

**UČNI NAČRT PREDMETA / COURSE SYLLABUS**

**Predmet:** EKSPERIMENTI IZ ORGANSKE KEMIJE V ŠOLI  
**Course Title:** SCHOOL EXPERIMENTS IN ORGANIC CHEMISTRY

Študijski program in stopnja Study Programme and Level	Študijska smer Study Field	Letnik Academic Year	Semester Semester
MAG Kemijsko izobraževanje, 2. stopnja	/	1.	2.
USP Chemical Education, 2 <sup>nd</sup> Cycle	/	1 <sup>st</sup>	2 <sup>nd</sup>

**Vrsta predmeta / Course Type:**

obvezni / Mandatory

**Univerzitetna koda predmeta / University Course Code:**

IZO213

Predavanja Lectures	Seminar Seminar	Vaje Tutorial	Klinične vaje Work	Druge oblike študija	Samost. delo Individual Work	ECTS
10	5	60 LV	/	/	75	5

**Nosilec predmeta /  
Lecturer:**

doc. dr. Krištof Kranjc / Dr. Krištof Kranjc, Assistant Professor

**Jeziki / Languages:**

**Predavanja / Lectures:** slovenski / Slovenian

**Vaje / Tutorial:** slovenski / Slovenian

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

Študent oz. kandidat mora imeti predmet opredeljen kot študijsko obveznost.

**Prerequisites:**

The course has to be assigned to the student.

**Vsebina:**

- Varnostni in zaščitni ukrepi pri eksperimentiranju.  
- Cilji poskusov, izbira in izvedba poskusov. Demonstracijski poskusi in poskusi, ki jih izvajajo študenti.  
- Izbira in prilagoditev poskusa ravni poučevanja.  
- Izdelava navodila za izvajanje poskusa  
- Uporaba raziskovalnega pristopa z namenom povečanja pedagoške vrednosti izvajanih eksperimentov.  
- Fotografiranje in filmsko snemanje poskusov, uporaba modernih multimedijskih orodij za predstavitev eksperimentov.

**Content (Syllabus outline):**

- Safety and protection measures during experimental work.  
- The aim of experiments and how to execute them. Demonstration experiments and experiments, carried out by students.  
- Selection and adaptation of demonstration or experiments to the level of the class.  
- Writing instructions.  
- Use of research principles to increase the pedagogical value of experiments presented.  
- Taking photos or videos of experiments, use of modern audiovisual equipment in presentation of experiments.  
- Application of computer simulations and other

- Uporaba računalniških programov in drugih medijev za predstavitev poskusa.

#### **PRAKTIČNE VAJE**

- Študent si v pogovoru z učiteljem izbere nekaj eksperimentov različne zahtevnosti iz ustrezne literature, jih pripravi in samostojno izvede pod nadzorom učitelja in v prisotnosti kolegov.
- Učitelj skupno s študenti kritično analizira demonstracijo in razlago posameznih eksperimentov. Predvsem je pomembno ugotoviti, ali je eksperiment ustrezno ilustriral želene vsebine na izbranem nivoju poučevanja. Oцени se tudi varno delo pri eksperimentiranju.
- Učitelj določi temo študentu, ki pregleda ustrezno literaturo in medmrežje ter pripravi nekaj eksperimentov vezanih na temo. Na novo zasnovane eksperimente opiše. Eksperimenti se kritično ovrednotijo.
- Eksperimente študentje posnamejo in izdelajo predstavitev eksperimenta npr. v Power Pointu ali drugem ustreznem programu.

Teme poskusov:

- Poskusi, s katerimi ilustriramo fizikalne lastnosti organskih snovi topnost v vodi, tališča, vrelišča, sublimacija ipd.
- Lastnosti in kemijska reaktivnost ogljikovodikov (alkani, alkeni, areni). Lastnosti in reaktivnost organskih kisikovih spojin (npr. oksidacija alkoholov, reakcije aldehydov in ketonov, lastnosti sladkorjev, lipidov, tenzidov...).
- Lastnosti in reaktivnost organskih dušikovih spojin (bazičnost aminov, amfoternost aminokislin, testi na aminokislino, peptide, delovanje encimov, denaturacija beljakovin ...).
- Pridobivanje in lastnosti polimerov (sinteza najlona, topnost in taljivost linearnih in zamreženih polimerov, ...).

multimedia tools for the presentation of experimental work.

#### **PRACTICAL COURSE**

- Students choose a few experiments of different levels and complexity from literature and under the supervision of the teacher carry out these experiments in the presence of their colleagues.
- Teacher and students together critically analyze the demonstration and explanation of each experiment. Of paramount importance is to find out if the experiment has suitably illustrated the topics presented and if it was appropriate for the teaching level. Also the safety measures are evaluated.
- Teacher assigns appropriate topic to the student, who then browses through the relevant literature (including WWW) and prepares a few experiments connected with the topic. Novel experiments are carefully explained. All experiments are critically evaluated.
- Students film the experiments progression and prepare presentations of their work (e.g. in PowerPoint).

Topics of experiments:

- Illustration of physical properties of organic compounds, e.g. water solubility, melting and boiling points, sublimation etc.
- Properties and chemical reactivity of hydrocarbons (alkanes, alkenes, arenes).
- Properties and reactivity of oxygen-containing organic compounds (e.g. oxidation of alcohols, reactions of aldehydes and ketones, properties of sugars, lipids, tensids etc.).
- Properties and reactivity of nitrogen-containing organic compounds (basicity of amines, amphoteric properties of amino acids, tests for amino acids, peptides, action of enzymes, denaturation of proteins etc.).
- Preparation and properties of polymers (synthesis of nylon, solubility and melting properties of linear and cross-linked polymers etc.)

#### **Temeljna literatura in viri / Readings:**

1) W. H. Brown, C. S. Foote, B. L. Iverson, E. V. Anslyn: Organic Chemistry, 6. izdaja, Brooks/Cole -

Cengage Brain, 2012 (ISBN: 1-111-42683-X)

2) J. R. Dean, A. M. Jones, D. Holmes, R. Reed, J. Weyers, A. Jones: Practical Skills in Chemistry, 2. izdaja, Prentice Hall, Harlow, 2011 (ISBN: 978-0-273-73118-4).

3) D. Dolenc, B. Šket: Kemija za gimnazije 3, DZS, Ljubljana, 2010 (ISBN: 978-961-02-0137-3).

4) L. F. Tietze, T. Eicher, U. Diederichsen, A. Speicher: Reactions and Syntheses in the Organic Laboratory, Wiley-VCH, Weinheim, 2007 (ISBN: 978-3-527-31223-8).

5) B. P. Mundy, M. G. Eller, F. G. Favaloro Jr.: Name Reactions and Reagents in Organic Synthesis, 2. izdaja, Wiley-Interscience, Hoboken NJ, 2005 (ISBN: 0-471-22854-0).

6) J. Svete: Preparativna organska kemija, FKKT, UL, Ljubljana, 1999 (ISBN: 961-6286-15-3).

### **Cilji in kompetence:**

**Cilji:** študentje se bodo naučili izbirati, izvajati in ovrednotiti poskuse za prikaz lastnosti in reaktivnosti organskih spojin. Študentje samostojno pripravijo demonstracijske poskuse s katerimi ponazorijo fizikalne lastnosti ali kemijsko reaktivnost organskih spojin.

- Študentje se bodo naučili, kako in kje vključiti ustrezne kemijske eksperimente v pri obravnavi organske kemije v srednji šoli; znali bodo zbrati vse podatke in ustrezno varno pripraviti kemijski eksperiment. Poskuse bodo zasnovali s pripomočki, ki so v srednjih šolah dostopni, po možnosti kar z vsakdanjimi komercialno dostopnimi spojinami oz. reagenti in inventarjem.

- Naučili se bodo uporabljati enostavne, vendar učinkovite, sodobne multimedijske pripomočke za boljši prikaz eksperimentov (filmsko snemanje, povečava itd.). Študentje v skupini bodo kritično ocenili posamezne demonstracijske eksperimente in to predstavili v pisni obliki.

**Kompetence:** Študent bo obvladal varno delo v laboratoriju, rokovanje s kemikalijami in opremo. Znal bo poiskati ustrezno strokovno literaturo in podatke. Znal bo samostojno izbrati, zasnovati in izvesti kemijske poskuse, primerne za ponazoritev učne snovi v srednji šoli. Naučil se bo, kako predstaviti poskuse z modernimi multimedijskimi pristopi. Naučili se bodo, kako izvedbo eksperimentov prilagoditi glede na potrebe po individualnem, skupinskem ali demonstracijskem načinu poučevanja.

### **Objectives and Competences:**

**Learning outcomes:** Students acquire knowledge and skills for planning, conducting and evaluating experiments that illustrate properties and reactivity of organic compounds. Students independently prepare demonstration experiments that illustrate physical properties and reactivity of organic compounds.

- Students learn how and where to include appropriate chemical experiments in the courses of organic chemistry that they will be teaching at secondary schools. They will be able to acquire all data necessary and execute the chemical experiment safely. The experiments will be planned with equipment that is available in secondary schools, or in some cases with compounds, reagents and equipment that is widely available in domestic environments.

- They will learn to use simple but efficient contemporary multimedia to better illustrate the experiments (filming, zooming etc.). Students arranged in groups will critically evaluate various aspects of demonstration experiments and provide a written report.

**Competences:** Students will be proficient in safety measures in laboratory, how to handle chemicals and equipment. They will know how to search in chemical literature in how to find relevant data. They will be able to independently select, plan and execute chemical experiments, also such that are necessary to illustrate the themes taught in secondary schools. They will also gain some knowledge of contemporary media presentation.

**Predvideni študijski rezultati:**

Znanje in razumevanje: Študent bo znal izbrati, ovrednotiti, izvajati in uporabljati kemijske eksperimente z namenom ilustracije kemijskih zakonitosti (vključno z uporabo pri pouku kemije v srednjih šolah).

Uporaba: Pridobljene teoretično znanje in spretnosti pri praktičnem delu so temelj za delo študenta v kemijskem laboratoriju, vključno z vlogo (srednješolskega) učitelja.

Refleksija: Študent bo znal kritično ovrednotiti pomen posameznega eksperimenta za določeno temo.

Prenosljive spretnosti: Študent pridobi praktične izkušnje pri delu v laboratoriju, zna pripraviti zaključeno učno enoto, zna predstaviti eksperimentalno delo na medmrežju s kratkimi filmskimi posnetki.

**Intended Learning Outcomes:**

Knowledge and Comprehension: Students will know how to select, evaluate, execute and use chemical experiments to illustrate chemical concepts (also in secondary schools)

Application: Theoretical background and experimental skills gained during the course will be fundamentals for further work of the student in chemical laboratory, including the role of a teacher (at secondary schools).

Analysis: Students will be able to critically evaluate the importance of each experiment for a selected topic.

Skill-transference Ability: Students will gain practical laboratory skills, will be able to prepare a self-contained teaching topic, will be able to use WWW to further illustrate experiments, also with short film clips.

**Metode poučevanja in učenja:**

- Predavanja predstavijo bistvena teoretična ozadja, ki so nujna za razumevanja izbranih eksperimentov, s seminarji še nadalje poglobimo razumevanje vseh vpletenih konceptov in študentom pomagamo izbrati primerne eksperimente. Glavni del predmeti so seveda eksperimentalne laboratorijske vaje in priprava predstavitev oz. poročil o tem delu. Delo študentov je kombinacija individualnega in timskega.

- Praktično delo v laboratoriju poteka samostojno ob pomoči učitelja in tehnika.

- Vse izvedene eksperimente študentje svojim kolegom in učitelju predstavijo v obliki zaključene učne enote.

**Learning and Teaching Methods:**

- Lectures to provide fundamental theoretical background necessary for the understanding of the experiments selected, seminars to further deepen the understanding of all concepts involved and to help the students select suitable experiments. The major part of the course is the experimental work and preparation of presentations and reports of the laboratory work. The work of students is a combination of individual and team-work.

- Laboratory work takes place independently or in small groups (2-3 students) with the help of teacher and technician.

- All experiments executed are carefully presented as self-containing teaching units to the teacher and their colleagues.

Delež (v %) /

**Načini ocenjevanja:**Weight (in %) **Assessment:**

A) Seminarska naloga (pisna) 30 %  
 B) Izvedba in predstavitev eksperimentalnega projekta 50 %  
 C) Ustni izpit 20 %

A) Seminar work (written) 30 %  
 B) Execution and presentation of the experimental project 50 %  
 C) Oral exam 20 %

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

- **KRANJC, Krištof**, PERDIH, Franc, KOČEVAR, Marijan. Effect of ring size on the exo/endo selectivity of a thermal double cycloaddition of fused pyran-2-ones. *Journal of organic chemistry*,

ISSN 0022-3263, 2009, vol. 74, no. 16, str. 6303-6306, doi: [10.1021/jo9011199](https://doi.org/10.1021/jo9011199). [COBISS.SI-ID [30678277](https://www.cobiss.si/id/30678277)]

- KRIVEC, Marko, GAZVODA, Martin, **KRANJC, Krištof**, POLANC, Slovenko, KOČEVAR, Marijan. A way to avoid using precious metals : the application of high-surface activated carbon for the synthesis of isoindoles via the Diels-Alder reaction of 2H-pyran-2-ones. *Journal of organic chemistry*, ISSN 0022-3263, 2012, vol. 77, no. 6, str. 2857-2864, doi: [10.1021/jo3000783](https://doi.org/10.1021/jo3000783).

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- KUKULJAN, Lovel, **KRANJC, Krištof**, PERDIH, Franc. Synthesis and structural evaluation of 5-methyl-6-acetyl substituted indole and gramine. *Acta chimica slovenica*, ISSN 1318-0207. [Tiskana izd.], 2016, vol. 63, no. 4, str. 905-913, doi: [10.17344/acsi.2016.2911](https://doi.org/10.17344/acsi.2016.2911). [COBISS.SI-ID [1537305795](https://www.cobiss.si/id/1537305795)]

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