



Univerza v Mariboru

Fakulteta za naravoslovje
in matematiko

UČNI NAČRT PREDMETA / COURSE SYLLABUS

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| Predmet: | Nevarne snovi v bivalnem okolju |
| Course title: | Pollutants in the Living Environment |

| Študijski program in stopnja Study programme and level | Študijska smer Study field | Letnik Academic year | Semester Semester |
|---|-------------------------------|-------------------------|----------------------|
| Biologija in ekologija z naravovarstvom, 2. stopnja | / | 1/2 | Poletni/ Zimski |
| Biology and Ecology with Nature Conservation, 2 nd Cycle | / | 1/2 | Summer/ Winter |

Vrsta predmeta / Course type

Univerzitetna koda predmeta / University course code:

| Predavanja Lectures | Seminar Seminar | LAB. VAJE Tutorial | Klinične vaje work | Druge oblike študija | Samost. delo Individ. work | ECTS |
|------------------------|--------------------|-----------------------|-----------------------|-------------------------|-------------------------------|------|
| 15 | 15 | 15 | | | 135 | 6 |

Nosilec predmeta / Lecturer:

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

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

Prerequisites:

Vsebina:

- ONESNAŽEVALA V OKOLJU
- ORGANSKE KEMIČNE SPOJINE
Obravnavane so posamezne skupine organskih onesnažil okolja:
- Dioksini in poliklorirani bifenili (PCB)
- Furani
- Organokositrove spojine
- Policiklični aromatski ogljikovodiki (PAH)
- Nonilfenoli
- Bromirani zaviralci gorenja
- Pesticidi
- Insekticidi
- Herbicidi

Content (Syllabus outline):

- POLLUTION IN THE ENVIRONMENT
- ORGANIC CHEMICAL COMPOUNDS
The course covers individual groups of organic pollutants:
- Dioxins and polychlorinated biphenyls (PCBs)
- Furans
- Organotin compounds
- Polycyclic aromatic hydrocarbons (PAHs)
- Nonylphenols
- Brominated flame retardants
- Pesticides
- Insecticides
- Herbicides

- DRUGE ZDRAVJU ŠKODLJIVE SPOJINE V OKOLJU (trdni delci v zraku (PM), mikroplastika, ostanki zdravil, ostanki drog, težke kovine itd.)

Omenjene skupine spojin kot tudi posamezne spojine so obravnavane po naslednjih sklopih:

- kemijska opredelitev spojin z njihovimi fizikalno kemijskimi lastnostmi
- porazdeljevanje spojin v okolju in njihova obstojnost in biotsko koncentriranje (voda, zrak, sediment)
- različne poti vstopanja spojin v okolje in možnosti ter sposobnosti okolja za njihovo razgradnjo
- poti vstopanja spojin v prehranjevalno verigo človeka in nevarnosti, ki jo predstavljajo za njegovo zdravje (posebej obravnava spojin, ki delujejo kot motilci naravnega hormonalnega (endokrinega) ravnotežja človeka)
- poti razširjanja in preprečevanja razširjanja nevarnih spojin v okolje
- različni analitski postopki za določevanje organskih onesnažil v različnih vzorcih v nizkih koncentracijah

praktični primeri izvedbe analiznih postopkov, ki se običajno uporabljajo v analitiki nevarnih organskih snovi, ki se nahajajo v bivalnem okolju človeka (Soxhlet ekstrakcija, SPE, postopki derivatizacij, ločevanje in identifikacija z GC-FID, GC-MS ali HPLC-UV)

- OTHER HARMFUL COMPOUNDS IN THE ENVIRONMENT (solid particles in the air (PM), micro-plastics, drug residues, heavy metals, etc.)

The mentioned groups of compounds as well as individual representative compounds are presented in the following sections:

- chemical identification of the substances with presentation of their chemical and physical properties, the distribution of the compounds in the environment and their persistence and biotic concentration (in water, air, sediment);
- different modes of introducing hazardous substances into the environment and the possibilities and abilities of the environment for their degradation;
- modes of incoming of substances into the food chain of humans and risks for human health (special discussion about compounds that act as endocrine disrupters- disrupters of the natural hormonal balance in human organism);
- modes of distribution and prevention of distribution of hazardous substances into environment;
- different analytical methods for determination of organic pollutants in different samples at low concentrations,

practical examples of analytical procedures used for the analysis of hazardous organic substances occurring in the human environment (Soxhlet extraction, derivatisation procedures, separation and identification using GD-FID, GC-MS or HPLC-UV)

Temeljni literatura in viri / Readings:

Temeljna literatura/Basic literature

Baird Colin and Michael Cann: *Environmental Chemistry*, Third edition, New York, 2005
 Manahan, Stanley E.: *Environmental Chemistry*, 9th ed., CRC Press, cop. New York, 2010.

Priporočeni viri/Recommended literature

James E Girard: *Principles of environmental chemistry*, Jones and Bartlett Publishers, cop. 2005.
 Roy M. Harrison: *Principles of Environmental Chemistry*, Royal Society of Chemistry. 2007.

Cilji in kompetence:

Objectives and competences:

- Predmet poglobljeno obravnava problematiko onesnaževanja okolja z organskimi in drugimi spojinami. Podaja in opisuje eksterno in interno izpostavljenost človeka v bivalnem in širšem okolju s kontaminanti. Razumevanje vpliva onesnažil na bivalno okolje in na zdravje ljudi je pomembno za ozaveščanje ljudi o tej problematiki in za ohranjanje čistega okolja. Predmet obravnava področje teoretično poglobljeno, praktično pa tako usmerjeno, da usposobi slušatelje ne samo za razumevanje, temveč tudi za reševanje analiznih problemov. Na tak način znajo študentje uporabiti pridobljeno znanje za klasifikacijo in razvrščanje nevarnih spojin, ki so predvsem posledica antropogenega vpliva na okolje. Poznajo osnovne principe delovanja nevarnih snovi na človeka in principe preprečevanja onesnaževanja. Razviti in optimirati znajo analize metode za ugotavljanje vsebnosti onesnažil in njihovih razgradnih produktov v različnih vzorcih iz vsakdanjega okolja.

- The subject gives the complete overview of the knowledge concerning the problems of environmental pollution with organic and other compounds. It explains and describes the external and internal exposure of humans to pollutants in the living environment. Understanding the influence of pollutants on the environment and human health is important for raising people's awareness of this issue and for preserving a clean environment. The subject gives the complete theoretical overview in the field, and during practical work gives the knowledge not only for understanding, but also for solving analytical problems. In this way, students can use the acquired knowledge to classify dangerous compounds, which are primarily formed through the anthropogenic environmental impact. Students know the basic principles of influence of hazardous substances to humans and the principles of prevention of contamination and pollution. They know how to develop and optimize analytical methods for determination of hazardous substances and their degradation products in various samples from the environment at low level concentrations.

Predvideni študijski rezultati:

Znanje in razumevanje:

študenti:

- usvojijo temeljno in poglobljeno znanje o prisotnosti nevarnih snovi v bivalnem okolju človeka;
- razumejo metode, ki se uporabljajo v moderni okoljski kemiji za odkrivanje in določanje vsebnosti nevarnih snovi in njihovih razgradnih produktov v okolju;
- spoznajo osnovne principe delovanja nevarnih snovi na človeka in poznajo principe preprečevanja onesnaževanja ;
- razlikujejo posamezne skupine spojin kot tudi znajo razvrščati posamezne spojine v določene skupine onesnaževal;

Intended learning outcomes:

Knowledge and Understanding:

Students:

- acquire basic and advanced knowledge on hazardous substances in living environment;
- understand basic methods used in modern environmental chemistry for detecting and determining the contents of hazardous substances and their degradation products in environments;
- learn basic principles of the influence of hazardous substances on environment and they are acquainted with basic

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| <ul style="list-style-type: none"> - pridobijo praktične izkušnje in laboratorijske spretnosti, ki so nujno potrebne pri samostojnem laboratorijskem delu; <p><u>Prenosljive/ključne spretnosti in drugi atributi:</u></p> <p>Študenti:</p> <ul style="list-style-type: none"> - razumejo znanstvene prispevke in zahtevnejšo študijsko literaturo iz področja nevarnih snovi v okolju; - usvojijo ročne spretnosti, predvsem pri predpripravi vzorcev za analize in zmožnost dela na analitskih instrumentih ter ovrednotenje rezultatov meritev - znajo načrtovati in razviti analizo metodo, na osnovi katere bodo uspešno ekstrahirali, ločili in določili posamezne nevarne snovi v vzorcih iz vsakdanjega življenja; - primerjajo rezultate z drugimi pristopi, objavljenimi v znanstveni literaturi; - sposobnost učinkovite komunikacije o strokovni problematiki iz tega področja. | <p>principles of prevention of contamination;</p> <ul style="list-style-type: none"> - are able to differ between the groups of hazardous compounds as well as they can sort individual compounds into certain groups of pollutants; - acquire experience and laboratory skills which are essential for an autonomous laboratory work; <p><u>Transferable/key skills and other attributes:</u></p> <p>Students:</p> <ul style="list-style-type: none"> - are able to understand scientific articles in basic scientific journals and more advanced text-books from the field of hazardous substances in the environment; - adopt manual skills, especially by preparing samples for analysis and capability of practical work with instruments and evaluation of the analytical results; - can plan and develop the analytical method for successful extraction, separation and determination of the individual hazardous substance in different samples from everyday's life; - compare results with other approaches published in scientific literature; - ability to efficiently communicate about problematics in this field. |
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Metode poučevanja in učenja:

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| <ul style="list-style-type: none"> • predavanja • seminarska naloga • laboratorijske vaje |
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Learning and teaching methods:

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| <ul style="list-style-type: none"> • lectures • seminar essay • laboratory work |
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Načini ocenjevanja:

Delež (v %) /

Assessment:

| Weight (in %) | | |
|---------------------|------|-----------------------------------|
| - kolokvij iz vaj | - 30 | - partial exam of laboratory work |
| - seminarska naloga | - 20 | - seminar essay |
| - pisni izpit | - 50 | - written test |

Reference nosilca / Lecturer's references:

1. ISLAMČEVIĆ RAZBORŠEK, Maša, IVANOVIĆ, Milena, KRAJNC, Peter, KOLAR, Mitja. Choline chloride based natural deep eutectic solvents as extraction media for extracting phenolic compounds from chokeberry (*Aronia melanocarpa*). *Molecules*. Apr. 2020, vol. 25, iss. 7, str. 1-14, ilustr. ISSN 1420-3049. <https://www.mdpi.com/1420-3049/25/7/1619>, DOI: [10.3390/molecules25071619](https://doi.org/10.3390/molecules25071619). [COBISS.SI-ID [1538563011](https://www.cobiss.si/record/1538563011)]
 2. IVANOVIĆ, Milena, ISLAMČEVIĆ RAZBORŠEK, Maša, KOŠIR, Iztok Jože, KOLAR, Mitja. Response surface methodology : an optimal design applied for maximum ultrasound-assisted extraction efficiency of phenolic acids from *Coriandrum sativum* L. *Journal of applied botany and food quality*. 2019, vol. 92, str. 378-387, ilustr. ISSN 1439-040X. <https://ojs.openagrar.de/index.php/JABFQ/article/view/12934>, DOI: [10.5073/JABFQ.2019.092.050](https://doi.org/10.5073/JABFQ.2019.092.050). [COBISS.SI-ID [1538484419](https://www.cobiss.si/record/1538484419)]
 3. ISLAMČEVIĆ RAZBORŠEK, Maša, IVANOVIĆ, Milena. Stability studies and determination of carnosic acid and its oxidative degradation products by gas chromatography-mass spectrometry. *International Journal of Mass Spectrometry*, ISSN 1387-3806. [Print ed.], 2016, vol. 407, str. 29-39, doi: [10.1016/j.ijms.2016.07.002](https://doi.org/10.1016/j.ijms.2016.07.002). [COBISS.SI-ID [19669526](https://www.cobiss.si/record/19669526)];
 4. IVANOVIĆ, Milena, PETEK, Anja, ISLAMČEVIĆ RAZBORŠEK, Maša, KOLAR, Mitja. Chemometric characterization of Slovenian red wines. *Acta chimica slovenica*, ISSN 1318-0207. [Tiskana izd.], 2017, str. 537-542, ilustr. [COBISS.SI-ID [20730646](https://www.cobiss.si/record/20730646)];
 5. IVANOVIĆ, Milena, ISLAMČEVIĆ RAZBORŠEK, Maša, KOLAR, Mitja. Simultaneous GC-MS determination of free and bound phenolic acids in Slovenian red wines and chemometric characterization. *Acta chimica slovenica*, ISSN 1318-0207. [Tiskana izd.], 2016, vol. 63, no. 3, str. 661-669, graf. prikazi. <https://journals.matheo.si/index.php/ACSi/article/view/2534>, doi: [10.17344/acsi.2016.2534](https://doi.org/10.17344/acsi.2016.2534). [COBISS.SI-ID [19728662](https://www.cobiss.si/record/19728662)];
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