Univerza v Mariboru

Fakulteta za naravoslovje in matematiko

UČNI NAČRT PREDMETA / COURSE SYLLABUS	
Predmet:	**Izbrana poglavja iz molekularne biofizike**
Course title:	***Selected Topics in Molecular Biophysics***

Študijski program in stopnja Study programme and level	Študijska smer Study field	Letnik Academic year	Semester Semester
Doktorski študij Ekološke znanosti, 3. stopnja		**1. ali 2.; 1st or 2nd**	**1. 2. ali 3. ; 1st, 2nd or 3rd**
Doctoral Study Ecological Sciences, 3rd degree			

Vrsta predmeta / Course type Izbirni/Elective

Univerzitetna koda predmeta / University course code:

Predavanja Lectures	Seminar Seminar	Vaje Tutorial	Lab. vaje Laboratory work	Terenske vaje Field work	Samost. delo Individ. work	ECTS
5	5				140	**5**

Nosilec predmeta / Lecturer: Milan BRUMEN

Jeziki / Languages:		
	Predavanja / Lectures:	slovenski / slovene
	Vaje / Tutorial:	slovenski / slovene

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:	**Prerequisits:**
Poznavanje fizike na ravni douniverzitetnega in biologije na ravni univerzitetnega programa	Knowledge of physics at undergraduate and biology at graduate level

Vsebina:	**Content (Syllabus outline):**
Obravnavana so izbrana poglavja iz naslednjih sklopov. • Kemijske vezi, medatomske in medmolekularne interakcije. Struktura biotskih makromolekul (beljakovine, nukleinske kisline, polisaharidi) in supramolekularnih kompleksov (lipoproteini, biotska membrana). Kooperativna vezava ligandov na makromolekule in alostericni	Selected topics in the following chapters are discussed. • Chemical bonds, intra- and intermolecular forces. Structure of biotic macromolecules (proteins, nucleic acids, polysaccharides) and supramolecular complexes (lipoproteins, biological membrane). Cooperative ligand binding to macromolecules and allosteric

pojavi. Encimske reakcije. Zveza med strukturo in biotsko funkcijo makromolekularnih in supramolekularnih sistemov ter regulacija biotske aktivnosti. Voda, njena struktura in pomen za biotske sisteme. Dinamika konformacijskih sprememb makromolekul. • Biofizika celicnega skeleta in molekularnih mehanizmov subcelicnih dimenzij. Mikrotubuli, mikrofilamenti. Pogonski proteini: miozini, kinezini, dineini; krcenje mišice, mitoza, transport organelov, gibanje bickov in migetalk. • Biofizika celicne membrane in celice. Struktura biotske celice. Osmozno ravnovesje in kislinsko-bazno ravnotežje. Metabolizem celice. Mehanske lastnosti celicne membrane, oblika celice in njene transformacije. Transport skozi celicno membrano. Elektricne osnove vzdražnosti celice in prenos elektricnega impulza. Znotrajcelicna in medcelicna signalizacija in komunikacija. • Pregled nekaterih eksperimentalnih metod v molekularni biofiziki: rentgenska kristalografija, absorpcijska in fluorescencna spektroskopija, spektroskopske metode NMR in EPR.	phenomena. Enzymatic reactions. Relation between structure and function of macromolecular and supramolecular systems, regulation of biotic activity. Water, its structure and meaning for biolotic systems. Dynamics of conformational changes of macromolecules. • Biophysics of cytoskeleton and molecular mechanisms of subcellular scales. Microtubules, microfilaments. Motor proteins: myosins, kinesins, dyneins; muscle contraction, mitosis, transport of organelles, cilia and flagella movement. protein motors • Cell and cell membrane biophysics. Structure of the biotic cell. Osmotic and acid-base equilibrium. Cell metabolism. Mechanical properties of cell membrane; cell shape and its transformation. Transmembraneous transports. Electrical base of the cell excitability and propagation of the nerve pulse. Intra- and intercellular signalisation and communications. • Overview of selected experimental methods in molecular biophysics: X-ray crystallography, absorption and fluorescence spectroscopy, spectroscopic methods NMR and EPR.

Temeljni literatura in viri / Readings:

Dill, K. A., S. Bromberg, 2003: Molecular Driving Forces: Statistical Thermodynamics in Chemistry and
Biology, Garland Science, New York. – Uvodna poglavja / introductory chapters.
Flyvbjerg, H., J. Hertz, M. H. Jensen, O. G. Mouritsen, K. Sneppen (Eds.), 1997: Physics of Biological Systems from Molecules to Species; Springer, New York.
Glaser, R., 2012: Biophysics, Springer, New York.
Univerzitetni ucbeniki biokemije in celicne biologije / university textbooks of biochemistry and cell biology.

Cilji in kompetence:	**Objectives and competences:**
Študent se podrobno seznani s strukturo in funkcijo biotskih sistemov oziroma njihovih gradnikov na molekularni in makromolekularni ravni, na stopnji supramolekularne organiziranosti, na ravni celice in interakcije med njimi. Celoten kurz temelji na konceptih in metodah teoreticne biofizike.	The main aim of the course is to present advanced structure and function of biotic systems with respect to different levels of organisation and complexity, from molecules to the cell and tissue. The approach is based on concepts and methods of theoretical biophysics.

Predvideni študijski rezultati:	**Intended learning outcomes:**
Znanje in razumevanje: • Študenti usvojijo podrobno znanje o strukturi biotskih sistemov in razume njihovo delovanje na osnovi fizikalnih konceptov in zakonitosti Prenesljive/kljucne spretnosti in drugi atributi: • Študenti znajo uporabiti zahtevna matematicna in fizikalna orodja in modele za kvantitativno obravnavo strukture in funkcije biotskih sistemov	Knowledge and Understanding: • Students get advanced knowledge of structure and function of selected biotic systems based on fundamental principles and concepts of physics Transferable/Key Skills and other attributes: • Students are able to use complex mathematical and physical tools and models for quantitative studies of structure and function of biotic systems

Metode poučevanja in učenja:	**Learning and teaching methods:**
Predavanja Seminar; seminarska naloga z izbranega podrocja iz biofizike Seminarske vaje	Lectures Seminar; coursework from selected field in biophysics Tutorials

Načini ocenjevanja:	Delež (v %) / Weight (in %)	**Assessment:**
Seminarska naloga	30%	Seminar essay
Pisni kolkvij	30%	Written partial exam
Ustni izpit	40%	Oral exam

Reference nosilca / Lecturer's references:

DOBOVIŠEK, Andrej, ŽUPANOVIĆ, Paško, BRUMEN, Milan, JURETIĆ, Davor. Maximum entropy production and maximum Shannon entropy as Germane principles for the evolution of enzyme kinetics. V: DEWAR, Roderick C. (ur.). Beyond the second law : entropy production and non-equilibrium systems, (Springer complexity), (Understanding complex systems, ISSN 1860-0832). Berlin; Heidelberg: Springer, cop. 2014, str. 361-382, graf. prikazi. [COBISS.SI-ID 20311048]

BOHINC, Klemen. Including solvent-mediated interactions into the Poisson-Boltzmann theory : doctoral dissertation. [Maribor: K. Bohinc], 2012. 124 str., ilustr. http://dkum.uni-mb.si/Dokument.php?id=48710. [COBISS.SI-ID 262942464]

DOBOVIŠEK, Andrej, ŽUPANOVIĆ, Paško, BRUMEN, Milan, BONAČIĆ LOŠIĆ, Željana, KUIĆ, Domagoj, JURETIĆ, Davor. Enzyme kinetics and the maximum entropy production principle. Biophysical chemistry, ISSN 0301-4622. [Print ed.], 2011, vol. 154, iss. 2/3, str. 49-55, doi: 10.1016/j.bpc.2010.12.009. [COBISS.SI-ID 18206984]

MBIKOU, Prisca, FAJMUT, Aleš, BRUMEN, Milan, ROUX, Etienne. Contribution of Rho kinase to the early phase of the calcium-contraction coupling in airway smooth muscle : supplemental model code. Cambridge: Cambridge University Press, 2011. http://ep.physoc.org/content/96/2/240/suppl/DC1. [COBISS.SI-ID 18486792]