

**UČNI NAČRT PREDMETA / COURSE SYLLABUS**

<b>Predmet:</b>	MODERNI IN KOMPLEMENTARNI PRISTOPI V STRUKTURNI BIOLOGIJI
<b>Course Title:</b>	MODERN AND COMPLEMENTARY APPROACHES IN STRUCTURAL BIOLOGY

Študijski program in stopnja Study Programme and Level	Študijska smer Study Field	Letnik Academic Year	Semester Semester
MAG Biokemija, 2. stopnja	/	2.	4.
USP Biochemistry, 2 <sup>nd</sup> Cycle	/	2 <sup>nd</sup>	4 <sup>th</sup>

**Vrsta predmeta / Course Type:**

izbirni strokovni / Elective Professional

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

BI2108

Predavanja Lectures	Seminar Seminar	Vaje Tutorial	Klinične vaje Work	Druge oblike študija	Samost. delo Individual Work	ECTS
40	10	25 LV	/	/	75	5

**Nosilec predmeta / Lecturer:**

prof. dr. Janez Plavec / Prof. dr. Janez Plavec, Full Professor  
 prof. dr. Kristina Djinović Carugo /  
 Dr. Kristina Djinović Carugo, 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. Predmet zahteva opravljene obveznosti iz predmeta Metod določanja 3D strukture makromolekul.

**Prerequisites:**

The course has to be assigned to the student. Course requires knowledge of course Methods for determining 3D macromolecular structure.

**Vsebina:**

- Uporaba mehkih roentgenskih žarkov v makromolekularni kristalografiji
- Škoda zaradi roentgenskega žarčenja v makromolekularni kristalografiji (radiation damage)
- Časovno razločeni eksperimenti v makromolekularni kristalografiji
- NMR spektri višjih dimenzij v povezavi z avtomatsko asignacijo
- Moderni pristopi v NMR (asignacija preko

**Content (Syllabus outline):**

- Use of soft X-ray in macromolecular crystallography
- X-ray induced radiation damage in macromolecular crystallography
- Time resolved experiments in macromolecular crystallography
- Higher dimensionality NMR spectra connected with automatic assignment
- Modern approaches to NMR (assignment through heteroatoms, protonless NMR)

- heteroatomov, ang. protonless NMR)
- Dinamične lastnosti makromolekul (naravno nestrukturirani proteini)
  - Relaksacijska disperzija
  - NMR v trdnem agregatnem stanju
  - Elektronska mikroskopija (s poudarkom na single particle reconstruction)
  - Nevtronska difrakcija za makromolekule
  - Small angle X-ray scattering (SAXS) za makromolekule v raztopini
  - Masna spektroskopija za strukturno biologijo
  - Karakterizacija interakcij s biofizikalnimi metodami (izotermna kalorimetrija, površinske plazmonske resonance, microscale thermophoresis)

- Dynamic properties of macromolecules (intrinsically unstructured proteins)
  - Relaxation dispersion
  - NMR in the solid state
  - Electron microscopy (with emphasis on single particle reconstruction)
  - Neutron diffraction for macromolecules
  - Small angle X-ray scattering (SAXS) for macromolecules in solution
  - Mass spectroscopy for structural biology
- Characterization of interactions with biophysical methods (Isothermal titration calorimetry, surface plasmon resonance, microscale thermophoresis)

#### Temeljna literatura in viri / Readings:

- David Blow, Outline of Crystallography for Biologists, Oxford University Press, 2002.
- Crystallography Made Crystal Clear, Gale Rhodes, Academic Press; 3 edition 2006.
- Bernhard Rupp, Biomolecular Crystallography: Principles, Practice, and Application to Structural Biology, GS, 2009
- J. Cavanagh, W. J. Fairbrother, A. G. Palmer, III, M. Rance, N. J. Skelton, Protein NMR Spectroscopy, Second Edition: Principles and Practice, Elsevier, 2007 (ca. 20% out of 900 pages)
- I. Bertini, K. S. McGreevy, G. Parigi (Eds.), NMR of Biomolecules, Wiley, 2012

#### Cilji in kompetence:

Predmet je zamišljen kot nadgradnja predmeta Metode določevanja 3D struktur makromolekul. Slušatelj bo seznanjen z modernimi in komplementarnimi metodami, katerih uporaba upodablja integriran, multidisciplinarni pristop k strukturni biologiji. Slušatelj bo znal oceniti primernost in potencial posamezne metode/tehnike za tvorbo in analizo določene strukturne informacije kakor tudi dinamičnih aspektov bioloških makromolekul.

#### Objectives and Competences:

This course is designed as an upgrade of course Methods for determining 3D macromolecular structure. Students will be acquainted with modern and complementary methods, whose use enables integrated, multidisciplinary approach to structural biology. Students will be able to assess the suitability and potential of the individual methods / techniques for the formation and analysis of certain structural information as well as the dynamic aspects of biological macromolecules.

#### Predvideni študijski rezultati:

##### Znanje in razumevanje

Študent se seznanja s številnimi metodami, ki dajejo strukturno informacijo o bioloških makromolekulah na različnih nivojih ločljivosti in dajejo statično oziroma dinamično podobo tridimenzionalne strukture makromolekule.

#### Intended Learning Outcomes:

##### Knowledge and Comprehension

The student gets acquainted with a number of methods which provide structural information on biological macromolecules at different levels of resolution and provide a static or dynamic image of three-dimensional structure of the

Študent je seznanjen s prednostmi in omejitvami posamezne metode in predvsem z njeno komplementarnostjo k drugim strukturnim tehnikam, ki se uporabljajo pri strukturni in funkcionalni analizi makromolekul.	macromolecules. The student is familiarized with the advantages and limitations of individual method and in particular with its complementarity to other structural techniques in structural and functional analysis of macromolecules.
<u>Uporaba</u> Predmet je podlaga za razumevanje molekularno in strukturno usmerjenih raziskovalnih pristopov in metod, ki jih bo študent uporabljal na različnih strokovnih področjih.	<u>Application</u> The course is the basis for understanding molecular and structure-oriented research approaches and methods that student will use in various professional areas.
<u>Refleksija</u> Študent pridobi vpogled v serijo komplementarnih strukturnih metod in razvije občutek za integriran strukturno biološki pristop in razumevanje ter razlago bioloških vprašanj.	<u>Analysis</u> The student gains insight into a series of complementary structural methods and develops sense of an integrated structural biological approach, understanding and interpretation of biological challenges.
<u>Prenosljive spretnosti</u> Timsko delo (pri vajah). Uporaba tuje literature. Podajanje poročil o opravljenem delu in prebrani literaturi (pismeno in ustno).	<u>Skill-transference Ability</u> Teamwork (at exercises). The use of foreign literature. Submission of written reports on lab results and literature survey (written and oral).

#### Metode poučevanja in učenja:

Predavanja.  
Laboratorijske vaje.  
Seminar iz literature.

#### Learning and Teaching Methods:

Lectures.  
Laboratory work.  
Literature seminar.

Delež (v %) /

Weight (in %)

#### Načini ocenjevanja:

#### Assessment:

Kolokvij iz laboratorijskih vaj  
Seminarska naloga.  
Pisni in ustni izpit (ocena > 6)

Examination of laboratory exercises  
Seminar  
Written and oral exam (mark >6)

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

- Carugo, O., and **Djinovic Carugo, K.** (2013) Half a century of Ramachandran plots. Acta Crystallogr D Biol Crystallogr 69, 1333-1341
- de Almeida Ribeiro, E., Jr., Beich-Frandsen, M., Konarev, P. V., Shang, W., Vecerek, B., Kontaxis, G., Hammerle, H., Peterlik, H., Svergun, D. I., Blasi, U., and **Djinović-Carugo, K.** (2012) Structural flexibility of RNA as molecular basis for Hfq chaperone function. Nucleic Acids Res 40, 8072-8084
- Galkin, V. E., Orlova, A., Salmazo, A., **Djinović-Carugo, K.**, and Egelman, E. H. (2010) Opening of tandem calponin homology domains regulates their affinity for F-actin. Nat Struct Mol Biol 17, 614-616.
- M. Marušič, R. N. Veedu, J. Wengel, **J. Plavec**, G-rich VEGF aptamer with locked and unlocked nucleic acid modifications exhibits a unique G-quadruplex fold, Nucleic Acids Res. 2013, 41(29), 9524-9536.
- M. Trajkovski, M. Webba da Silva, **J. Plavec**, Unique Structural Features of Interconverting

Monomeric and Dimeric G-Quadruplexes Adopted by a Sequence from the Intron of the N-myc Gene, *J. Am. Chem. Soc.* 2012, 134 (9), 4132–4141.

- I. Biljan, G. Ilc, G. Giachin, **J. Plavec**, G. Legname, Structural Rearrangements at Physiological pH: NMR insights from the V210I Human Prion Protein Mutant, *Biochemistry* 2012, 51 (38), 7465-7474.

ULFEKKT