

**UČNI NAČRT PREDMETA / COURSE SYLLABUS**

Ime predmeta:	Izbrane vsebine in novosti v biofiziki in medicinski fiziki
Course title:	Selected topics and novelties in biophysics and medical physics

Študijski program in stopnja Study programme and cycle	Študijska smer Study option	Letnik Year of study	Semester Semester
Splošna medicina, enovit magistrski študijski program		Prvi	1.
General medicine, Uniform master's degree study program		First	1st

Vrsta predmeta (obvezni ali izbirni) /
Course type (compulsory or elective)

izbirni
elective

Univerzitetna koda predmeta / University course code:

Predavanja Lectures	Seminar Seminar	Vaje Tutorial	Klinične vaje Clinical training	Druge oblike študija Other forms of study	Samost. delo Individual work	ECTS
5	40	AV LV RV			45	3

Nosilec predmeta / Course coordinator:

prof. dr. Marko Marhl

Jeziki /Languages:

Predavanja / Lectures: slovenski/slovene

Vaje / Tutorial: slovenski/slovene

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

Prerequisites for enrolling in the course or for performing study obligations:

Vsebina (kratek pregled učnega načrta):

Študent oziroma skupina študentov si po svoji presoji izbere eno temo izmed tukaj navedenih, lahko pa predlaga popolnoma drugo temo iz področij biofizike, biotehnologije, medicinske fizike ipd. in jo predstavi v seminarju ostalim študentom tega izbirnega predmeta.

Delo je lahko teoretično ali eksperimentalno.

Kalcij v celičnih procesih in signalizacija med celicami. Biofizikalni mehanizmi krčenja mišice in kontraktilnih proteinov. Dušikov monoksid in napetostno stanje stene žil. Molekularni motorji. Biofizikalni mehanizmi izbranih fizioloških procesov oziroma sistemov kot na primer so

Content (syllabus outline):

A student or group of students can, at discretion, choose one topic from those mentioned here, however, it is possible to propose a completely different topic from the fields of biophysics, biotechnology, medical physics, etc., and present it in a seminar to other students of this elective course. Work can be theoretical or experimental.

Calcium in cell function and signaling between cells. Biophysical mechanisms of muscle contraction and contractile proteins. Nitric oxide and a stress state of arteries. Molecular motors. Biophysical mechanisms of selected physiological processes and systems such as the

dihalni sistem, srčnožilni sistem, prenos živčnega signala, vid, sluh. Ionizirajoče sevanje in interakcija s humanim tkivom. Napredne eksperimentalne metode v diagnostiki in terapiji kot na primer CT-rentgen, termografija, upodabljanje z magnetno resonanco, ultrazvok ipd. Medicinska sistemska biologija, kaj je to?

respiratory system, the cardiovascular system, the transmission of the nervous signal, vision, hearing and similar. Ionizing radiation and interaction with human tissue. Advanced experimental methods in diagnosis and therapy such as CT-X-ray, thermography, magnetic resonance imaging, ultrasound, etc. Medical systems biology, what is it?

Temeljni literatura in viri / Reading materials:

- J. Newman: Physics of the Life Sciences, Springer Science+Business Media, LLC, 2008.
- I. P. Herman, Physics of the Human Body, Springer-Verlag, 2007.

Dopolnilno gradivo:

- R. Glaser, Biophysics: An Introduction, Springer-Verlag, 2012.
- P. F. Dillon, Biophysics: A Physiological Approach, Cambridge University Press, 2012.
- P. K. Skrivastava: Elementary Biophysics, An Introduction, Alpha Science International Ltd., Harrow, U.K., 2005.
- S. Amador Kane, Introduction to Physics in Modern Medicine, CRC Press, 2009.
- Diagnostična in intervencijska radiologija. Splošni del. Urednik V. Jevtič, sourednika M. Šurlan, J. Matela. Založba Pivec, 2014.

Cilji in kompetence:

Na osnovi fizikalnih konceptov in zakonitosti ter biofizikalnih mehanizmov osvojiti razumevanje fizioloških procesov v človeškem organizmu ter bioloških procesov na ravneh tkiva, celice ter supramolekularnih in makromolekularnih struktur. Razumeti fizikalne osnove naprednih diagnostičnih in terapevtskih metod medicinske fizike. Doseči vedenje o načinu samostojne obravnave izbrane teme ter njene predstavitve svojim kolegom v seminarju v ustrezni pisni in ustni obliki.

Objectives and competences:

To comprehend human physiological processes as well as biological processes running on different levels of biological organisation such as tissues, cells, and supramolecular and macromolecular structures, from the point of view of physical concepts and laws and biophysical mechanisms. To comprehend basic physics of advanced diagnostic methods and therapeutic methods of medical physics. To achieve knowledge on the method of self-treatment of a selected topic and its presentation to their colleagues in a seminar in appropriate oral and written form.

Predvideni študijski rezultati:

Znanje in razumevanje:

Študentje osvojijo razumevanje različnih procesov v biologiji in fiziologiji na osnovi fizikalnih konceptov in zakonov ter biofizikalnih mehanizmov in modelov.

Razumejo osnovne principe delovanja eksperimentalne opreme v diagnostiki in terapiji.

Prenesljive/ključne spretnosti in drugi atributi:

Študentje znajo uporabiti biofizikalne modele za obravnavo strukture in funkcije izbranih bioloških sistemov in primerov iz humane fiziologije. Znajo samostojno raziskati izbran problem in ga predstaviti v pisni in ustni obliki v seminarju.

Intended learning outcomes:

Knowledge and Understanding:

Students get understanding of various processes in biology and physiology based on concepts and laws in physics as well as on biophysical mechanisms and models. They understand the basic physical principles of experimental equipment in diagnostics and therapy.

Transferable/Key Skills and other attributes:

Students are able to use biophysical models for discussing structure and function of selected biological systems and cases in human physiology. They are able to explore the chosen problem and present it in oral and written form in the seminar.

Metode poučevanja in učenja:

Predavanja.

Learning and teaching methods:

Lectures.

Seminar.	Course work.
Načini ocenjevanja:	Delež (v %) / Share (in %) Assessment methods:
Seminar:	Seminar:
Seminarska naloga (pisna)	Course work (written)
Ustna predstavitev seminarske naloge	Oral presentation of course work
ŠTUDIJSKE OBVEZNOSTI ŠTUDENTOV:	ACADEMIC OBLIGATIONS OF STUDENTS:
Obvezna prisotnost na seminarjih	Compulsory participation at seminars
Izdelava pisne seminarske naloge	Course work written.
Ustna Ppt predstavitev seminarske naloge	Oral Ppt presentation of course work
POGOJI ZA PRISTOP K POSAMEZNEMU PREVERJANJU ZNANJA:	REQUIREMENTS FOR ACCESS TO INDIVIDUAL KNOWLEDGE CHECKING:
Pravočasno oddana pisna seminarska naloga	Written seminar work which has to be submitted to the lecturer in time.
Pravočasno oddana priprava na ustno predstavitev seminarske naloge	Arrangements of the oral presentation discussed with the lecturer in time.

Reference nosilca / Course coordinator's references:

ZMAZEK, Jan, GRUBELNIK, Vladimir, MARKOVIČ, Rene, **MARHL, Marko**. Modeling the amino acid effect on glucagon secretion from pancreatic alpha cells. *Metabolites*. 2022, vol. 12, iss. 4, str. 1-15, ilustr. ISSN 2218-1989. DOI: [10.3390/metabo12040348](https://doi.org/10.3390/metabo12040348). [COBISS.SI-ID [105003779](https://cobiss.si/id/105003779)]

GRUBELNIK, Vladimir, ZMAZEK, Jan, ZAVRŠNIK, Matej, **MARHL, Marko**. Lipotoxicity in a vicious cycle of pancreatic beta cell exhaustion. *Biomedicines*. [Online ed.]. 2022, vol. 10, iss. 7, str. 1-16, ilustr. ISSN 2227-9059. <https://www.mdpi.com/2227-9059/10/7/1627>, DOI: [10.3390/biomedicines10071627](https://doi.org/10.3390/biomedicines10071627). [COBISS.SI-ID [114930947](https://cobiss.si/id/114930947)]

MARKOVIČ, Rene, ŠTERK, Marko, **MARHL, Marko**, PERC, Matjaž, GOSAK, Marko. Socio-demographic and health factors drive the epidemic progression and should guide vaccination strategies for best COVID-19 containment. *Results in physics*. 2021, vol. 26, str. 1-12. ISSN 2211-3797. DOI: [10.1016/j.rinp.2021.104433](https://doi.org/10.1016/j.rinp.2021.104433). [COBISS.SI-ID [66892547](https://cobiss.si/id/66892547)]

ŠTERK, Marko, KRIŽANČIĆ BOMBEK, Lidija, SKELIN, Maša, RUPNIK, Marjan, **MARHL, Marko**, STOŽER, Andraž, GOSAK, Marko. NMDA receptor inhibition increases, synchronizes, and stabilizes the collective pancreatic beta cell activity : insights through multilayer network analysis. *PLoS computational biology*. [Print ed.]. May 2021, vol. 17, no. 5, str. 1-29. ISSN 1553-734X. DOI: [10.1371/journal.pcbi.1009002](https://doi.org/10.1371/journal.pcbi.1009002). [COBISS.SI-ID [63055107](https://cobiss.si/id/63055107)]

ZMAZEK, Jan, SKELIN, Maša, MARKOVIČ, Rene, DOLENŠEK, Jurij, **MARHL, Marko**, STOŽER, Andraž, GOSAK, Marko. Assessing different temporal scales of calcium dynamics in networks of beta cell populations. *Frontiers in physiology*. Mar. 2021, vol. 12, 16 str., ilustr. ISSN 1664-042X. DOI: [10.3389/fphys.2021.612233](https://doi.org/10.3389/fphys.2021.612233). [COBISS.SI-ID [56986115](https://cobiss.si/id/56986115)]