

UČNI NAČRT PREDMETA / COURSE SYLLABUS

Predmet:	NOVA PODROČJA V ANALIZNI KEMIJI
Course Title:	FRONTIERS IN ANALYTICAL CHEMISTRY

Študijski program in stopnja Study Programme and Level	Študijska smer Study Field	Letnik Academic Year	Semester Semester
DR Kemijske znanosti, 3. stopnja	/	1.	1. in 2.
Doctoral programme in Chemical Sciences, 3 rd Cycle	/	1 st	1 st and 2 nd

Vrsta predmeta / Course Type: izbirni/Elective

Univerzitetna koda predmeta / University Course Code: KZ304

Predavanja Lectures	Seminar Seminar	Vaje Tutorial	Klinične vaje Work	Druge oblike študija	Samost. delo Individual Work	ECTS
5	50	/	/	/	95	5

Nosilec predmeta / Lecturer: prof. dr. Helena Prosen /Dr. Helena Prosen, Full Professor

Jeziki / Languages: slovenski, angleški / Slovenian, English

Vaje / Tutorial: /

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:

Študent s soglasjem mentorja med spodaj navedenimi temami izbere tiste, ki so najtesneje povezane z njegovim raziskovalnim delom. Nosilec predmeta poskrbi, da obseg študentovega dela ustreza 5 ECTS. Če je izvajalcev več, izvajanje koordinira nosilec.

- Metodologija in aplikacije novejših spektroskopskih metod v analizni kemiji. Problematika uvajanja plinastih, tekočih in trdnih vzorcev v atomski spektrometriji. Pomen laserske ablacije v elementni masni spektrometriji. Uporaba atomske spektrometrije (ICP-OES, ICP-MS) za karakterizacijo materialov, okoljskih in

Content (Syllabus outline):

From the topics listed below the student selects (in agreement with their mentor) those that are closely related to their research work. The course coordinator provides the student's workload corresponding to 5 ECTS. If several lecturers cooperate on the course, the whole process is coordinated by course coordinator.

- Methodology and application of novel spectroscopic methods in analytical chemistry. Sample introduction problems in atomic spectroscopy related to gas, liquid and solid samples. Laser ablation in elemental analysis. The application of atomic spectrometry (ICP-OES, ICP-MS) for characterization of materials,

bioloških vzorcev.

- Masna spektrometrija v analizni kemiji: instrumentacija, tehnike ionizacije in fragmentacije, interpretacija masnih spektrov, tandemska masna spektrometrija. Nove tehnike v masni spektrometriji .
 - Sklopitve GC-MS, HPLC-MS, HPLC-ICP-MS in druge.
 - Elektroanalizne tehnike (voltometrija in inverzne tehnike) in njihova aplikacija v analitiki anorganskih in organskih komponent, v analitiki sledov, študiju interakcij kovina-ligand, karakterizaciji in analizi bioloških sistemov ter materialov in v okoljski kemiji.
 - Elektrokemijski senzorji: principi, aplikacija pri študiju ravnotežij, mikroelektrode, kemijsko modificirane elektrode, pretočne mikroelektrode, ultramikroelektrode.
- Sestavljene tehnike: spektroelektrokemija (EC-UV-Vis, EC-IR, EC-MS, SEM, EC-STM, EC-AFM).

environmental and biological samples.

- Mass spectrometry in analytical chemistry: instrumentation, ionization and fragmentation techniques, mass spectra interpretation, tandem mass spectrometry. Novel mass spectrometric techniques.
 - Hyphenated techniques GC-MS, HPLC-MS, HPLC-ICP-MS and others.
 - Electroanalytical techniques (voltammetry and stripping techniques), their applications in analysis of inorganic and organic components, trace analysis, studies of metal-ligand interactions, characterization and analysis of biological systems and materials, and in environmental analysis.
 - Electrochemical sensors: principles, application in equilibria studies, microelectrodes, chemically modified electrodes, microelectrodes for flow systems, ultramicroelectrodes.
- Hyphenated techniques: spectroelectrochemistry (EC-UV-Vis, EC-IR, EC-MS, SEM, EC-STM, EC-AFM).

Temeljna literatura in viri / Readings:

Izbrani pregledni članki iz znanstvene literature. / Selected review papers in relevant scientific literature.

Cilji in kompetence:

Študenti nadgradijo znanja s področja novejših instrumentalne analize, spoznajo trende razvoja in novejših tehnike (tako teorijo kot možne praktične aplikacije), ki so jih pridobili na predhodnem študiju. Kompetence s področja sodobne instrumentalne analitike razvijejo do ravni, ki jo terja raziskovalno delo in reševanje kompleksnih strokovnih problemov v praksi.

Objectives and Competences:

Students extend their knowledge of novel instrumental analytical techniques (theoretical basis and practical applications), which they have acquired at the previous studies. They raise their knowledge and skills to the level required for academic research and for solving complex professional problems in industry.

Predvideni študijski rezultati:

Znanje in razumevanje

Seznanjenost z modernimi instrumentalnimi tehnikami in napredki na tem področju. Razumevanje principov, delovanja in omejitev posameznih analiznih tehnik za analizo različnih vzorcev, s katerimi se srečujejo pri raziskovalnem delu.

Intended Learning Outcomes:

Knowledge and Comprehension

Knowledge of modern instrumental techniques and new developments from the field. Understanding of the concepts, working principles and limitations of certain analytical techniques for the analysis of different samples encountered in their research.

<u>Uporaba</u> Študent pridobi znanja o sodobnih instrumentalnih tehnikah analize za uporabo na področju najrazličnejših kemijskih raziskav.	<u>Application</u> Student acquires practical knowledge of modern instrumental analytical techniques to apply in different areas of chemical research.
<u>Refleksija</u> S povezavo osnovnega znanja o analiznih tehnikah in informacij iz preglednih člankov se nauči razmisleka o možnosti prenosa novosti v lastno raziskovalno prakso.	<u>Analysis</u> By connecting the basic knowledge of analytical techniques and information from the review papers, student learns to reflect on innovation transfer possibilities into their own research work.
<u>Prenosljive spretnosti</u> Študent obvlada problemsko orientirane raziskave, zna uporabljati strokovno in znanstveno literaturo in obvlada večšine sinteze znanstvenih informacij ter poročanja o njih.	<u>Skill-transference Ability</u> Student masters the problem-oriented research; knows how to use professional and scientific literature; masters the skill of scientific information synthesis and presentation.

Metode poučevanja in učenja:

Tematska uvodna predavanja, individualno delo s konzultacijami, priprava in predstavitev seminarskih nalog.

Learning and Teaching Methods:

Thematic introductory lectures, individual work with consultations, preparation and presentation of seminar courseworks.

Delež (v %) /

Načini ocenjevanja:

Weight (in %) **Assessment:**

Priprava dveh pisnih seminarskih nalog in njun zagovor.	100 %	Preparation of two written seminar courseworks with their presentation.
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Reference nosilca / Lecturer's references:

MALINOVIĆ, Borislav N., MARKELJ, Jernej, ŽGAJNAR GOTVAJN, Andreja, KRALJ CIGIĆ, Irena, PROSEN, Helena. Electrochemical treatment of wastewater to remove contaminants from the production and disposal of plastics: a review. Environmental chemistry letters, 2022, 20(6): 3765-3787.

VEROVŠEK, Taja, ŠUŠTARIČ, Ariana, LAIMOU-GERANIOU, Maria, KRIZMAN MATASIĆ, Ivona, PROSEN, Helena, ELERŠEK, Tina, KRAMARIČ ZIDAR, Vlasta, MISLEJ, Vesna, MIŠMAŠ, Boštjan, STRAŽAR, Marjetka, LEVSTEK, Meta, CIMRMANČIČ, Bernardka, LUKŠIČ, Simon, URANJEK, Nataša, KOZLOVIČ-BOBIČ, Tjaša, KOSJEK, Tina, KOČMAN, David, HEATH, David John, HEATH, Ester. Removal of residues of psychoactive substances during wastewater treatment, their occurrence in receiving river waters and environmental risk assessment. Science of the total environment, 2023, 866: 161257, 1-9.

KRAŠEVEC, Ida, PROSEN, Helena. Determination of polar benzotriazoles in aqueous environmental samples by hollow-fibre microextraction method with LC-MS/MS and its comparison to a conventional solid-phase extraction method. Microchemical journal, 2021, 166: 106191, 1-9.