Univerza v Mariboru

Fakulteta za naravoslovje in matematiko

UČNI NAČRT PREDMETA / COURSE SYLLABUS	
Predmet:	**Napredne računske metode za biofizikalne in biomedicinske aplikacije**
Course title:	**Advanced computational methods for biophysical and biomedical aplications**

Študijski program in stopnja Study programme and level	Študijska smer Study field	Letnik Academic year	Semester Semester
Fizika		**1. ali 2.**	**1., 2. ali 4.**
Physics		**1. or 2.**	**1. or 2.**

Vrsta predmeta / Course type Izbirni za vse module

Univerzitetna koda predmeta / University course code:

Predavanja Lectures	Seminar Seminar	Vaje Tutorial	Klinične vaje work	Druge oblike študija	Samost. delo Individ. work	ECTS
10	**5**				**165**	**6**

Nosilec predmeta / Lecturer: Marko Gosak

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

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:	**Prerequisits:**
Osnove programiranja	Basic programming skills

Vsebina:	**Content (Syllabus outline):**
Linearna in nelinearna analiza časovnih vrst, valčna analiza, filtriranje podatkov, statistične analize, vizualizacija podatkov. Teorija kompleksnih mrež, korelacijska analiza, ekstrakcija funckionalne povezanosti, večplastne mreže.	Linear and non-linear time series analysis, wavelet analysis, data filtration, statistical analyses, data visualization. Complex network theory, correlation analysis, functional connectivity patterns, multilayer networks.

Metode za kvantitativno obdelavo in procesiranje biomedicinskih slik in video posnetkov. Deterministično in stohastično modeliranje bioloških sistemov na različnih nivojih organiziranosti, večslakni modeli, stabilnostna analiza.	Methods for quantitative biomedical image and video processing and analysis. Deterministic and stochastic modelling of biological systems at different levels of biological organization, multiscale models, stability analysis.

Temeljni literatura in viri / Readings:

1. J. A. Etchings, Strategies in Biomedical Data Science: Driving Force for Innovation, John Wiley & Sons, Inc. 2017 New Jersey USA.
2. R. H. Shumway & D. S. Stoffer, Time Series Analysis and Its Applications, Springer 2011, New York USA.
3. A.-L. Barabasi, Network Science, Cambridge University Press 2016, Cambridge UK.
4. C.P. Fall, Computational Cell Biology, Springer-Verlag 2002, New York USA.
5. J. Keener & J. Sneyd, Mathematical Physiology, Springer-Verlag 1998, New York USA.
6. K. Sameshima & L. A. Baccala, Methods in Brain Connectivity Inference through Multivariate Time Series Analysis, CRC Press 2014, Boca Raton USA.

Cilji in kompetence:	**Objectives and competences:**
Študentje pridobijo poglobljeno znanje s področja teoretičnih in računskih metod pri preučevanju realnih biomedicinskih podatkov in biofizikalnih sistemov. Spoznajo najnovejše raziskave na tem področju.	Students acquire advanced knowledge on theoretical and computational methods for exploring real biomedical data and biophysical systems. Students become familiar with recent research activities in this field.

Predvideni študijski rezultati:	**Intended learning outcomes:**
Znanje in razumevanje: Sposobnost izdelave lastnih algoritmov za napredne analize konkretnih primerov biomedicinskih sistemov, poglabljanje znanj s področij biofizikalnega modeliranja in numeričnih metod. Prenosljive ključne spretnosti in drugi atributi: Sposobnost oblikovanja in implementacije izvirnih znanstvenih rešitev v danih biofizikalnih in medicinskih problemih. Sposobnost predstavitve pridobljenih	Knowledge and understanding: The ability to create own algorithms for advanced analysis of concrete examples of biomedical systems, upgrading the knowledge of biophysical modelling and numerical methods. Transferable/key skills and other attributes: ability of defining and implementing unique scientific solution within defined biophysical and medical problems. Ability of presenting the acquired results and scientific findings on biophysical and biomedical

znanstvenih izsledkov in rezultatov s področja biofizike in biomedicine na nivoju mednarodnih konferenc in publikacij.	systems on the level of international conferences and publications

Metode poučevanja in učenja:	**Learning and teaching methods:**
Predavanja, seminar, individualno raziskovalno delo.	Lectures, seminar, individual research work.

Načini ocenjevanja:	Delež (v %) / Weight (in %)	**Assessment:**
Način (pisni izpit, ustno izpraševanje, naloge, projekt):		Type (examination, oral, coursework, project):
Ustni izpit	**50**	Oral examination
Projekt	**50**	Project

Reference nosilca / Lecturer's references:

1. MARKOVIČ, Rene, PELTAN, Julien, GOSAK, Marko, HORVAT, Denis, ŽALIK, Borut, SEGUY, Benjamin, CHAUVEL, Remi, MALANDAIN, Gregoire, COUFFINHAL, Thierry, DUPLÁA, Cécile, MARHL, Marko, ROUX, Etienne. Planar cell polarity genes frizzled4 and frizzled6 exert patterning influence on arterial vessel morphogenesis. PloS one, ISSN 1932-6203, 2017, vol. 12, iss. 3, str. 1-19, doi: 10.1371/journal.pone.0171033. [COBISS.SI-ID 22990856]

2. GOSAK, Marko, STOŽER, Andraž, MARKOVIČ, Rene, DOLENŠEK, Jurij, MARHL, Marko, RUPNIK, Marjan, PERC, Matjaž. The relationship between node degree and dissipation rate in networks of diffusively coupled oscillators and its significance for pancreatic beta cells. Chaos, ISSN 1054-1500, July 2015, vol. 25, iss. 7, 073115-1-073115-8, doi: 10.1063/1.4926673. [COBISS.SI-ID 512523576]

3 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]

4. GOSAK, Marko, GUIBERT, Christelle, BILLAUD, Marie, ROUX, Etienne, MARHL, Marko. The influence of gap junction network complexity on pulmonary artery smooth muscle reactivity in normoxic and chronically hypoxic conditions. Experimental physiology, ISSN 0958-0670, 2014, vol. 99, no. 1, str. 272-285, doi: 10.1113/expphysiol.2013.074971. [COBISS.SI-ID 20068872]

5. STOŽER, Andraž, GOSAK, Marko, DOLENŠEK, Jurij, PERC, Matjaž, MARHL, Marko, RUPNIK, Marjan, KOROŠAK, Dean. Functional connectivity in islets of Langerhans from mouse pancreas tissue slices. PLoS computational biology, ISSN 1553-734X. [Print ed.], Feb. 2013, vol. 9, iss. 2, str. e100292312-1-e1002923-12, doi: 10.1371/journal.pcbi.1002923. [COBISS.SI-ID 512264760]