



Univerza v Mariboru



MEDICINSKA FAKULTETA

UČNI NAČRT PREDMETA / SUBJECT SPECIFICATION

Predmet:	Biofizika
Subject Title:	Biophysics

Študijski program Study programme	Študijska smer Study field	Letnik Year	Semester Semester
Splošna medicina General medicine	Splošna medicina General medicine	1	1

Univerzitetna koda predmeta / University subject code:

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

Nosilec predmeta / Lecturer:

Red. prof. dr. Milan Brumen

Jeziki /

Predavanja / Lecture: slovenski/Slovene

Languages:

Vaje / Tutorial: Slovenski/Slovene

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:

Prerequisites:

Vsebina:

Mehanika: sila, tlak, navor, delo, energija, napetosti in deformacije; tlak v mirujočih tekočinah, tok tekočin. Električne in magnetne lastnosti snovi; sile (polje). Termodinamika: termodinamski zakoni; termodinamski potenciali; transport snovi. Nihanje in valovanje: zvok, svetloba; osnovne lastnosti valovanja, optične naprave. Zgradba in model atoma, medatomske in medmolekularne interakcije. Zgradba in stabilnost atomskega jedra, radioaktivnost.

Izbrani biološki procesi oziroma sistemi: biomehanika človeškega telesa; dihanje, transport respiratornih plinov; krvni obtok; voda: struktura, hidrofilne in hidrofobne interakcije, hidracija ionov; struktura in mehanske lastnosti biološke membrane, prehajanje vode in ionov preko celične membrane; prevajanje živčnega impulza; biofizika vida in sluha; struktura bioloških makromolekul, alosterične interakcije; interakcija ionizirajočega sevanja s tkivom.

Izbrane eksperimentalne metode in naprave v povezavi z laboratorijskimi vajami: merjenje tlaka in krvnega tlaka, določitev moči mišic pri delu in gibanju, merjenje pretoka tekočine, merjenje elastičnih lastnosti snovi, optične naprave in meritve: leče, model očesa, mikroskop, spektroskopija; merilci električnih količin, osciloskop, merjenje membranskega električnega potenciala, rentgen in absorpcija rentgenskih žarkov v snovi, rentgenska kristalografija, elektrokardiografija,

Content (Syllabus outline):

Mechanics: force, pressure, torque, work, energy; tension and deformations; hydrostatics and liquid flow. Electric and magnetic properties of matter: forces (field). Thermodynamics: thermodynamic laws and potentials, transport of matter. Oscillations and waves: sound, light; properties of waves, optical devices. Structure and models of atoms, atomic and molecular interactions. Structure and stability of atomic nucleus, radioactivity. Selected biological processes and systems: Biomechanics of human body; respiration and transport of respiratory gases; blood circulatory system; water: structure, hydrophilic and hydrophobic interactions, hydration of ions; structure and mechanical properties of biological membranes, transport of water and ions across the cell membrane; propagation of nerve pulses; biophysics of vision and hearing; structure of biological macromolecules, allosteric interactions; interaction of ionizing radiation with tissue. Selected experimental methods and devices in relation to lab work: measurements of pressure, blood pressure, and volume flow; determination of muscle power in movement and doing work; optical devices and measurements: lenses, light microscope; model of human eye, optical spectroscopy; instruments for measuring systems electrical properties, oscilloscope, measurements of membrane potential; roentgen apparatus and absorption of X rays, roentgen crystallography; electrocardiography

sonografija.

and sonography.

Temeljni literatura in viri / Textbooks:

- 1) George B. Benedek, Felix M.H. Villars: Physics with Illustrative Examples from Medicine and Biology:
- 2) Mechanics, 2. Statistical Physics, 3. Electricity and Magnetism; Springer Verlag, New York 2000.
Russell K. Hobbie: Intermediate Physics for Medicine and Biology; John Wiley & Sons, New York 1997.
- 3) Rudolf Kladnik: Visokošolska fizika, 1., 2. in 3. del, DZS, Ljubljana 1991
- 4) Rob Phillips, Jane Kondev, Julie Theriot, Physical Biology of the Cell; Garland Science, Taylor & Francis Group, LLC, New York 2009.

Cilji:

Osvojiti osnovne fizikalne koncepte in zakonitosti pomembne za razumevanje bioloških procesov na ravneh organizma, organa, tkiva, celice ter supramolekularnih in makromolekularnih struktur. Spoznati fizikalne pojave, ki so osnova fizioloških procesov v človeškem organizmu ter nekaterih metod v diagnostiki in zdravljenju.

Objectives:

To attain the knowledge of the fundamental concepts and laws in physics important for understanding various biological processes running on different levels of biological organisation such as organisms, organs, tissues, cells, and supramolecular and macromolecular structures. To get acquainted with phenomena in physics which serve as fundamental understanding of physiological processes in human as well as of some diagnostic methods and methods of medical treatment.

Predvideni študijski rezultati:**Znanje in razumevanje:**

Študentje osvojijo znanje fundamentalnih fizikalnih konceptov in zakonov usmerjenih v razumevanje različnih procesov v biologiji in fiziologiji.

Prenesljive/ključne spretnosti in drugi atributi:

Študentje znajo uporabiti preproste matematične modele za kvantitativni študij strukture in funkcije izbranih bioloških sistemov in primerov iz humane fiziologije. Študentje osvojijo široko razgledanost na področju naravoslovja. Znajo prikazati izmerjene eksperimentalne podatke.

Knowledge and Understanding:

Students get knowledge of fundamental concepts and laws in physics applied to understanding various processes in biology and physiology.

Transferable/Key Skills and other attributes:

Students are able to use simple mathematical models for quantitative studies of structure and function of selected biological systems and cases in human physiology. They become well broadly versed in science. They know how to present their measured experimental data.

Metode poučevanja in učenja:

Predavanja.
Seminar.
Laboratorijske vaje.

Learning and teaching methods:

Lectures.
Course work.
Lab work.

Načini ocenjevanja:

Delež (v %) /
weight (in %)

Assessment:

Sklepni kolokvij iz laboratorijskih vaj oziroma pisni izpit
Seminar
Ustni izpit
(Opravljene laboratorijske vaje in seminar sta pogoja za pristop k izpitu)

50 %**10 %****40 %**

Final test on lab work or written exam

Course work.

Oral examination.

(Lab and course work done are conditions to get to examination)

Reference nosilca / Lecturer's references:

DOBOVIŠEK, Andrej, FAJMUT, Aleš, BRUMEN, Milan. Strategy for NSAID administration to aspirin-intolerant asthmatics in combination with PGE [sub] 2 analogue: a theoretical approach. Medical & biological engineering & computing, ISSN 0140-0118. [Print ed.], 2012, vol. 50, no. 1, str. 33-42, doi: 10.1007/s11517-011-0844-x. [COBISS.SI-ID 18845192], [JCR, SNIP, WoS do 5. 4. 2012: št. citatov (TC): 0, čistih citatov (CI): 0, normirano št. čistih citatov (NC): 0, Scopus do 28. 8. 2013: št. citatov (TC): 1, čistih citatov (CI): 1, normirano št. čistih citatov (NC): 1]

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. Experimental physiology, ISSN 0958-0670, 2011, vol. 96, issue 2, str. 240-258, ilustr., doi: 10.1113/expphysiol.2010.054635. [COBISS.SI-ID 18009864], [JCR, SNIP, WoS do 8. 5. 2013: št. citatov (TC): 4, čistih citatov (CI): 4, normirano št. čistih citatov (NC): 1, Scopus do 10. 4. 2013: št. citatov (TC): 5,

čistih citatov (CI): 5, normirano št. čistih citatov (NC): 2]

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*, ISSN 1567-567X, 2011, vol. 38, no. 2, str. 261-278, doi: 10.1007/s10928-011-9192-6. [COBISS.SI-ID 18203144], [JCR, SNIP, WoS do 5. 6. 2013: št. citatov (TC): 2, čistih citatov (CI): 1, normirano št. čistih citatov (NC): 0, Scopus do 23. 10. 2013: št. citatov (TC): 3, čistih citatov (CI): 2, normirano št. čistih citatov (NC): 1]

HALOŽAN, David, RIEBENTANZ, Uta, BRUMEN, Milan, DONATH, Edwin. Polyelectrolyte microcapsules and coated CaCO₃ particles as fluorescence activated sensors in flowmetry. *Colloids and surfaces. A, Physicochemical and Engineering Aspects*, ISSN 0927-7757. [Print ed.], 2009, vol. 342, str. 115-121, ilustr., doi: 10.1016/j.colsurfa.2009.04.024. [COBISS.SI-ID 64115201], [JCR, SNIP, WoS do 13. 8. 2013: št. citatov (TC): 12, čistih citatov (CI): 12, normirano št. čistih citatov (NC): 4, Scopus do 24. 12. 2013: št. citatov (TC): 13, čistih citatov (CI): 13, normirano št. čistih citatov (NC): 5]

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]