

## UČNI NAČRT PREDMETA / COURSE SYLLABUS

<b>Predmet:</b>	BIOANALIZNA KEMIJA
<b>Course Title:</b>	BIOANALYTICAL CHEMISTRY

Študijski program in stopnja Study Programme and Level	Študijska smer Study Field	Letnik Academic Year	Semester Semester
MAG Biokemija, 2. stopnja	/	2.	3.
USP Biochemistry, 2 <sup>nd</sup> Cycle	/	2 <sup>nd</sup>	3 <sup>rd</sup>

**Vrsta predmeta / Course Type:** izbirni strokovni / Elective Professional

**Univerzitetna koda predmeta / University Course Code:** BI2T04

Predavanja Lectures	Seminar Seminar	Vaje Tutorial	Klinične vaje Work	Druge oblike študija	Samost. delo Individual Work	ECTS
30	30	15 LV	/	/	75	5

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

**Jeziki / Languages:**

<b>Predavanja / Lectures:</b>	slovenski / Slovenian
<b>Vaje / Tutorial:</b>	slovenski / Slovenian

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

Študent oz. kandidat mora imeti predmet opredeljen kot študijsko obveznost.	<b>Prerequisites:</b> The course has to be assigned to the student.
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**Vsebina:**

Inštrumentacija in analizni pristopi za analizo bioloških sistemov:  
 - teoretske osnove in praktične izvedbe inštrumentacije za analizo bioloških sistemov (elektroforezne tehnike: conska elektroforeza, izoelektrično fokusiranje, kapilarna elektroforeza, eno- in dvodimenzionalna gelska elektroforeza; kromatografske tehnike: izključitvena/gelska, afinitetna, ionsko-izmenjalna kromatografija; spektroskopske tehnike: spektrometrične, fluorescenčne, luminiscenčne metode; masna spektrometrija: ionizacije - elektrorazprševanje, MALDI, DIOS; masni analizatorji - kvadrupol, ionska past, čas preleta, orbitrap; načini fragmentacije in

**Content (Syllabus outline):**

Instrumentation and analytical approaches for the analysis of biological systems:  
 - theoretical basis and practical instrumental solutions for the analysis of biological systems (electrophoresis: zone electrophoresis, isoelectric focusing, capillary electrophoresis, one- and two-dimensional gel electrophoresis; chromatography: size-exclusion/gel, affinity, ion-exchange chromatography; spectroscopy: spectrometric, fluorescence, luminiscence methods; mass spectrometry: ionizations - electrospray, MALDI, DIOS; mass analyzers - quadrupole, ion trap, time of flight, orbitrap; types of fragmentation and product ion scan in tandem MS; electrochemistry: amperometry,

snemanja produktnih ionov v tandemski MS; elektrokemijske tehnike: amperometrija, potenciometrija, konduktometrija; drugo: merjenje radioaktivnega sevanja)

- spoznavanje teorije in praktičnih izvedb postopkov za izolacijo in ločevanje spojin iz bioloških sistemov (ekstrakcija, preparativna elektroforetska in kromatografska separacija).
- imunski testi / immunoassay (na principu protiteles, ligandov, radioizotopov, fluoroforjev, kemiluminiscence, encimov)

Aplikacije, prednosti in omejitve analiznih metod za določanje različnih spojin v bioloških sistemih:

- določanje zdravil in drugih eksogenih biološko aktivnih spojin
- aplikacije imunskih testov
- biosenzorji (amperometrični, potenciometrični, optično-fluorescenčni, piezoelektrični, encimski termistorji...)
- uporaba masne spektrometrije za analizo bioloških makromolekul (kvalitativna in kvantitativna proteomika, določanje strukture proteinov in peptidov ter PTM, genomika in sekvenciranje oligonukleotidov, glikomika, lipidomika, kompleksomika, metabolomika in metabonomika, biomarkerji in diagnostika bolezni, določitev mikroorganizmov)

Validacija bioanaliznih metod.

potentiometry, conductometry; other: radioactivity measurement)

- theory and practical approaches to isolation and separation of compounds from biological systems (extraction, preparative electrophoretic and chromatographic separation)
- immunoassays (on the basis of antibodies, ligands, radioisotopes, fluorophores, chemiluminiscence, enzymes)

Applications, advantages and limitations of analytical methods for the determination of different compounds in biological systems:

- determination of drugs and other exogenous biologically active compounds
- applications of immunoassay
- biosensors (amperometric, potentiometric, optical- fluorescent, piezoelectric, enzyme thermistors...)
- application of mass spectrometry to analysis of biological macromolecules (qualitative and quantitative proteomics, determination of protein and peptide structure, PTM, genomics and oligonucleotide sequencing, glycomics, lipidomics, complexomics, metabolomics and metabonomics, biomarkers and disease diagnostics, determination of microorganisms)

Validation of bioanalytical methods.

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

Bioanalytical Chemistry, S.R. Mikkelsen, E. Corton, Wiley (2004) 361 str. (50 %)  
Mass Spectrometry for Biotechnology, G. Siuzdak, Academic Press (1996) 161 str. (30 %)  
Mass Spectrometry, Principles and Applications (nekatera poglavja), E. de Hoffmann, V. Stroobant, Wiley, 2. izd. (2001) 407 str. (20 %)

#### **Dopolnilna literatura:**

Mass Spectrometry, A Foundation Course, K. Downard, RSC (2004) 210 str.  
Practical Organic Mass Spectrometry, J.R. Chapman, Wiley, 2. izd. (1993) 330 str.  
Primarna literatura (znanstveni članki) / primary literature (scientific articles)

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

Cilj predmeta je spoznavanje modernih analiznih tehnik, ki se uporabljajo v analitiki bioloških sistemov. Študentje naj bi spoznali

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

Objective of the course is to gain knowledge of modern analytical techniques used in the analytics of biological systems. Students should

prednosti in pomanjkljivosti posameznih pristopov, primerjali rezultate, pridobljene z njimi, in jih kritično vrednotili. Pridobili naj bi možnost samostojne izbire in uporabe primerne analize pristopa za reševanje specifičnih problemov.

Študentje si pri predmetu pridobijo naslednje specifične kompetence:

- možnost izbire najprimernejšega analize pristopa za reševanje specifičnih raziskovalnih problemov
- možnost poiskati v razpoložljivi primarni in sekundarni literaturi problemu primerno analizo metodo/postopek
- usposobljenost za implementacijo obstoječih analize metod na svoje specifične raziskovalne probleme
- kritično vrednotenje rezultatov, dobljenih z aplikiranimi metodami/postopki
- usposobljenost za pisanje poročil, kritično vrednotenje in interpretacijo eksperimentalnih rezultatov
- usposobljenost za vodenje bioanalize laboratorija

get to know the advantages and disadvantages of different approaches, compare the obtained results and critically evaluate them. They should gain the ability to autonomously select and apply an appropriate analytical method to solve a specific problem.

Students acquire the following specific competences during the course:

- ability to select the most appropriate analytical approach to solve a specific research problem
- ability to find an appropriate analytical method/procedure for the respective problem in the available primary and secondary literature
- skill to implement the existing analytical methods to their specific research problem
- critical evaluation of the results obtained by the applied methods/procedures
- skills for report writing, critical evaluation and interpretation of experimental results
- skills and ability to run a bioanalytical laboratory

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

##### Znanje in razumevanje

Študent pozna osnove delovanja inštrumentov in teoretične osnove postopkov, ki se uporabljajo v bioanalize kemiji. Razume prednosti in omejitve posameznih tehnik. Ve, kaj lahko vpliva na analize postopek, pozna vire motenj in napak.

##### Uporaba

Študent zna izbrati ustrezni analize pristop za reševanje specifičnega problema in prirediti obstoječe postopke nanj. Zna rokovati z enostavnejšimi analize inštrumenti. Zna uporabljati imunske teste.

##### Refleksija

Študent bo interpretiral, kritično vrednotil vsebino ter pred kolegi predstavil lastno

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

##### Knowledge and Comprehension

Student knows the fundamentals of instrumental operation and theoretical basis of the procedures used in analytical chemistry. Understands the advantages and limitations of different techniques. Knows the factors which can influence the analytical procedure, knows the sources of interference and error.

##### Application

Student is able to select an appropriate analytical approach to solve a specific problem and apply the existing procedures to it. Is able to operate simple analytical instruments. Is able to use immunoassay.

##### Analysis

Student will interpret, critically evaluate the contents and present their understanding of the

razumevanje člankov iz znanstvenih publikacij. Pri tem bo uporabil pridobljena teoretična znanja ter jih vrednotil s predstavljenimi praktičnimi problemi oziroma izkušnjami.	scientific articles to their peers. They will use the acquired theoretical knowledge and evaluate it with the presented practical problems or experience.
<u>Prenosljive spretnosti</u> Uporaba domačih in tujih primarnih in sekundarnih literaturnih virov. Znanje, kako zbrati in interpretirati podatke. Ustno in pisno poročanje in interpretacija rezultatov. Identifikacija in reševanje problemov in virov napak. Kritična analiza in sinteza rezultatov, pisanje člankov.	<u>Skill-transference Ability</u> Use of domestic and foreign primary and secondary literature sources. Knowledge of data collection and interpretation. Oral and written reporting and interpretation of the results. Identification and solving of problems and error sources. Critical analysis and synthesis of results, manuscript preparation.

**Metode poučevanja in učenja:**

Predavanja, seminarji, laboratorijske vaje.

**Learning and Teaching Methods:**

Lectures, seminar coursework, laboratory work.

	Delež (v %) / Weight (in %)	Assessment:
<b>Načini ocenjevanja:</b> Opravljene laboratorijske vaje in seminarska naloga so pogoj za pristop k pisnemu izpitu. Seminarska naloga Pisni izpit Ocene: 6-10 (pozitivno), 1-5 (negativno)		Concluded laboratory work and seminar coursework are prerequisites for the written exam. Seminar coursework Written exam Grades: 6-10 (positive), 1-5 (negative)

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

1. T. Vnučec Popov, L. Cvitkovič-Maričić, **H. Prosen**, D. Brodnjak-Vončina. Development and validation of dried blood spots technique for quantitative determination of topiramate using liquid chromatography-tandem mass spectrometry. Biomed. Chromatogr. 2013, 27, 1054-1061.
2. 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.
3. **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.