

## UČNI NAČRT PREDMETA / COURSE SYLLABUS

<b>Predmet:</b>	NOVA PODROČJA V ANALIZNI KEMIJI
<b>Course Title:</b>	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 <sup>rd</sup> Cycle	/	1 <sup>st</sup>	1 <sup>st</sup> and 2 <sup>nd</sup>

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
20	55	/	/	/	75	5

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

Študent s soglasjem mentorja med spodaj navedenimi temami v izbere tiste, ki so najtesneje povezane z njegovim raziskovalnim delom. Nosilec predmeta in vodja študija poskrbita, da obseg študentovega dela ustreza 5 KT. Če je nosilec več, izvajanje koordinira nosilec.  
 - Metodologija in aplikacije novejših spektroskopskih metod v analizni kemiji. Problematika uvajanja plinastih, tekočih in trdih vorcev v atomski spektrometriji. Pomen laserske ablacije v elementni masni spektrometriji. Uporaba atomske spektrometrije (ICP-OES, ICP-MS) za

**Content (Syllabus outline):**

From the topics listed below the student selects (in agreement with the supervisor) those that are most related to their research work. The course coordinator, and the leader of the study programme provide the student's workload corresponding to 5 credits. 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 spectrometry related to gas, liquid and solid samples. Laser ablation in elemental analysis. The application of atomic spectrometry (ICP-

karakterizacijo materialov, okoljskih in bioloških vzorcev.

- Masna spektrometrija v analizni kemiji; instrumentacija, tehnike ionizacije in interpretacija masnih spektrov. Nove tehnike v masni spektrometriji (MALDI, proton transfer mass spectrometry, desorption electrospray ionization - DESI).
- Sklopitve GC-MS, HPLC-MS in HPLC-ICP-MS.
- Elektroanalizne tehnike (voltometrija in stripping tehnike) in aplikacija v analitiki anorganskih in organskih komponent, v analitiki sledov, študiju interakcij kovina-ligand, bioloških sistemih ter karakterizaciji in analizi materialov in 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).

OES, ICP-MS) for characterization of materials, environmental and biological samples.

- Mass spectrometry in analytical chemistry: instrumentation, ionization techniques, mass spectra interpretation. Novel mass spectrometric techniques (MALDI, proton transfer mass spectrometry, desorption electrospray ionization - DESI).
- Hyphenated techniques GC-MS, HPLC-MS, HPLC-ICP-MS
- Electroanalytical techniques (voltammetry and stripping techniques), their applications in analysis of inorganic and organic components, trace analysis, studies of metal-ligand interactions, characterization of biological systems and analysis of materials, and 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 literature.

### Cilji in kompetence:

Študenti nadgradijo znanja s področja instrumentalne analize, spoznajo trende razvoja in novejšje tehnike (tako teorijo kot možne praktične aplikacije), ki so jih pridobili na magistrskem 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 master's level and 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 during 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 use in different chemical research areas.
<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 literature, student learns to reflect on innovation transfer possibilities into their own research work.
<u>Prenosljive spretnosti</u> Ovlada problemsko orientirane raziskave, zna uporabljati strokovno in znanstveno literaturo in obvlada veščine 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 nadgrajena s primeri iz znanstvene literature, individualno delo s konzultacijami, seminarsko delo.

**Learning and Teaching Methods:**

Thematic introductory lectures upgraded with case studies based on scientific literature, individual work, seminars.

Delež (v %) /

**Načini ocenjevanja:**

Weight (in %) **Assessment:**

Pisni pregledni test	33 %	Written test
Priprava pisne seminarske naloge in njen zagovor	67 %	Preparation of a written seminar with presentation

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

- KOŽELJ, Gordana, PERHARIČ, Lucija, STANOVNIK, Lovro, PROSEN, Helena. Simple validated LC-MS/MS method for the determination of atropine and scopolamine in plasma for clinical and forensic toxicological purposes. *J. Pharm. Biomed. Anal.*, 2014, 96, 197-206.

- ĆIRIĆ, Andrija, PROSEN, Helena, JELIKIĆ STANKOV, Milena, ĐURĐEVIĆ, Predrag. Evaluation of matrix effect on determination of some bioflavonoids in food samples by LC-MS/MS method. *Talanta*, 2012, 99, 780-790.

- PROSEN, Helena, KOKALJ, Meta, JANEŠ, Damjan, KREFT, Samo. Comparison of isolation methods for the determination of buckwheat volatile compounds. *Food Chem.*, 2010, 121, 298-306.