

**UČNI NAČRT PREDMETA / COURSE SYLLABUS**

<b>Predmet:</b>	Napredne eksperimentalne metode v biofiziki
<b>Course title:</b>	Advanced Experimental Methods in Biophysics

Študijski program in stopnja Study programme and level	Študijska smer Study field	Letnik Academic year	Semester Semester
Nanoznanosti in nanotehnologije, 3. stopnja		1	1
Nanosciences and Nanotechnologies, 3 <sup>rd</sup> cycle		1	1

**Vrsta predmeta / Course type** izbirni / Elective

**Univerzitetna koda predmeta / University course code:** NANO3-886

Predavanja Lectures	Seminar Seminar	Sem. vaje Tutorial	Lab. vaje Laboratory work	Druge oblike Others	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:** Doc. dr. Zoran Arsov

**Jeziki / Languages:** **Predavanja / Lectures:** slovenščina, angleščina / Slovenian, English  
**Vaje / Tutorial:**

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

Zaključena druga stopnja bolonjskega študija ali diploma univerzitetnega študijskega programa s področja naravoslovja, medicine ali tehnologije.

**Prerequisites:**

Completed Bologna second cycle study program or an equivalent pre-Bologna university study program in natural sciences, medicine or technology.

**Vsebina:**

1) Uvod. Pomen poznavanja in razumevanja prednosti in omejitev posameznih metod. Kombiniranje metod za celovit pristop k reševanju problemov.  
2) Krajevne in časovne skale metod. Izkoriščanje komplementarnosti.  
3) Različni koncepti eksperimentalnih metod.  
4) Mikroskopije.  
5) Spektroskopije.  
6) Metode na osnovi sipanja.  
7) Površinske metode.  
8) Metode na osnovi termodinamskih konceptov.  
9) Metode na osnovi hidrodinamskih konceptov.

**Content (Syllabus outline):**

1) Introduction. Significance of recognizing and understanding advantages and limitations of particular methods. Combining methods for a comprehensive approach in problem solving.  
2) Length and time scales of methods. Exploitation of complementarity.  
3) Different concepts of experimental methods.  
4) Microscopies.  
5) Spectroscopies.  
6) Methods based on scattering.  
7) Surface methods.  
8) Methods based on thermodynamic concepts.  
9) Methods based on hydrodynamic concepts.

- 10) Merjenje mehanskih lastnosti na mikroskopski skali.
- 11) Trendi razvoja novih metod.
- 12) Uporaba naprednih metod za vrednotenje postopkov v inovativnih tehnologijah.
- 13) Študij na primerih.

- 10) Measurements of mechanical properties on microscopic scale.
- 11) Trends in development of novel methods.
- 12) Application of advanced methods for assessing procedures in innovative technologies.
- 13) Case studies.

### Temeljna literatura in viri / Readings:

Zaradi hitrega razvoja na področju so temeljni študijski viri pregledni članki v zadnjih letih. Uvod v posamezne teme se bo naslanjal na vsebino iz naslednjih knjig: / Due to a fast development in this subject the recommended readings will be recent review papers. Introduction to particular topics will be based on the content from the following books:

- N. R. Zaccai, I. N. Serdyuk, and J. Zaccai, *Methods in Molecular Biophysics: Structure, Dynamics, Function for Biology and Medicine*, 2<sup>nd</sup> Ed., Cambridge University Press, 2017.
- B. Nölting, *Methods in Modern Biophysics*, 3<sup>rd</sup> Ed., Springer, 2009.

### Cilji in kompetence:

Cilj predmeta je seznaniti študenta z naprednimi eksperimentalnimi metodami na področju biofizike in znanostih o življenju. Pri tem je pomemben celovit pristop, kjer se primernost uporabe posamezne metode ocenjuje z vidika pojava, ki ga želimo raziskovati. Velik poudarek je na predstavitvi prednosti in omejitev posameznih metod ter na prikazu prednosti kombiniranja metod.

Kompetence študentov z uspešno zaključenim predmetom bodo vključevale poznavanje najnovejših metod ter primere njihove uporabe. Predmet študentom poda osnove razumevanja podobnosti in razlik med metodami, kar jim bo omogočilo, da bodo sami sposobni izbrati ustrezne metodološke pristope za reševanje svojih problemov ter nadgrajevati svoja znanja na področju eksperimentalnih metod s prebiranjem ustrezne strokovne literature.

### Objectives and competences:

The goal of this course is to familiarize students with the advanced experimental methods in biophysics and life sciences. A comprehensive approach will be taken, where convenience of a particular method is evaluated in a context of phenomenon under study. A strong emphasis is given on the presentation of strengths and weaknesses of particular methods and illustration of advantages gained by using them in combinations.

The competencies of the students completing successfully this course would include knowledge of the latest methods and examples of their use. The course will give students a basis for understanding similarities and differences between the methods, which will enable them to independently choose the appropriate methodological approaches to solve their problems and to upgrade their knowledge in the field of experimental methods by reading the relevant technical literature.

### Predvideni študijski rezultati:

- 1) Poznavanje fizikalnih osnov najnovejših eksperimentalnih tehnik na področju biofizike in znanostih o življenju.
- 2) Sposobnost presoje prednosti in omejitev posameznih metod.
- 3) Primerjanje metod s stališča občutljivosti, krajevne ločljivosti, časovne ločljivosti, specifičnosti.
- 4) Izbira primerne kombinacije različnih komplementarnih metod za reševanje določenih

### Intended learning outcomes:

- 1) Understanding physical basis of modern experimental techniques in biophysics and life sciences.
- 2) Ability to evaluate strengths and weaknesses of particular methods.
- 3) Comparison of methods with respect to their sensitivity, spatial resolution, time resolution, specificity.
- 4) Selection of an appropriate combination of different complementary methods for tackling

raziskovalnih problemov.  
 5) Uporaba znanja, pridobljenega preko študija na primerih za reševanje eksperimentalnih problemov študentov.  
 6) Sposobnost obnavljanja in nadgrajevanja znanja s prebiranjem različne strokovne literature.  
 7) Poiskati tri laboratorije v regiji z opremo, ki bi koristila študentom pri njihovem raziskovalnem delu.

specific research problems.  
 5) Use of knowledge obtained through case studies to solve experimental problems that students have.  
 6) Ability to renew and upgrade knowledge by reading different literature in the field.  
 7) Finding three labs in the region with equipment that would be valuable for the research work conducted by students.

#### Metode poučevanja in učenja:

predavanja, konzultacije, usmerjena seminarska naloga s področja metod, uporabljenih za pripravo doktorskega dela študenta, obiski in delo v laboratorijih, študij na primerih – skupinsko/individualno delo

#### Learning and teaching methods:

lectures, consultancy, seminar work focused on methods used by a student in preparing PhD thesis, visits of and work in laboratories, case studies – group/individual work

Delež (v %) /

#### Načini ocenjevanja:

Weight (in %)

#### Assessment:

Načini ocenjevanja:	Delež (v %) / Weight (in %)	Assessment:
Seminarska naloga	25 %	Seminar work
Ustna predstavitev	25 %	Oral presentation
Ustni izpit	50 %	Oral exam

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

- 1) ARSOV, Zoran, URBANČIČ, Iztok, ŠTRANCAR, Janez. Aggregation-induced emission spectral shift as a measure of local concentration of a pH-activatable rhodamine-based smart probe. *Spectrochim. Acta A Mol. Biomol. Spectrosc.*, 2018, vol. 190, str. 486-493
- 2) ARSOV, Zoran, ŠVAJGER, Urban, MRAVLJAK, Janez, PAJK, Stane, KOTAR, Anita, URBANČIČ, Iztok, ŠTRANCAR, Janez, ANDERLUH, Marko. Internalization and accumulation in dendritic cells of a small pH-activatable glycomimetic fluorescent probe as revealed by spectral detection. *ChemBioChem*, 2015, vol. 16, no. 18, str. 2660-2667
- 3) ARSOV, Zoran. Long-range lipid-water interaction as observed by ATR-FTIR spectroscopy. *Subcell. Biochem.*, 2015, vol. 71, str. 127-159
- 4) URBANČIČ, Iztok, ARSOV, Zoran, LJUBETIČ, Ajasja, BIGLINO, Daniele, ŠTRANCAR, Janez. Bleaching-corrected fluorescence microspectroscopy with nanometer peak position resolution. *Opt. Express*, 2013, vol. 21, no. 21, str. 25291-25306
- 5) ARSOV, Zoran, URBANČIČ, Iztok, GARVAS, Maja, BIGLINO, Daniele, LJUBETIČ, Ajasja, KOKLIČ, Tilen, ŠTRANCAR, Janez. Fluorescence microspectroscopy as a tool to study mechanism of nanoparticles delivery into living cancer cells. *Biomed. Opt. Express*, 2011, vol. 2, no. 8, str. 2083-2095