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
Enovit magistrski študijski program druge stopnje Predmetni učitelj	/	4	8
Five-year master's degree program Subject Teacher	/		

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		90	5

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:**
Potrebno je formalno ali neformalno znanje pridobljeno pri predmetih Mehanika, Elektromagnetizem, Termodinamika, Nihanje in valovanje ter Moderna fizika.	Formal or informal knowledge of subjects Mechanics, Electromagnetism, Thermodynamics, Oscillations and waves and Modern physics is required.

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

Vsebina predavanj:

- FIZIKA ČLOVEŠKEGA TELESA:
- biomehanika (mehanika človeškega telesa: stoja, dvigovanje, zvijanje, skok, hoja, tek, težišče telesa)
- energetika človeškega telesa
- fizikalni vplivi okolja na človeka (temperatura, tlak, mehanske oscilacije, zvok, elektromagnetno (EM) polje in EM valovanje)
- BIOMEDICINSKE MERITVE:
- merilni instrumenti
- meritve električnih potencialov (EKG, EEG, in ob elektrostimulaciji)
- meritve MCG (magnetokardiogram)
- merjenje tlaka in krvnega tlaka
- merjenje pretoka izdihanega zraka in dihalne naprave
- optične metode (laserji, optični vodniki, endoskopija)
- ultrazvok (širjenje ultrazvoka v telesu, dopplerski in pulzni način merjenja, kardiovaskularna analiza, fiziološki učinki)
- IONIZIRAJOČE SEVANJE:
- vrste ionizirajočega sevanja
- X-žarki (lastnosti, interakcija s snovjo, oprema, radioterapija)
- radioizotopi (produkcija, izbira v zdravilih, nuklearna medicina, dozimetrija)
- merilci, detektroji in prikazovalniki ionizirajočega sevanja

Lectures outline:

- BODY PHYSICS:
- biomechanics (human mechanics: standing, lifting, bending, jumping, walking, running, centre of mass)
- energetics of human body
- physical factors of the environment on human (temperature, pressure, mechanical oscillations, sound, electromagnetic (EM) field and EM vawes)
- BIOMEDICAL MEASUREMENTS:
- instrumentation
- electric potential measurements (ECG, EEG, and in application of electro-stimulation)
- measuring MCG (magnetocardiogram)
- measuring pressure and blood pressure
- gas volume and flow measurements and breathing systems
- optics (lasers, fibre optics, endoscopy)
- ultrasonics (ultrasound propagation in the body, Doppler and pulse methods of measurements, cardiovascular analysis, physiological effects)
- IONISING RADIATION:
- X-rays (properties, interaction with matter, equipment, radiotherapy)
- radioizotopi (production, choice of radiopharmaceuticals, nuclear medicine)
- measuring, detecting and imaging of radiation and radiation protection
- IMAGING IN MEDICINE:
- classical and tomographic methods of

- zaščita pred sevanjem - SLIKANJE V MEDICINI: - klasični in CT način slikanja - rentgenski aparat (principi delovanja in načini merjenja) - ultrazvočno slikanje - slikanje z X-žarki (SPET in PET metoda slikanja) - NMR - termografija Vsebina seminarja: Študent izbere eno izmed tem, ki jih razpiše predavatelj. Projektna naloga ima obliko krajšega strokovnega prispevka. Študent po izdelavi in predavateljevem pregledu naloge pripravi predstavitev pred kolegi. Vsebina laboratorijskih vaj: V okviru laboratorijskih vaj študent izvede meritveEKG, EEG, na rentgenskem aparatu, kardiovaskularne analize z ultrazvokom, termografije, elektrostimulacije in s področja biomehanike.	imaging - Roentgen apparatus (principles and methods of imaging) - ultrasonics - X-ray tomography (SPET, PET) - NMR - termography Seminar outline: Student chooses one of the themes offered by the lecturer. Project has a form of short scientific contribution. After the review of the final version student presents his project for the colleagues. Laboratory work outline: Student performs measurements of ECG, EEG, measurements on Roentgen apparatus, works out cardiovascular analysis with ultrasound, and performs measurement on the principle of thermography, electro-stimulation and from the field of biomechanics.

Temeljni literatura in viri / Readings:

- Hollins M. Medical physics, Thomas Nelson and Sons Ltd, 1990, Surrey
- Magee P. in Tooley M. The physics, clinical measurement and equipment of anaesthetic practice, Oxford University Press, 2005, New York
- 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

Cilji in kompetence:	**Objectives and competences:**

Študenti spoznajo aplikacijo fizikalnih znanj v medicini. - Študentom podati pregled preko celotnega spektra uporabe fizike v medicini in jim na ta način omogočiti, da sami prepoznajo prenos fizikalnih znanj v medicino. - Na praktičnih primerih študenta naučiti posameznih tehničnih spretnosti, fizikalnih metod merjenja in dela z napravami, ki so uporabne v medicini.	Students get the knowledge of application of physics to medicine. - To present students a wide overview over the field of medical physics, which enables them to recognize the transfer of knowledge from physics to medicine. - To learn students basic skills and methods from physics and their application to medical equipment in praxis.

Predvideni študijski rezultati:	**Intended learning outcomes:**
Znanje in razumevanje: Študent pridobi: - poznavanje širokega spektra primerov prenosa znanja fizike na področje medicine - globlje razumevanje fizikalnih vsebin, ki jih je že osvojil pri osnovnih fizikalnih predmetih, kot so Mehanika, Termodinamika, Optika, Moderna fizika idr. - zmožnost samostojnega prepoznavanja prenosa fizikalnih znanj v medicino - praktične spretnosti za delo z napravami s področja medicinske fizike - razumevanje fizikalnih metod merjenja, ki so uporabne v medicini	**Knowledge and understanding:** Student gets: - an overview of wide range of examples of transferable knowledge from physics to medicine - deeper comprehension of physical theory and praxis gained at general subjects, such as Mechanics, Thermodynamics, Optics, Modern physics and others. - the ability of recognition of transferable knowledge from physics to medicine - practical skills for working with the equipment used in medical physics - comprehension of measurement methods used in medical praxis
Prenesljive/ključne spretnosti in drugi atributi: - Študentje bodo zapustili predmet s širšim vpogledom aplikacije fizike v medicino. - Osvojili bodo osnovne spretnosti pri delu z	**Transferable/Key Skills and other attributes:** - Students leave subject with broader insight of application of physics to medicine.

napravami, ki so uporabljane v medicinski fiziki. Na ta način se jim odpirajo nove možnosti zaposlitve. - Študent lahko pridobljena znanja v primeru nadaljnjega študija na drugi stopnji s pridom uporabi in nadgradi pri predmetih, ki spadajo v sklop biofizike.	- Students gain basic skills of working with equipment used in medical physics. In this way they broaden their possibilities for employment. - Students can realize their knowledge in the case of master-degree study within biophysics module.

Metode poučevanja in učenja: **Learning and teaching methods:**

Predavanja Seminar Laboratorijske vaje	Lectures Seminar Laboratory work

Načini ocenjevanja:	Delež (v %) / Weight (in %)	**Assessment:**
Način (pisni izpit, ustno izpraševanje, naloge, projekt)		Type (examination, oral, coursework, project):
Ustni izpit	**50**	Oral exam
Opravljeno laboratorijsko delo in izdelan dnevnik vaj	**25**	Done lab work and logbook
Seminarska naloga	**25**	Project

Reference nosilca / Lecturer's references:

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]

FAJMUT, Aleš, BRUMEN, Milan. MLC-kinase/phosphatase control of Ca2+ signal transduction in airway smooth muscles. J. theor. biol., 2008, vol. 252, no. 3, str. 474-481.[COBISS.SI-ID 15856392]

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]

DOBOVIŠEK, Andrej, FAJMUT, Aleš, BRUMEN, Milan. Role of expression of prostaglandin synthases 1 and 2 and leukotriene C 4 synthase in aspirin-intolerant asthma: a theoretical study. J. Pharmacokin. Pharmacodyn., 2011, vol. 38, no. 2, str. 261-278. [COBISS.SI-ID 18203144]

DOBOVIŠEK, Andrej, FAJMUT, Aleš, BRUMEN, Milan. Strategy for NSAID administration to aspirin-intolerant asthmatics in combination with PGE 2 analogue: a theoretical approach. Med. biol. eng. comput., 2012, vol. 50, no. 1, str. 33-42. [COBISS.SI-ID 18845192]