

UČNI NAČRT PREDMETA / COURSE SYLLABUS

Predmet:	Speciacija elementov v bioloških sistemih in okolju
Course title:	Speciation of Elements in Biological Systems and Environment

Študijski program in stopnja Study programme and level	Študijska smer Study field	Letnik Academic year	Semester Semester
Ekotehnologije, 3. stopnja	/	1	1
Ecotechnologies, 3 rd cycle	/	1	1

Vrsta predmeta / Course type

Izbirni /Elective

Univerzitetna koda predmeta / University course code:

EKO3-778

Predavanja Lectures	Seminar Seminar	Vaje Tutorial	Klinične vaje work	Druge oblike študija	Samost. delo Individ. work	ECTS
15	15			15	105	5

**Navedena porazdelitev ur velja, če je vpisanih vsaj 15 študentov. Drugače se obseg izvedbe kontaktnih ur sorazmerno zmanjša in prenese v samostojno delo. / This distribution of hours is valid if at least 15 students are enrolled. Otherwise the contact hours are linearly reduced and transferred to individual work.*

Nosilec predmeta / Lecturer:

Prof. dr. Radmila Milačič
Prof. dr. Janez Ščančar
Prof. dr. Milena Horvat

**Jeziki /
Languages:**

Predavanja / Lectures: slovenščina, angleščina
Slovenian, English

Vaje / Tutorial: angleščina
English

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

Zaključen študij druge stopnje naravoslovne ali tehniške smeri ali zaključen študij drugih smeri z dokazanim poznavanjem osnov s področja kemije in biologije (pisna dokazila, pogovor).

Prerequisites:

Completed second level studies in natural sciences or engineering or completed second level studies in other fields with proven knowledge of chemistry and biology (certificates, interview).

Vsebina:

Uvod v področje speciacijske analize. (Definicija speciacije elementov glede na oksidacijsko stanje elementa in speciacija organskih in anorganskih spojin posameznih elementov).

- **Pomen speciacije elementov z vidika strupenosti in esencialnosti.** (Nekateri elementi, kot na primer krom, izkazujejo v različnih kemijskih oblikah različno strupenost. Tako je na primer šestvalentni krom izredno strupen, medtem ko je krom v trivalentni obliki veliko manj toksičen in je celo esencialen

Content (Syllabus outline):

Introduction to the field of chemical speciation analysis. (Definition of chemical speciation regarding the oxidation state of element and speciation of organic and inorganic species of elements).

- **The role of speciation of elements regarding the toxicity and essentiality.** (Some elements e.g. chromium exhibit different toxicity in different chemical forms. Hexavalent chromium is extremely toxic species, while trivalent chromium species are far less toxic and are even

element).

- **Osnovne analizne metode za speciacijo elementov.** (Koprecipitacija, selektivna ekstrakcija, spektrofotometrija, kromatografske metode (HPLC, GC, elektroforeza...) povezane z on-line in off-line elementnimi specifičnimi detektorji (ICP-MS, ICP-OES, AFS, AAS, INAA) v kombinaciji z masno spektrometrijo).
- **Kroženje in pretvorba kemijskih zvrsti elementov v naravi.** (Biogeokemijsko kroženje zvrsti elementov v sistemu zemlja, voda, zrak, prisotnost kemijskih zvrsti elementov v živih organizmih in hrani).
- **Speciacijska analiza izbranih elementov** (kot na primer krom, aluminij, platina, rutenij, cink, nikelj, kositer, brom, živo srebro, selenium...).

essential).

- **Basic analytical methods for speciation analysis.** (Co-precipitation, selective extraction, spectrophotometry, chromatographic methods (HPLC, GC, electrophoresis...) coupled on-line and off-line with element specific detectors (ICP-MS, ICP-OES, AFS, AAS, INAA) in combination with mass spectrometry).
- **Cycling and transformation of elements in environment.** (Biogeochemical cycling of element species in system soil, water, air, the chemical species of elements in living organisms and foodstuffs).
- **Speciation analysis of selected elements** (as for instance chromium, aluminium, platinum, ruthenium, zinc, nickel, tin, bromine, mercury, selenium, ...).

Temeljni literatura in viri / Readings:

- Cornelis, R., *Handbook of Elemental Speciation II, Species in the Environment, Food Medicine and Occupational Health*, John Wiley & Sons, Ltd, 2005, 768 pages
- Garcia Alonso, J., Rodriguez-Gonzalez P., *Isotope Dilution Mass Spectrometry*, RCS Publishing, Cambridge, UK, 2013, 453 pages
- Michalke, B., *Metallomics: Analytical Techniques and Speciation Methods*, Wiley-VCH Verlag GmbH & Co. KGaA, 2016, 496 pages

Cilji in kompetence:

Predstaviti študentom pomen speciacijske analize pri študijah kroženja elementov v okolju in bioloških sistemih.

Študente bomo seznanili s kemizmom številnih elementov, ki v različnih kemijskih oblikah izkazujejo različno strupenost oziroma so lahko esencialni.

Predstavili bomo osnovna orodja speciacijske analize, ki omogočajo zanesljivo določanje posameznih kemijskih zvrsti elementov v različnih matricah bioloških vzorcev in vzorcev iz okolja. Vlogo kemijske speciacije bomo za posamezne elemente predstavili na področju zdravja, prehrane, privzema posameznih kemijskih zvrsti v rastline in pri študiju biogeokemijskih ciklov.

Predvideni študijski rezultati:

Znanje in razumevanje:

- Kroženja kemijskih zvrsti elementov v okolju in bioloških sistemih in poznavanje pomena speciacijske analize pri tovrstnih študijah.
- Vloge kemijske speciacije na področju zdravja, prehrane, privzema posameznih kemijskih zvrsti

Objectives and competences:

To introduce the students the importance of speciation analysis in investigations of cycling of elements in environment and biological systems. Students will gain basic knowledge on chemistry of numerous elements that in various chemical forms exhibit different toxicity or are even essential.

The basic tools of speciation analysis that enable reliable determination of different chemical species of elements in matrices of biological and environmental samples will be introduced.

The role of chemical speciation will be presented for particular elements in the field of health, nutrition, uptake of particular chemical species to plants and in the investigations of biogeochemicaly cycling.

Intended learning outcomes:

Knowledge and understanding:

- Of cycling of chemical species of elements in the environment and biological systems and the importance of the speciation analysis in such investigations.
- Of the role of chemical speciation in the field of

v rastline in pri študiju biogeokemijskih ciklusov.

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Metode poučevanja in učenja:

- Predavanja
- Seminar
- Konzultacije
- Timsko delo in diskusije

Learning and teaching methods:

- Lectures
- Seminar work
- Consultations
- Team work and discussions

Delež (v %) /

Načini ocenjevanja:

Weight (in %)

Assessment:

Načini ocenjevanja:	Delež (v %) / Weight (in %)	Assessment:
Seminarska naloga.	50 %	Seminar work.
Zagovor seminarske naloge, pri katerem se dokaže osvojitve študijskega gradiva in prikaz enega primera speciacijske analize v okolju ali bioloških sistemih.	50 %	Defence of the seminar work where the student demonstrate achievements of the study programme and presenting one case of speciation analysis in the environment or biological systems.

Reference nosilca / Lecturer's references:

- ŠČANČAR, Janez, MILAČIČ, Radmila. A critical overview of Cr speciation analysis based on high performance liquid chromatography and spectrometric techniques. *Journal of Analytical Atomic Spectrometry*, 2014, 29, 427-443.
- PEETERS, Kelly, ZULIANI, Tea, ŠČANČAR, Janez, MILAČIČ, Radmila. The use of isotopically enriched tin tracers to follow the transformation of organotin compounds in landfill leachate. *Water research*, 2014, 53, 297-309.
- DRINČIČ, Ana, ŠČANČAR, Janez, ZULIANI, Tea, NIKOLIĆ, Irena, MILAČIČ, Radmila. Simultaneous speciation of chromate, arsenate, molybdate and vanadate in alkaline samples by HPLC-ICP-MS at different concentration levels of vanadate. *Journal of Analytical Atomic Spectrometry*, 2017, 32, 2200-2209.
- VIDMAR, Janja, MARTINČIČ, Anže, MILAČIČ, Radmila, ŠČANČAR, Janez. Speciation of cisplatin in environmental water samples by Hydrophilic interaction liquid chromatography coupled to inductively coupled plasma mass spectrometry. *Talanta*, 2015, 138, 1-7.
- BRATKIČ, Arne, VAHČIČ, Mitja, KOTNIK, Jože, OBU, Kristina, BEGU, Ermira, WOODWARD, E. Malcolm S., HORVAT, Milena. Mercury presence and speciation in the South Atlantic Ocean along the 40°S transect. *Global Biogeochemical Cycles*, 2016, 30, 105-119.