

UČNI NAČRT PREDMETA/COURSE SYLLABUS

Predmet: Biološki sistemi
Course title: Biological Systems

Študijski programi in stopnja	Študijska smer	Letnik	Semestri
Elektrotehnika, druga stopnja, magistrski	Biomedicinska tehnika (smer)	1. letnik	Zimski

Univerzitetna koda predmeta/University course code: 64208

Predavanja	Seminar	Vaje	Klinične vaje	Druge oblike študija	Samostojno delo	ECTS
45		30			75	6

Nosilec predmeta/Lecturer: Damijan Miklavčič, Tadej Kotnik

Vrsta predmeta/Course type: Obvezni-strokovni /Compulsory professional

Jeziki/Languages:

Predavanja/Lectures:	Slovenščina
Vaje/Tutorial:	Slovenščina

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

Prerequisites:

Vpis v letnik.

Enrolment in the year of the course.

Vsebina:

Teorije nastanka in razvoja življenja. Termodinamika bioloških sistemov. Osnove kemije bioloških sistemov. Samoorganizacija. Molekularna genetika. Zgradba, rast in delitev biološke celice. Celična membrana. Pretvorbe energije v biologiji. Biološki regulacijski sistemi in homeostaza. Pregled fizioloških sistemov pri človeku. Sestava, funkcije in kroženje krvi. Imunski sistem. Pretok snovi v bioloških sistemih. Populacijska dinamika. Deterministični kaos in fraktali v biologiji.

Content (Syllabus outline):

Theories on the origins and development of life. Thermodynamics of biological systems. Basic chemistry of biological systems. Self-organization. Molecular genetics. Structure, growth, and division of biological cells. Cell membrane. Energy conversions in biology. Biological regulation and homeostasis. Physiological systems in human. Structure, function and circulation of blood. Immune system. Flow of matter in biological systems. Population dynamics. Deterministic chaos and fractals in biology.

Temeljna literatura in viri/Readings:

Tadej Kotnik, Damijan Miklavčič. Biološki sistemi, 2. izdaja. 2016, Založba FE, Ljubljana

Cilji in kompetence:

Predstavitve bioloških sistemov z vidika tehnike, analiza učinkov električnih tokov in elektromagnetnih polj na biološke sisteme.

Objectives and competences:

To describe biological systems from an engineering perspective, analysis of the effects of electric currents and electromagnetic fields on biological systems.

Predvideni študijski rezultati:

Integrirati znanje fiziologije živih organizmov z inženirskega stališča in uporabiti inženirsko znanje za reševanje biomedicinskih problemov.

Intended learning outcomes:

To integrate knowledge of the physiology of living organisms from the engineering point of view and to use engineering knowledge in solving biomedical problems.

Metode poučevanja in učenja:	Learning and teaching methods:
Predavanja, individualne naloge, vodeni individualni študij, laboratorijske vaje.	The course will be guided through lectures in the class, individual study and laboratory work.

Načini ocenjevanja:	Delež/Weight	Assessment:
Način (pisni izpit, ustno izpraševanje, naloge, projekt) Ocena 5 je negativna, ocene od vključno 6 do 10 so pozitivne. Preverjanje znanja: laboratorijske vaje, domača naloga in ustni izpit; pozitivna ocena laboratorijskih vaj in domače naloge je pogoj za pristop k ustnemu izpitu. Prispevki k oceni: laboratorijsko delo in domače naloge, ustni izpit		Oral examination Type (examination, oral, homework, laboratory exercises, project) Negative grade: 5 Positive grades: from 6 to 10 Positive evaluation of laboratory exercises and homework is a prerequisite for the final exam. Contributions to the final grade: laboratory work and home work, oral examination
laboratorijsko delo in domače naloge	55,00 %	laboratory work and home work
ustni izpit	45,00 %	oral examination

Reference nosilca/Lecturer's references:

JARM, Tomaž, ČEMAŽAR, Maja, MIKLAVČIČ, Damijan, SERŠA, Gregor. Antivascular effects of electrochemotherapy : implications in treatment of bleeding metastases. *Expert review of anticancer therapy*, 2010, vol. 10, no. 5, str. 729-746.

YARMUSH, Martin L., GOLBERG, Alexander, SERŠA, Gregor, KOTNIK, Tadej, MIKLAVČIČ, Damijan. Electroporation-based technologies for medicine: principles, applications, and challenges. *Annual review of biomedical engineering*, 2014, vol. 16, str. 295-320.

SERŠA, Gregor, TEISSIE, Justin, ČEMAŽAR, Maja, SIGNORI, Emanuella, KAMENŠEK, Urška, MARSHALL, Guillermo, MIKLAVČIČ, Damijan. Electrochemotherapy of tumors as in situ vaccination boosted by immunogene electrotransfer. *Cancer immunology and immunotherapy*, 2015, vol. 64, no. 10, str. 1315-1327.

ZOREC, Barbara, PRÉAT, Véronique, MIKLAVČIČ, Damijan, PAVŠELJ, Nataša. Active enhancement methods for intra- and transdermal drug delivery: a review. *Zdravniški vestnik*, 2013, letn. 82, št. 5, str. 339-356.

MALI, Barbara, JARM, Tomaž, SNOJ, Marko, SERŠA, Gregor, MIKLAVČIČ, Damijan. Antitumor effectiveness of electrochemotherapy: a systematic review and meta-analysis. *European journal of surgical oncology*, 2013, vol. 39, no. 1, str. 4-16.

KOTNIK, Tadej, PUCIHAR, Gorazd, MIKLAVČIČ, Damijan. Induced transmembrane voltage and its correlation with electroporation-mediated molecular transport. *The journal of membrane biology*, 2010, vol. 236, no. 1, str. 3-13.

KOTNIK, Tadej, KRAMAR, Peter, PUCIHAR, Gorazd, MIKLAVČIČ, Damijan, TAREK, Mounir. Cell membrane electroporation. Part 1, The phenomenon. *IEEE electrical insulation magazine*, 2012, vol. 28, no. 5, str. 14-23.

KOTNIK, Tadej. Lightning-triggered electroporation and electrofusion as possible contributors to natural horizontal gene transfer. *Physics of life reviews*, 2013, vol. 10, no. 3, str. 351-370.

YARMUSH, Martin L., GOLBERG, Alexander, SERŠA, Gregor, KOTNIK, Tadej, MIKLAVČIČ, Damijan. Electroporation-based technologies for medicine : principles, applications, and challenges. *Annual review of biomedical engineering*, 2014, vol. 16, str. 295-320.

KOTNIK, Tadej, FREY, Wolfgang, SACK, Martin, HABERL MEGLIČ, Saša, PETERKA, Matjaž, MIKLAVČIČ, Damijan. Electroporation-based applications in biotechnology. *Trends in biotechnology*, 2015, vol. 33, no. 8, str. 480-488.

UČNI NAČRT PREDMETA/COURSE SYLLABUS

Predmet: Biomedicinska elektronika
Course title: Biomedical Electronics

Študijski programi in stopnja	Študijska smer	Letnik	Semestri
Elektrotehnika, druga stopnja, magistrski	Biomedicinska tehnika (smer)	1. letnik	Zimski

Univerzitetna koda predmeta/University course code: 64211

Predavanja	Seminar	Vaje	Klinične vaje	Druge oblike študija	Samostojno delo	ECTS
45		30			75	6

Nosilec predmeta/Lecturer: Tomaž Jarm

Vrsta predmeta/Course type: Vpis v letnik./Compulsory professional

Jeziki/Languages:	Predavanja/Lectures:	Slovenščina
	Vaje/Tutorial:	Slovenščina

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

Prerequisites:

Vpis v letnik.	Enrolment in the year of the course.
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Vsebina:

Zajem biomedicinskih signalov: pogojevanje bioelektričnih in drugih signalov; galvanska ločitev signalov; predojačevalniki; viri šuma in ukrepi za zmanjšanje električnih motenj; merjenje majhnih signalov; ojačevalniki in krmilniki; instrumentacijski ojačevalnik; pasivni in aktivni filtri; frekvenčna področja biomedicinskih signalov; pasovno prepustno filtriranje biomedicinskih signalov; viri signalov za električno stimulacijo v biomedicini. Inštrumentacija za zajem bioelektričnih signalov: elektrokardiograf, elektroencefalograf, elektromiograf. Električna stimulacija vzdražnih tkiv: srčni spodbujevalniki, kardioverterji, defibrilatorji. Električni kirurški nož. Elektromagnetna kompatibilnost medicinskih naprav in varnost (nevarnosti električnega udara, uhajavi tokovi, varnostni ukrepi pri načrtovanju in uporabi elektronskih naprav, označevanje in testiranje medicinske opreme, varnostni standardi).

Content (Syllabus outline):

Biomedical signal acquisition: conditioning of bioelectric and other signals; signal isolation, preamplifiers; noise sources and measures to limit their contribution to signal contamination; small signal acquisition; instrumentation amplifiers; active and passive filters; frequency bands of typical biomedical signals; filtering of biomedical signals; pulse and waveform generators for electrical stimulation of tissues. Biomedical instrumentation for signal acquisition: ECG, EMG, EEG. Electrical stimulation of excitable tissues, heart pacemakers, cardioverters, defibrillators, functional electrical stimulation. Electrosurgical devices. Electromagnetic compatibility and safety of electrical medical devices (sources of danger (electrical hazards), safety measures, leakage currents, safety-related markings on equipment, safety testing, safety and other standards).

Temeljna literatura in viri/Readings:

- David Prutchi, Michael Norris: Design and Development of Medical Electronic Instrumentation: A Practical Perspective of the Design, Construction, and Test of Medical Devices. Wiley-Interscience, 2004
- N. Leitgeb: Safety of electromedical devices. Springer, 2010.
- J.D. Bronzino (editor): The biomedical engineering handbook (3rd ed.). CRC Press, 2006.
- J. G. Webster (editor): Medical Instrumentation Application and Design (4th edition). Wiley, 2008.
- Alojz Kralj (editor): Osnove medicinske elektrotehnike. Dopsna delavska univerza Univerzum, Ljubljana, 1983.
- A. Šantić: Biomedicinska elektronika, Školska knjiga Zagreb, 1994.