UČNI NAČRT PREDMETA / COURSE SYLLABUS	
Predmet:	Molekularna biofizika
Course title:	Molecular Biophysics

Študijski program in stopnja Study programme and level	Študijska smer Study field	Letnik Academic year	Semester Semester
Fizika 2. st.		2	**3**
Physics 2nd degree		2	**3**

Vrsta predmeta / Course type	izbirni/ optional
Univerzitetna koda predmeta / University course code:	

Predavanja Lectures	Seminar Seminar	Sem. vaje Tutorial	Lab. vaje Laboratory work	Teren. vaje Field work	Samost. delo Individ. work	ECTS
30	15	30	0	0	75	5

Nosilec predmeta / Lecturer:	Milan Brumen

Jeziki / Languages:	**Predavanja / Lectures:**	slovenski/Slovenian in/and angleški/English
	Vaje / Tutorial:	slovenski/Slovenian in/and angleški/English

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:	**Prerequisits:**
Predznanje klasične in moderne fizike ter statistične termodinamike.	Preknowledge of classical and modern physics and statistical thermodynamics.

Vsebina:	**Content (Syllabus outline):**
1. Kemijske vezi, medatomske in medmolekularne interakcije. Struktura bioloških makromolekul (beljakovine, nukleinske kisline, polisaharidi) in supramolekularnih kompleksov (lipoproteini, biološka membrana). Kooperativna vezava ligandov na makromolekule in alosterični pojavi. Encimske reakcije. Zveza med strukturo in biološko funkcijo makromolekularnih in supramolekularnih sistemov ter regulacija biološke aktivnosti. Voda, njena struktura in pomen za biološke sisteme. Dinamika konformacijskih sprememb makromolekul. 2. Biofizika celičnega skeleta in molekularnih strojev subceličnih dimenzij. Mikrotubuli, mikrofilamenti. Proteinski motorji: miozini, kinezini, dineini; krčenje mišice, mitoza, transport organel, gibanje bičkov in migetalk. 3. Biofizika celične membrane in celice. Struktura biološke celice. Osmozno ravnovesje in kislinsko-bazno ravnotežje. Metabolizem celice. Mehanske lastnosti celične membrane, oblika celice. Transport preko celične membrane. Električna vzdražljivost celice in prenos električnega impulza. Znotrajcelična in medcelična signalizacija in komunikacija.	1. Chemical bonds, intra- and intermolecular forces. Structure of biological macromolecules (proteins, nucleic acids, polysaccharides) and supramolecular complexes (lipoproteins, biological membrane). Cooperative ligand binding to macromolecules and allosteric phenomena. Enzymatic reactions. Relation between structure and function of macromolecular and supramolecular systems, regulation of biological activity. Water, its structure and meaning for biological systems. Dynamics of conformational changes of macromolecules. 2. Biophysics of cytoskeleton and molecular machines of subcellular scales. Microtubules, microfilaments. Motor proteins: myosins, kinesins, dyneins; muscle contraction, mitosis, transport of organelles, cilia and flagella movement. protein motors 3. Cell and cell membrane biophysics. Structure of biological cell. Osmotic and acid-base equilibrium. Cell metabolism. Mechanical properties of cell membrane; cell shape and its transformation. Electrical excitability of the cell and propagation of the nerve pulse. Intra and intercellular signalisation and communications.

Temeljni literatura in viri / Readings:

1. J.A. Tuszynski in M. Kurzynski: Introduction to Molecular Biophysics, CRC Press 20
2. R. Glaser: Biophysics, Springer, New York, 2004
3. H. Flyvbjerg, J. Hertz, M:H.Jensen, O.G. Mouritsen,K. Sneppen: Physics of biological systems: From molecules to species, Springer 1997
4. K.A. Dill, S. Bromberg: Molecular Driving Forces: Statistical Thermodynamics in Chemistry and Biology, Garland Science, New York 2003
5. Univerzitetni učbeniki biokemije in celične biologije / university textbooks of biochemistry and cell biology.

Cilji in kompetence:

Študent se seznani s strukturo in funkcijo bioloških 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 teoretične biofizike.

Objectives and competences:

The main aim of the course is to present structure and function of biological 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:

Znanje in razumevanje:

Študent osvoji znanje o strukturi bioloških sistemov in njihovo delovanje razume na osnovi fizikalnih konceptov in zakonitosti.
Prenesljive/ključne spretnosti in drugi atributi:

Študent zna uporabiti zahtevne matematične fizikalne modele za kvantitativno obravnavo strukture in funkcije bioloških sistemov.

Intended learning outcomes:

Knowledge and Understanding:

Students get knowledge of structure and function of selected biological systems based on fundamental principles and concepts of physics
Transferable/Key Skills and other attributes:

Students are able to use advanced mathematical tools and models for quantitative studies of structure and function of biological systems.

Metode poučevanja in učenja:

Predavanja
Seminar; seminarska naloga iz izbranega področja iz biofizike.
Seminarske oziroma računske vaje.

Learning and teaching methods:

Lectures
Seminar; coursework from selected field in biophysics
Tutorials

Načini ocenjevanja:	Delež (v %) / Weight (in %)	**Assessment:**
Pisni izpit	35	Written exam
Ustni izpit	35	Oral exam
Seminarska naloga	30	Course work

Reference nosilca / Lecturer's references:

DOBOVIŠEK, Andrej, ŽUPANOVIĆ, Paško, BRUMEN, Milan, BONAČIĆ LOŠIĆ, Željana, KUIĆ, Domagoj, JURETIĆ, Davor. Enzyme kinetics and the maximum entropy production principle. *Biophysical chemistry*. [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. *Exp. physiol. (Print)*, 2011, vol. 96, issue 2, str. 240-258, ilustr., doi: 10.1113/expphysiol.2010.054635. [COBISS.SI-ID 18009864]

DOBOVIŠEK, Andrej, FAJMUT, Aleš, BRUMEN, Milan. Role of expression of prostaglandin synthases 1 and 2 and leukotriene C [sub] 4 synthase in aspirin-intolerant asthma: a theoretical study. *Journal of pharmacokinetics and pharmacodynamics*, 2011, vol. 38, no. 2, str. 261-278, doi: 10.1007/s10928-011-9192-6. [COBISS.SI-ID 18203144]

DOBOVIŠEK, Andrej, FAJMUT, Aleš, BRUMEN, Milan. Strategy for NSAID administration to aspirin-intolerant asthmatics in combination with PGE [sub] 2 analogue: a theoretical approach. *Med. biol. eng.*

comput.. [Print ed.], 2012, vol. 50, no. 1, str. 33-42, doi: 10.1007/s11517-011-0844-x. [COBISS.SI-ID 18845192]

BOHINC, Klemen, SHRESTHA, Ahis, BRUMEN, Milan, MAY, Sylvio. Poisson-Helmholtz-Boltzmann model of the electric double layer : analysis of monovalent ionic mixtures. *Phys. rev., E Stat. nonlinear soft matter phys. (Print)*, 2012, vol. 85, no. 3, str. 031130-1-031130-12, doi: 10.1103/PhysRevE.85.031130. [COBISS.SI-ID 4353131]