Univerza v Mariboru

Fakulteta za naravoslovje in matematiko

UČNI NAČRT PREDMETA / COURSE SYLLABUS	
Predmet:	**Fizika v medicini**
Course title:	**Physics in medicine**

Študijski program in stopnja Study programme and level	Študijska smer Study field	Letnik Academic year	Semester Semester
Fizika 1. st.		**3**	**6**
Physics 1st 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
30	**15**		**15**		**120**	**6**

Nosilec predmeta / Lecturer:	Aleš Fajmut

Jeziki / Languages:	**Predavanja / Lectures:**	slovenski/Slovenian
	Vaje / Tutorial:	slovenski/Slovenian

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:	Prerequisits:
Jih ni.	None.

Vsebina:	Content (Syllabus outline):
FIZIKA ČLOVEŠKEGA TELESA (biomehanika, regulacija temperature in tlaka, energetika človeka, metabolizem in poraba kisika) BIOMEDICINSKE MERITVE (meritve električnih potencialov (EKG, EEG, in elektrostimulacija) spirometrija, ultrazvočno slikanje in terapija, oksigenacija krvi, sestava tkiva) ANALITIČNE METODE V BIOMEDICINI (masna in FTIR spektrometrija, fluorescenčna mikroskopija)	PHYSICS OF THE HUMAN BODY (biomechanics, temperature and pressure regulation, energetics of human, metabolism, oxygen consumption) BIOMEDICAL MEASUREMENTS (measurements of electrical potentials (ECG, EEG, and electrostimulation), spirometry, ultrasound imaging and therapy, blood oxygenation, tissue composition) ANALYTICAL MEASUREMENTS IN BIOMEDICINE (mass spectrometry, FTIR, fluorescence microscopy)

IONIZIRAJOČE SEVANJE (vrste ionizirajočega sevanja, dozimetrija, detektorji, zaščita pred sevanjem) SLIKANJE V MEDICINI (klasični in CT načini slikanja, rentgensko, SPET in PET metoda slikanja, MRI, termografija) V okviru seminarja študent izbere eno izmed razpisanih tem za projektno nalogo, ki ima obliko krajšega strokovnega prispevka. Študent po izdelavi in pregledu naloge pripravi predstavitev pred kolegi. V okviru laboratorijskih vaj študenti izvedejo več vaj na rentgenskem aparatu, slikanje in vaskularno analizo z ultrazvokom, elektrostimulacijo, detekcijo in spektrometrijo gama žarkov, EKG ter obiščejo Onkološki Inštitut UKC Maribor.	IONIZING RADIATION (types of ionizing radiation, dosimetry, detectors, protection against radiation) IMAGING IN MEDICINE (classic and CT modes of imaging, X-ray, SPET and PET imaging techniques, MRI, thermography) The seminar is intended for the presentations of student projects, which should have the form of a shorter professional paper. After preparing and reviewing the project, the student prepares a presentation in front of colleagues. Within the laboratory work, students perform several exercises on X-ray apparatus, imaging and vascular analysis with ultrasound, electrostimulation, detection and spectrometry of gamma rays, ECG and visit the Oncology Institute at UKC Maribor.

Temeljni literatura in viri / Readings:

1. Bushberg J.T., Seibert J.A., Leidholdt E.M., Boone J.M., The essential physics of medical imaging, Lippincott Williams & Wilkins, 2001, Philadelphia
2. Magee P. in Tooley M. The physics, clinical measurement and equipment of anaesthetic practice, Oxford University Press, 2005, New York
3. Brown B. H., Smallwood R. H., Barber D. C., Lawford P. V. in Hose D. R. Medical physics and biomedical engineering, Institute of Physics Publishing, 2001, Bristol
4. Herman P.I. Physics of the human body, Springer, 2007, Berlin

Interna skripta in navodila za laboratorijske vaje, izročki prosojnic s predavanj in druga dodatna interna študijska literatura, ki je v elektronski obliki dostopna na: https://estudij.um.si/ v okviru predmeta Fizika v medicini.

Pojasnilo/Remark: Med temeljno študijsko literaturo sodijo samo tista poglavja iz omenjenih knjig, ki so del vsebine predmeta v okviru predavanj, seminarja in vaj. / Only those chapters from the abovementioned books that are considered within the syllabus outline of the course, including lectures, seminar and laboratory work, are regarded as core readings.

Cilji in kompetence:	**Objectives and competences:**
Študent je po uspešno opravljenem izpitu zmožen: - prenosa osnovnih fizikalnih znanj na biomedicinsko področje,	After passing the exam, the student is able: - to transfer basic physical knowledge to the biomedical field,

- razumeti obravnavane fizikalne koncepte delovanja raznih diagnostičnih, terapevtskih in analitičnih naprav v medicini - razumeti obravnavane fizikalne teorije in zakone ter jih aplicirati na razlago pojavov in fizioloških procesov v človeškem telesu - strokovnega sodelovanja, komunikacije ter prenosa znanj s področja fizike v interdisciplinarnem bolnišničnem okolju - osnovnega rokovanja s posameznimi diagnostičnimi in merilnimi napravami, ki se uporabljajo v medicini	- to understand the discussed physical concepts of the functioning of various diagnostic, therapeutic and analytical devices in medicine - to understand the discussed physical theories and laws and apply them to the interpretation of phenomena and physiological processes in the human body - of professional cooperation, communication and transfer of knowledge in the field of physics in an interdisciplinary hospital environment - basic handling of some diagnostic and measuring devices used in medicine

Predvideni študijski rezultati:	**Intended learning outcomes:**
Znanje in razumevanje: Po zaključku predmeta je študent zmožen: prepoznave širokega spektra primerov prenosa znanja fizike na področje medicine aplikacije posameznih fizikalnih vsebin, ki jih je že usvojil pri osnovnih fizikalnih predmetih (Mehanika, Termodinamika, Moderna fizika idr.) na osnovnejše primere v medicini izvesti posamezne metode merjenj, ki so uporabne v medicini, in analizirati meritve utemeljiti primernost in smiselnost uporabe posameznih diagnostičnih, terapevtskih in analiznih metod v medicini predvideti posamezne vplive na uspešnost in kvaliteto nekaterih fizikalnih meritev v medicini **Prenesljive/ključne spretnosti in drugi atributi:** - sposobnost prenosa znanj iz teorije v prakso - tehnične spretnosti merjenja in dela s posameznimi napravami, ki so uporabne v medicini in biofiziki	**Knowledge and understanding:** Upon completion of the course, the student is able: - to recognize a wide range of cases of transfer of knowledge of physics to the field of medicine - to apply individual physical contents that he/she has already adopted in basic physical subjects (Mechanics, Thermodynamics, Modern Physics, etc.) to basic examples in medicine - to carry out selected methods of measurements that are useful in medicine, and analyse the measurements - to justify the appropriateness and meaningfulness of the use of particular diagnostic, therapeutic and analytical methods in medicine - to foresee some impacts on the success and quality of certain physical measurements in medicine **Transferable/Key Skills and other attributes:** - the ability to transfer knowledge from theory into practice - technical skills of measuring and working with particular devices that are used in medicine and biophysics

Metode poučevanja in učenja:	**Learning and teaching methods:**
Predavanja podkrepljena s simulacijami in demonstracijskimi eksperimenti Seminar; pisne in ustne predstavitve projektnih nalog iz izbrane teme	Lectures, supported by simulations and demonstration experiments Seminar; oral and written presentations of projects from selected topics

Laboratorijske vaje.	Laboratory work

Načini ocenjevanja:	Delež (v %) / Weight (in %)	**Assessment:**
Ustni izpit iz vsebin predavanj in laboratorijskih vaj	70	Oral exam from the topics of lectures and laboratory work
Projektna naloga (pisni izdelek in predstavitev)	30	Project (written paper and presentation)
Izdelana in predstavljena projektna naloga je pogoj za pristop h končnemu preverjanju.		Written and presented project is required for the approach to the final examination

Reference nosilca / Lecturer's references:

1. DOBOVIŠEK, Andrej, MARKOVIČ, Rene, BRUMEN, Milan, FAJMUT, Aleš. The maximum entropy production and maximum Shannon information entropy in enzyme kinetics. Physica. A, Statistical mechanics and its applications, ISSN 0378-4371. [Print ed.], 2018, vol. 496, str. 220-232, doi: 10.1016/j.physa.2017.12.111. [COBISS.SI-ID 23601416],
2. DOBOVIŠEK, Andrej, VITAS, Marko, BRUMEN, Milan, FAJMUT, Aleš. Energy conservation and maximal entropy production in enzyme reactions. Biosystems, ISSN 0303-2647. [Print ed.], 2017, vol. 158, str. 47-56, doi: 10.1016/j.biosystems.2017.06.001. [COBISS.SI-ID 23218696]
3. FAJMUT, Aleš, EMERŠIČ, Tadej, DOBOVIŠEK, Andrej, ANTIĆ, Nataša, SCHÄFER, Dirk, BRUMEN, Milan. Dynamic model of eicosanoid production with special reference to non-steroidal anti-inflammatory drug-triggered hypersensitivity. IET systems biology, ISSN 1751-8849. [Print ed.], 2015, vol. 9, iss. 5, str. 204-215, doi: 10.1049/iet-syb.2014.0037. [COBISS.SI-ID 21404168]
4. GOSAK, Marko, MARKOVIČ, Rene, FAJMUT, Aleš, MARHL, Marko, HAWLINA, Marko, ANDJELIĆ, Sofija. The analysis of intracellular and intercellular calcium signaling in human anterior lens capsule epithelial cells with regard to different types and stages of the cataract. PloS one, ISSN 1932-6203, 2015, vol. 10, iss. 12. http://dx.doi.org/10.1371/journal.pone.0143781, doi: 10.1371/journal.pone.0143781. [COBISS.SI-ID 2645676]