Univerza v Mariboru

Fakulteta za naravoslovje in matematiko

UČNI NAČRT PREDMETA / COURSE SYLLABUS	
Predmet:	**Fizika bioloških sistemov**
Course title:	**Physics of Biological Systems**

Študijski program in stopnja Study programme and level	Študijska smer Study field	Letnik Academic year	Semester Semester
Dvopredmetna izobraževalna fizika	/	**2**	**3**
Double major Educational Physics	/		

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
30	15	30			75	5

Nosilec predmeta / Lecturer: Aleš Fajmut

Jeziki / Languages:		
	Predavanja / Lectures:	slovenski, angleški /Slovene, English
	Vaje / Tutorial:	Slovenski, angleški /Slovene, English

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:	**Prerequisits:**
Formalno oziroma neformalno osvojeno znanje iz vsebin predmetov Mehanika, Termodinamika, Elektromagnetizem, Nihanje in valovanje, Moderna fizika in Kemija.	Formal or informal knowledge from subjects Mechanics, Thermodynamics, Electromagnetism, Oscillations and Wave motion, Modern Physics and Chemistry.

Vsebina:	**Content (Syllabus outline):**

Pregled izbranih zgledov iz biologije ter njihova obravnava s koncepti in metodami teoretične in eksperimentalne biofizike. Biomehanika: sile v kosteh in mišicah; dinamika gibanja organizma; trki, zlomi, poškodbe; delovanje krvožilnega sistema in transport respiratornih plinov. Termodinamika: 1. zakon termodinamike in metabolizem, toplota, delo in moč organizma; tok vode in topljencev preko selektivno prepustne celične membrane; kooperativna vezava kisika na hemoglobin, mehanizem encimske reakcije; regulacijski sistemi in mehanizmi, regulacija telesne temperature, regulacija volumna celice. 3) Elektromagnetizem: difuzija ionov, Donnanovo ravnovesje, membranski potencial; akcijski potencial in širjenje električnega pulza po živčni celici, model Hodgkina in Huxleya 4) Nihanje in valovanje: celični in biokemijski oscilatorji. 5) Molekularna biofizika: kemijske vezi; struktura vode; struktura in funkcija beljakovin (encimi, transportne beljakovine), nukleinskih kislin (genetska informacija), molekularnih motorjev, in bioloških membran.	Selected illustrative examples from biology studied by concepts and methods of theoretical and experimental biophysics. 1) Biomechanics: forces in bones and muscles; motion of living things; impacts, fractures, injuries; flow of blood in the circulatory system; transport of respiratory gases. 2) Thermodynamics: the first law of thermodynamics, metabolism, heat, work and power of human and animals; flow of water and solute across the selective cell membrane; cooperative binding of oxygen to haemoglobin, mechanism of enzyme reactions; regulatory systems and mechanisms, body temperature regulation, cell volume regulation. 3) Electromagnetism: diffusion of ions, the Donnan equilibrium, membrane potential; action potential and nerve impulses, the Hodgkin and Huxley model. 4) Vibrational and wave motion: biochemical and cellular oscillators; 5) Molecular biophysics: chemical bonds; molecular structure of water; structure and function of proteins (enzymes, transport-mediated proteins), nucleic acids (genetic information), molecular motors, biological membranes.

Temeljni literatura in viri / Readings:

- G: B. Benedek in F:M:H: Villars: Physics with Illustrative Examples from Medicine and Biology: Mechanics, Statistical Physics, Electricity and Magnetism, Springer 2000
- M. Cerdonio in R.W. Noble: Introductory Biophysics, World Scientific1986
- R. Nossal in H. Lecar: Molecular and Cell Biophysics, Addison-Wesley 1991
- R. Glaser: Biophysics, Springer 2001

Cilji in kompetence:	**Objectives and competences:**
Seznaniti študenta z izbranimi biološkimi sistemi in jih obravnavati s koncepti in metodami teoretične biofizike. Pri tem je poudarek na preprostih matematičnih modelih.	The main objective is to discuss selected biological systems with the concepts and methods of theoretical biophysics. The course is focused to formulation of simple mathematical models.
Predvideni študijski rezultati:	**Intended learning outcomes:**

Znanje in razumevanje:	**Knowledge and Understanding:**
Študent osvoji znanje o strukturi bioloških sistemov in njihovo delovanje razume na osnovi fizikalnih konceptov in zakonitosti.	Students get knowledge of structure and function of selected biological systems based on fundamental principles and concepts of physics.
Prenesljive/ključne spretnosti in drugi atributi: Študent zna uporabiti preproste matematične modele za kvantitativno obravnavo strukture in funkcije bioloških sistemov.	**Transferable/Key Skills and other attributes:** Students are able to use simple mathematical models for quantitative studies of structure and function of biological systems.

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

Načini ocenjevanja:	Delež (v %) / Weight (in %)	**Assessment:**
- Pisni izpit	30%	- Written exam
- Ustni izpit	30%	- Oral exam
- Seminarska naloga	40%	- Course work

Reference nosilca / Lecturer's references:

1. 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. 2012, vol. 50, no. 1, str. 33-42 [COBISS.SI-ID 18845192]

2. 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., 2011, vol. 96, issue 2, str. 240-258 [COBISS.SI-ID 18009864]

3. 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 [COBISS.SI-ID 18203144]

4. FAJMUT, Aleš, BRUMEN, Milan. MLC-kinase/phosphatase control of Ca[sup]2+ signal transduction in airway smooth muscles. J. theor. biol., 2008, vol. 252, no. 3, str. 474-481. [COBISS.SI-ID 15856392]

5. MBIKOU, Prisca, FAJMUT, Aleš, BRUMEN, Milan, ROUX, Etienne. Theoretical and experimental investigation of calcium-contraction coupling in airway smooth muscle. Cell Biochem Biophys, 2006, vol. 46, no. 3, str. 233-251. [COBISS.SI-ID 15168776]