

UČNI NAČRT PREDMETA/COURSE SYLLABUS

Predmet: Nevrokibernetika
Course title: Neurocybernetics

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

Univerzitetna koda predmeta/University course code: 64212

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

Nosilec predmeta/Lecturer: Damijan Miklavčič

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.
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Vsebina:

Zgradba nevrona, Nernstova enačba, mirovna membranska napetost, nastanek akcijskega potenciala, prenos signalov vzdolž nevronov in med nevroni, sinapse, nevrottransmiterji in njihovi receptorji. Ideja formalnega nevrona in osnove nevronske mreže. Zgradba mišic in posebnosti skeletnih, gladkih in srčne mišice. Hillova enačba, proces mišičnega utrujanja. Gibanje in njegov nadzor: spodnji motorični nevron, zgornji motorični nevron, vloga možganskega debla, malih možganov, globljih možganskih struktur in motoričnega korteksa. Receptorji in senzorični organi: nastanek in oblika signala, ki je posledica percepcije; vid, sluh, bolečina in zaznavanje kemijskih substanc. Refleksi. Višje možganske funkcije, spomin, učenje, senzorično-motorična integracija. Elektrotehniške naprave, ki nadomeščajo izgubljene telesne funkcije.

Content (Syllabus outline):

Structure of the neuron, Nernst equation, transmembrane potential, the formation of an action potential, transmission of signals along the neurons and between neurons, synapses, neurotransmitters and their receptors. The idea of formal neuron and the basic neural networks. Muscles and specialities of skeletal, smooth and cardiac muscle. Hill's equation, the process of muscle fatigue. Movement and its control: the lower motor neuron, upper motor neuron, the role of the brainstem, cerebellum, deeper brain structures and motor cortex. Receptors and sensory organs: the formation and shape of the signal, which is a result of perception; vision, hearing, pain and detection of chemical substances. Reflexes. Higher brain functions, memory, learning, sensory-motor integration. Electrotechnical devices that replace lost body functions.

Temeljna literatura in viri/Readings:

1. Purves D, Augustine GJ, Fitzpatrick D, Hall WC, LaMantia AS, McNamara JO, White LE. Neuroscience. Sinauer Associates; 4th Edition edition, 2007.
2. Deutsch S, Deutsch A. Understanding the nervous system An engineering perspective. Wiley-IEEE Press, 1993.
3. Pflanzner RG. Experimental and Applied Physiology. McGraw-Hill, 2007.
4. Guyton AC, Hall JE. Textbook Of Medical Physiology. W.B. Saunders Company: 10th ed. 2000.
5. Barth FG, Humphrey JAC, Secomb TW. Sensors and sensing in biology and engineering. Springer, 2003.

Cilji in kompetence:

Objectives and competences:

Seznanimi slušatelje z delovanjem živih organizmov in njihovih sestavnih delov. Poudarek je na razumevanju načinov sprejemanja različnih informacij iz okolja, prenašanju informacij po organizmu, procesiranju informacij, integraciji različnih tipov informacij in nastanku odziva na te informacije. Fiziologija živega organizma je predstavljena z inženirskega stališča. Tak način omogoča slušatelju bodisi prenos optimiranih rešitev iz narave v tehniško okolje (bionika) bodisi idejno snovanje novih naprav, ki bodo nadomeščale izgubljene ali dopolnjevale okrnjene telesne funkcije.	To introduce the students with the activity of living organisms and their components. The focus of the course is in understanding the ways of acquiring various information from the environment, transferring information in the organism, information processing, integration different types of information and producing appropriate response to this information. Physiology of a living organism is represented by an engineering point of view. This concept allows the student the transfer of optimized solutions from the nature to the technical environment (bionics) or design of the new facilities that are appropriate for compensation of lost body functions.
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Predvideni študijski rezultati:	Intended learning outcomes:
Integrirati znanje fiziologije živih organizmov z inženirskega stališča in uporabiti inženirsko znanje za reševanje biomedicinskih problemov.	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:
Snov predmeta bodo študenti osvojili na predavanjih, z vodenim individualnim študijem in na laboratorijskih vajah.	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		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:

1. MALI, Barbara, ZULJ, Sara, MAGJAREVIĆ, Ratko, MIKLAVČIČ, Damijan, JARM, Tomaž. Matlab-based tool for ECG and HRV analysis. *Biomedical signal processing and control*, 2014, vol. 10, str. 108-116.
2. MALI, Barbara, MIKLAVČIČ, Damijan, SERŠA, Gregor, JARM, Tomaž. Comparison of protocols for synchronized electroporation pulse delivery. V: 6th European Conference of the International Federation for Medical and Biological Engineering, MBEC 2014, 7-11 September 2014, Dubrovnik, Croatia. LACKOVIĆ, Igor (ur.), VASIĆ, Darko (ur.). *IFMBE proceedings*, (IFMBE proceedings, ISSN 1680-0737, vol. 45). Cham [etc.]: Springer, cop. 2014, str. 586-589, ilustr.
3. MALI, Barbara, JARM, Tomaž, ČOROVIĆ, Selma, PAULIN-KOŠIR, Marija Snežna, ČEMAŽAR, Maja, SERŠA, Gregor, MIKLAVČIČ, Damijan. The effect of electroporation pulses on functioning of the heart. *Medical & biological engineering & computing*, 2008, vol. 46, no. 8, str. 745-757.
4. ŽUPANIČ, Anže, RIBARIČ, Samo, MIKLAVČIČ, Damijan. Increasing the repetition frequency of electric pulse delivery reduces unpleasant sensations that occur in electrochemotherapy. *Neoplasma*, 2007, vol. 54, 3, str. 246-250.
5. MIKLAVČIČ, Damijan, PUCIHAR, Gorazd, PAVLOVEC, Miran, RIBARIČ, Samo, MALI, Marko, MAČEK LEBAR, Alenka, PETKOVŠEK, Marko, NASTRAN, Janez, KRANJC, Simona, ČEMAŽAR, Maja, SERŠA, Gregor. The effect of high frequency electric pulses on muscle contractions and antitumor efficiency in vivo for a potential use in clinical electrochemotherapy. *Bioelectrochemistry*, 2005, vol. 65, no. 2, str. 121-128.

