UČNI NAČRT PREDMETA / COURSE SYLLABUS	
Predmet:	Stabilnost, zvijanje in agregacija proteinov
Course title:	Stability, Folding and Aggregation of Proteins

Študijski program in stopnja Study programme and level	Študijska smer Study field	Letnik Academic year	Semester Semester
Nanoznanosti in nanotehnologije, 3. stopnja	Bioznanosti	1	1
Nanosciences and nanotechnologies, 3rd cycle	Biosciences	1	1

Vrsta predmeta / Course type Izbirni / Elective

Univerzitetna koda predmeta / University course code: NANO3-834

Predavanja Lectures	Seminar Seminar	Vaje Tutorial	Klinične vaje work	Druge oblike študija	Samost. delo Individ. work	ECTS
30	**30**			**30**	**210**	**10**

**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 transfered to individual work.*

Nosilec predmeta / Lecturer: Prof. dr. Eva Žerovnik

Jeziki / Languages:	**Predavanja / Lectures:**	Slovenščina, angleščina / Slovene, English
	Vaje / Tutorial:	/

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:	**Prerequisits:**
Končan študij druge stopnje biokemije, biologije, medicine ali katerekoli druge naravoslovne smeri.	Second cycle degree in biochemistry, biology , medicine or any other natural sciences discipline.

Vsebina:	**Content (Syllabus outline):**
• Stabilnost proteinov: osnovna znanja o določanju stabilnosti • Problem zvijanja proteinov – kako se proteini zvijajo *in vitro* in *in vivo* • Kinetika, prehodna stanja in energije prehodov (energijske površine) • Kako se zvijanje začne – najzgodnejše stopnje • Razrahljani klopčič (molten globule) – pomen za zvijanje, napačno zvijanje in prehajanje preko membrane • Encimi, ki sodelujejo pri procesih zvijanja • Vloga šaperonov na zvijanje *in vivo* • Agregacija proteinov do amiloidnih fibril: in vitro in v celici • Zvijanje proteinov in bolezni: nevrodegenerativne bolezni	• Stability of proteins: basic knowledge of stability and its determination • The problem of protein folding – folding in vitro and in vivo • Kinetics, transition states and energy landscapes • How does folding start? - detecting the early stages • The molten globule – its relevance in folding, aggregation and protein translocation • The enzymology of protein folding • The role of chaperones in folding in vivo • Aggregation to amyloid-fibrils: in vitro and in the cell • Protein folding and disease; neurodegenerative diseases

Temeljni literatura in viri / Readings:

Books:

Mechanisms of Protein Folding, 2nd edn., (2000) R. H. Pain (ed.), Oxford University Press

Protein Folding-Misfolding: some current concepts of protein chemistry. Zbilut JP and Scheibel T (eds.), Nova Sci Publi., New York, 2007.

Protein misfolding diseases; current and emerging therapies. eds Raminez-Alvarado, J.W. Kelly, C.M. Dobson, Wiley Series in Protein and Peptide Science, Series Ed. V.N. Uversky. John Wiley & Sons, New Jersey 2010.

Selected papers:

special issue: http://www.mdpi.com/journal/biomolecules/special_issues/protein-folding#published

Eichner T, Kalverda AP,. Thompson GS, Homans SW. and Radford SE (2011) **Conformational Conversion during Amyloid Formation at Atomic Resolution**. Molecular Cell **41**: 161–172.

Sharma, S. et al. (2008). **Monitoring protein conformation along the pathway of chaperone-assisted folding.** *Cell*, **133**,142-153.

Felitsky et al., (2008). **Modeling transient collapsed states of an unfolded protein to provide insights into early folding events.** Proc. Natl. Acad. Sci USA 105: 6278-6283.

Žerovnik E, Stoka V, Mirtič A, Gunčar G, Grdadolnik J, Staniforth RA, Turk D, Turk V. (2011). Mechanisms of amyloid fibril formation--focus on domain-swapping. FEBS J. 278:2263-82. doi: 10.1111/j.1742-4658.2011.08149.x. Epub 2011 May 31. Review.

Di Scala e tal., (2016) Common molecular mechanism of amyloid pore formation by Alzheimer's b- amyloid peptide and a-synuclein Scien. Reports, DOI: 10.1038/srep28781

Sengupta U, Nilson N.A., Kayed R., The role of amyloid-b oligomers in toxicity, propagation, and immunotherapy EBioMedicine , 2016, vol6, 42-49

Cilji in kompetence:

CILJI: Študentje spoznajo osnove zvijanja proteinov in njihove stabilnosti. Pridobijo vpogled v termodinamske, kinetične in strukturne vidike procesa zvijanja. Nadalje se seznanijo s povezanim mehanizmom agregacije proteinov. Ta se pojavlja pri nevrodegenerativnih boleznih.

KOMPETENCE: Spoznavanje z interdisciplinarnimi področji strukturne biologije, biokemije in biofizike. Samostojno mišljenje, formuliranje problemov in vprašanj.

Objectives and competences:

OBJECTIVES: To enable students to understand the principles of protein folding and stability. Thermodynamic, kinetic and structural aspects are discussed. In addition, they become familiar with the associated mechanisms of protein aggregation which is involved in neurodegenerative diseases.

COMPETENCES: get to know interdisciplinary fields of structural biology, biochemistry and biophysics. Independent and creative thinking; be able to formulate problems and open questions.

Predvideni študijski rezultati:

Splošno

Študent bo spoznal:

- metode in procedure, ki se uporabljajo na področju stabilnosti in zvijanja proteinov. Te obsegajo razne biofizikalne in biokemijske metode kot tudi razne spektroskopije, med drugim fluorescenco, CD, NMR, FTIR,
- razvoj kritične in samokritične presoje,
- razvoj komunikacijskih sposobnosti in predstavitve rezultatov raziskav,

Intended learning outcomes:

General:

- The student will get to know research methods and procedures used in the field of protein stability and folding, which comprise biophysical methods, biochemical methods and various spectroscopies: fluorescence, CD, NMR, FTIR
- The student will develop critical thinking
- The student will develop communication skills to present research achievements
- Cooperation, team work

• kooperativnost, delo v skupini, • seznanil se bo z multidisciplinarnim pristopom k reševanju znanstvenih problemov. Predmetnospecifična znanja: • Predmet pripravlja študente za delo na temeljnih raziskavah na področju predmeta • Pridobljeno znanje pa je uporabno tudi v biotehnologiji in živilski tehnologiji Daje molekularne osnove za razumevanje nekaterih patologij – povezava z biomedicino.	• The student will gain insight in multidisciplinary approach to solve scientific problems Course Specific knowledge: • This course prepares students to work in basic research projects • The knowledge is important for biotechnology and food technology It provides a molecular understanding of some pathological processes – related to biomedicine

Metode poučevanja in učenja:	**Learning and teaching methods:**
• Predavanja • Konzultacije • Individualno delo • Laboratorijsko delo (samo v primeru mentorstva)	• Lectures • Consultations • Individual work • Laboratory work (If supervising the student)

Načini ocenjevanja:	Delež (v %) / Weight (in %)	**Assessment:**
Ustno izpraševanje	100 %	Oral assesment

Reference nosilca / Lecturer's references:

Polajnar M, Zerovnik E. Impaired autophagy: a link between neurodegenerative and neuropsychiatric diseases. J Cell Mol Med. 2014 Sep;18(9):1705-11. doi: 10.1111/jcmm.12349. Epub 2014 Aug 19.

Polajnar M, Zavašnik-Bergant T, Škerget K, Vizovišek M, Vidmar R, Fonović M, Kopitar-Jerala N, Petrovič U, Navarro S, Ventura S, Žerovnik E. Human stefin B role in cell's response to misfolded proteins and autophagy. PLoS One. 2014 Jul 21;9(7):e102500. doi: 10.1371/journal.pone.0102500. eCollection 2014.

Polajnar M, Zavašnik-Bergant T, Kopitar-Jerala N, Tušek-Žnidarič M, Zerovnik E. Gain in toxic function of stefin B EPM1 mutants aggregates: correlation between cell death, aggregate number/size and oxidative stress. Biochim Biophys Acta. 2014 Sep;1843(9):2089-99. doi: 10.1016/j.bbamcr.2014.05.018. Epub 2014 Jun 5.

Taler-Verčič A, Kirsipuu T, Friedemann M, Noormägi A, Polajnar M, Smirnova J, Znidarič MT, Zganec M, Skarabot M, Vilfan A, Staniforth RA, Palumaa P, Zerovnik E. The role of initial oligomers in amyloid fibril formation by human stefin B. Int J Mol Sci. 2013 Sep 5;14(9):18362-84. doi: 10.3390/ijms140918362.

An older citation classic paper:
Ptitsyn, OB, Pain RH, Semisotnov GV, Žerovnik, E and Razgulyaev OI .Evidence for a molten globule state as a general intermediate in protein folding. FEBS lett. 262, 20-24 (1990).