪ dobro 7: 68-75%</li> <li>▪ prav dobro 8: 76-83%</li> <li>▪ prav dobro 9: 84-90%</li> <li>▪ odlično 10: 91-100%</li> </ul>	<p><b>30</b></p> <p><b>20</b></p> <p><b>50</b></p>	<ul style="list-style-type: none"> <li>- successful completed laboratory work with confirmed diary of laboratory work</li> <li>- written colloquiums on solving chemical equations and problems</li> <li>- written exam</li> </ul> <p>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.</p> <p>Grading system:</p> <ul style="list-style-type: none"> <li>▪ Sufficient D (6): 60-67%</li> <li>▪ Good C (7): 68-75%</li> <li>▪ Very good B (8): 76-83%</li> <li>▪ Very good B+ (9): 84-90%</li> <li>▪ Excellent A (10): 91-100%</li> </ul>
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**Materialni pogoji za izvedbo predmeta :**

- Predavalnica z multimedijsko opremo, (projektor,...)
- kemijski laboratorij ( pH meter, merilnik motnosti, analitska tehnica, 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:**

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

**Student's commitments:**

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

**Reference nosilca predmeta:****Lecturer's references:**

(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**, Sanacija vodnih virov Segovci in Podgrad, Vodni dnevni 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

(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**, Rehabilitation of water sources Segovci and Podgrad, Vodni dnevni 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.

vode, čiščenja odpadnih vod in obdelave odpadkov.