

## UČNI NAČRT PREDMETA / COURSE SYLLABUS

<b>Predmet:</b>	NAPREDNE INŠTRUMENTALNE ANALIZNE TEHNIKE
<b>Course Title:</b>	ADVANCED METHODS OF INSTRUMENTAL ANALYSIS

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

**Vrsta predmeta / Course Type:** obvezni / Mandatory

**Univerzitetna koda predmeta / University Course Code:** KE222

Predavanja Lectures	Seminar Seminar	Vaje Tutorial	Klinične vaje Work	Druge oblike študija	Samost. delo Individual Work	ECTS
45	15	15 LV	/	/	75	5

**Nosilec predmeta / Lecturer:** prof. dr. Helena Prosen / Dr. Helena Prosen, Full Professor  
prof. dr. Matevž Pompe / Dr. Matevž Pompe, Full Professor  
prof. dr. Matija Strlič / Dr. Matija Strlič, Full Professor

**Jeziki / Languages:** slovenski / Slovenian

**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:**

Kemometrični pristopi v instrumentalni analizi, npr. ANOVA, PCA.

Kvantitativna IR spektroskopija, ATR, DR. Ramanska spektroskopija.

Sodobne eno in večdimenzionalne kromatografske separacije. Kapilarna elektroforeza. Sklopitve kromatografskih in spektroskopskih tehnik.

Pregled sodobne molekulske masne spektrometrije in sklopljenih tehnik. Ionizacijske tehnike, masni analizatorji,

**Content (Syllabus outline):**

Chemometric approaches in instrumental analysis, e.g. ANOVA, PCA.

Quantitative IR spectroscopy, ATR, DR. Raman spectroscopy.

Modern one- and multidimensional chromatographic separations. Capillary electrophoresis. Hyphenations of chromatographic and spectroscopic techniques.

Overview of modern molecular mass spectrometry and hyphenated techniques. Ionization techniques, mass analyzers, tandem

tandemska masna spektrometrija. Aplikacije MS.  
Elementna masna spektrometrija in sklopljene tehnike.

Osnove tehnik za karakterizacijo površin: elektronska spektroskopija in elektronska mikroskopija.

Analitika ultrasledov: nevtronska aktivacijska analiza.

Avtomatizirana analiza, robotizirana analiza, miniaturni sistemi.

Senzorji: elektrokemijski, optični, imunski, drugi tipi.

Seminarji in vaje projektnega tipa: teoretična obdelava literaturnih rešitev za praktične analizne probleme z uporabo analiznih tehnik, predstavljenih na predavanjih.  
Demonstracijske vaje.

mass spectrometry. Applications of MS.  
Elemental mass spectrometry and hyphenated techniques.

Basics of techniques for surface characterization: electron spectroscopy and electron microscopy.

Analytics of ultra-trace components: neutron activation analysis.

Automated analysis, robotic analysis, miniaturized systems.

Sensors: electrochemical, optical, immunosensors, other.

Seminars and laboratory work projects: theoretical discussion of literature solutions for practical analytical problems by the use of discussed analytical techniques.  
Demonstrative laboratory work.

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

- Analytical Chemistry A Modern Approach to Analytical Science, Ed. by R. J.- Mermet, M. Otto, M. Valcarcel, Founding Editors: R. Kellner, H.M. Widmer, Wiley - VCH, Weinheim, 2004, izbrana poglavja, ca. 300 strani

#### Dodatna literatura:

- F. Rouessac, A. Rouessac, Chemical Analysis, Modern Instrumentation Methods and Techniques, J. Wiley & Sons, Ltd, Chichester, 2000.  
- pregledni znanstveni članki iz posameznih področij / scientific review articles from different fields

#### **Cilji in kompetence:**

Študenti se seznanijo s kemometričnimi in numeričnimi pristopi v analizni praksi, spoznajo napredne metode za analizo in kontrolo bioloških učinkovin in snovi ter karakterizacijo in analizo anorganskih in organskih materialov. Seznanijo se z analitiko sledov, ugotavljanjem kemijskih zvrsti in avtomatizacijo analiznih metod in postopkov.

#### **Objectives and Competences:**

Students are informed of chemometric and numerical approaches in the analytics; they learn about the advanced analytical methods for biological active components control and for characterization and analysis of inorganic and organic materials. They are introduced to trace analysis, chemical speciation and automation of analytical methods and procedures.

#### **Predvideni študijski rezultati:**

#### **Intended Learning Outcomes:**

<p><u>Znanje in razumevanje</u> Obvladovanje kemometričnih pristopov, numeričnih postopkov optimizacije, modeliranja in statistične obravnave podatkov. Razumevanje principov, delovanja in omejitev posameznih analiznih tehnik za analizo materialov in bioloških sistemov ter poznavanje in razumevanje pristopov za avtomatizacijo analiznih metod.</p>	<p><u>Knowledge and Comprehension</u> Mastering of chemometric approaches, numerical optimization methods, modelling and statistical data evaluation. Understanding of the concepts, working principles and limitations of certain analytical techniques for the analysis of materials and biological systems; knowledge and understanding of the approaches to analytical method automation.</p>
<p><u>Uporaba</u> Študent pridobi znanja za uporabo na področju kemijskih raziskav ter na področju raziskav materialov in bioloških snovi.</p>	<p><u>Application</u> Student acquires practical knowledge to use in chemical research and research of materials and biological samples.</p>
<p><u>Refleksija</u> Poveže konkretno uporabo določene kemijsko-fizikalne zakonitosti z rezultati, ki jih pridobi z meritvami.</p>	<p><u>Analysis</u> Student connects the application of a certain physico-chemical principle with the results obtained by the measurement.</p>
<p><u>Prenosljive spretnosti</u> Osvoji metodologijo in raziskovalne pristope, obvlada problemsko orientirane raziskave, zna uporabljati strokovno in znanstveno literaturo in obvlada veščine poročanja in obravnave podatkov.</p>	<p><u>Skill-transference Ability</u> Student masters the methodology and research approaches, as well as problem-oriented research; knows how to use professional and scientific literature; masters the skill of data evaluation and presentation.</p>

**Metode poučevanja in učenja:**

Predavanja in seminarska dela iz aktualne tematike, demonstracijske vaje

**Learning and Teaching Methods:**

Lectures, seminar coursework on realistic problems, demonstrative laboratory work

<b>Načini ocenjevanja:</b>	Delež (v %) / Weight (in %)	<b>Assessment:</b>
Pisni izpit: ocene od 6-10 (poz.) oz. 5 (neg.). Seminarska naloga. Laboratorijske vaje.	<b>60 %</b>	Written exam: grades 6-10 (pass) or 5 (fail).
	<b>30 %</b>	Seminar coursework.
	<b>10 %</b>	Laboratory work.
Opravljenе vaje in seminarska naloga so pogoj za pristop k izpitu.		Finished laboratory and seminar work are prerequisites for the exam.

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

- A. Ćirić, H. Prosen, M. Jelikić Stankov, P. Đurđević. Evaluation of matrix effect in determination of some bioflavonoids in food samples by LC-MS/MS method. *Talanta* 2012, 99, 780-790.  
- H. Prosen, M. Kokalj, D. Janeš, S. Kreft. Comparison of isolation methods for the determination of buckwheat volatile compounds. *Food Chem.* 2010, 121, 298-306.

- I. Kralj Cigić, **H. Prosen**. An overview of conventional and emerging analytical methods for the determination of mycotoxins. *Int. J. Mol. Sci.* 2009, 10, 62-115.
- S. Kose, S. Koral, B. Tufan, **M. Pompe**, A. Ščavničar, D. Kočar. Biogenic amine contents of commercially processed traditional fish products originating from European countries and Turkey. *European Food Research and Technology. A, Zeitschrift für Lebensmittel-Untersuchung und -Forschung.* 2012, 235, 669-683.
- G. Arh, L. Klasinc, M. Veber, **M. Pompe**. Calibration of mass selective detector in non-target analysis of volatile organic compounds in the air. *J. chromatogr. A* 2011, 1218, 1538-1543.
- J. Cerar, **M. Pompe**, M. Guček, J. Cerkovnik, J. Škerjanc. Analysis of sample of highly water-soluble T<sub>sub</sub>-symmetric fullerenehexamalic acid C<sub>sub</sub>(66)(COOH)<sub>sub</sub>(12) by ion-chromatography and capillary electrophoresis. *J. chromatogr. A* 2007, 1169, 86-94.
- R. Brigham, J. Grau-Bové, A. Rudnicka, M. Cassar, **M. Strlič**: "Crowd-sourcing as an analytical method: Metrology of smartphone measurements in heritage science", *Angew. Chem.*, 57 (2018) 7423-7427, DOI: 10.1002/anie.201801743.
- L. Cséfalvayová, **M. Strlič**, H. Karjalainen: "Quantitative NIR chemical imaging in heritage science", *Anal. Chem.*, 83 (2011), 5101-5106.
- T. Trafela, **M. Strlič**, J. Kolar, D.A. Lichtblau, M. Anders, D. Pucko Mencigar, B. Pihlar: "Non-destructive analysis and dating of historical paper based on IR spectroscopy and chemometric data evaluation", *Anal. Chem.*, 79 (2007) 6319-6323.