Univerza v Novi Gorici
Fakulteta za naravoslovje

University of Nova Gorica
School of Science

UČNI NAČRT PREDMETA / COURSE SYLLABUS	
Predmet	Biofizika
Course name	Biophysics

Študijski program in stopnja Study program and level	Študijska smer Study field	Letnik Academic year	Semester Semester
Fizika in Astrofizika I. stopnja	/	3	2
Physics and Astrophysics I. level	/	3	2

Vrsta predmeta / Course type	izbirni / optional
Univerzitetna koda predmeta / University course code	1FAF28

Predavanja Lectures	Seminar Seminar	Sem. vaje Tutorial	Lab. vaje Lab. work	Teren. vaje Field work	Samost. delo Indiv. work	ECTS
30	/	30	/	/	120	6

Nosilec predmeta / Lecturer	Izr. prof. dr. Artem Badasyan	
Jeziki / Languages	**Predavanja / Lectures**	slovenščina / english
	Vaje / Tutorial	slovenščina / english

Pogoji za opravljanje študijskih obveznosti	Prerequisites
Vpis v tekoče študijsko leto. Za študente v okviru študentskih izmenjav bo izpolnjevanje pogojev preverila Študijska komisija FN	Enrollment into the current study year. For the exchange students, meeting of the course prerequisites will be checked by the Study committee of the school

Vsebina	Syllabus outline
1. UVOD Živi organizmi. Celica kot minimalni živi sistem. Struktura celic. Biofizika kot fizika bioloških sistemov. Posebnosti bioloških sistemov. 2. BIOPOLIMERI Vloga biopolimerov v celicah in s tem povezane konformacijske prehode. Primarne, sekundarne, terciarne in kvartarne ravni strukturne organizacije. Pomen biopolimernih modelov:	1. INTRODUCTION Living Organisms. Cell as a minimal living system. Structure of cells. Biophysics as the Physics of Biological Systems. Peculiarities of biological systems. 2. BIOPOLYMERS Role of biopolymers in cells and related conformational transitions. Primary, secondary, tertiary and quaternary levels of structural organisation. Importance of biopolymer models:

eksperimentalni in teoretični pristopi. 3. OSNOVNA POLIMERNA FIZIKA Struktura in klasifikacija polimerov. Parametri, pomembni za opis polimernih sistemov. Pomen grobozrnate ocene. Polimerna molekula kot statistični sistem. Porazdelitve velikosti. Kroglice na vrvici, prosti let, prosto vrtenje in drugi modeli polimerov. Idealne verige. Intramolekularne interakcije in Floryjeva teorija. Prehod globula-klobčič. 4. PREHOD VIJAČNICA-KLOBČIČ V POLIPEPTIDIH Poskusna opazovanja. Teoretični opis s spinski modeli. Modeli Zimm-Bragg, Lifson-Roig in Potts. Vpliv topil. Konformacijski prehodi v 1D sistemih: fazni prehodi ali ne? 5. TALIŠČE DNK Poskusi taljenja. Teorija taljenja DNK in pomen faktorja zanke. Strukturna heterogenost in algebra nekomutativnih operaterjev. 6. FOLDING PROTEINOV Pomen foldinga. Poskusi foldinga in fazni diagram. Nativne strukture, Protein Data Bank in Go-like pristop. Spin-based vs Lennard-Jones opis in simulacije foldinga. Grobo zrnati vs all-atom pristop.	experimental and theoretical approaches. 3. BASIC POLYMER PHYSICS Structure and classification of polymers. Parameters, relevant for the description of polymer systems. Importance of coarse-graining. Polymer molecule as a statistical system. Size distributions. Balls-on-a-string, free flight, free rotation and other polymer models. Ideal chains. Intramolecular interactions and Flory theory. Coil-globule transition. 4. HELIX-COIL TRANSITION IN POLYPEPTIDES Experimental observations. Theoretical description with spin models. Zimm-Bragg, Lifson-Roig and Potts-like models. Account of solvent. Conformational transitions in 1D systems: phase transitions or not? 5. DNA MELTING Melting experiments. Theory of DNA melting and importance of loop factor. Structural heterogeneity and algebra of non-commutative operators. 6. PROTEIN FOLDING Importance of folding. Folding experiments and phase diagram. Native structures, Protein Data Bank and Go-like approach. Spin-based vs Lennard-Jones description and folding simulations. Coarse-grained vs all-atom approach.

Temeljni literatura in viri / Basic readings

1. M. Rubinstein, Ralph H. Colby, *Polymer Physics*, Oxford University Press (2003).
2. C.R. Schimmel, P.R. Cantor, *Biophysical chemistry* - part I and III, W. H. Freeman and Company, San Francisco (1980).
3. B. Alberts, A. Johnson, J. Lewis, M. Raff, K. Roberts and P. Walter, *Molecular Biology of the Cell*, 4th edition New York: Garland Science (2002).

Cilji in kompetence	Objectives and competences
Biofizika kot fizika bioloških sistemov. Uvod v Fiziko makromolekul.	Biophysics as a Physics of biological systems. Introduction to the Physics of Macromolecules.

Predvideni študijski rezultati	Intended learning outcomes
Razumevanje strukture in posebnostej živih sistemov ter mej za uporabo fizičnih pristopov. Znanje najbolj pomembnih celičnih procesov ter jih opis.	Understanding of the structure and the peculiarity of living systems and the limit of applicability of physical approaches. Knowledge of most relevant processes in cells and their description.

Metode poučevanja in učenja	Learning and teaching methods
- predavanja - računske vaje	- lectures - tutorial

Načini ocenjevanja	Utež / Weight (%)	Assessment
- ustni izpit	100	- oral exam

Reference nosilca / references of the course principal

Dr. Artem Badasyan je izredni profesor za področje fizike na Univerzi v Novi Gorici.
Artem Badasyan is associate professor of physics at the University of Nova Gorica.

Izbrane publikacije / selected publications:

1. PEZHUMKATTIL PALAKKAL, Jasnamol, VALANT, Matjaž, BADASYAN, Artem, et al. Unusual magnetodielectric effects in La2CuMnO6 induced by a dynamic crossover in dielectric relaxation at TC. *Materials research bulletin*, ISSN 0025-5408., Apr. 2018, vol. 100, str. 226-233, doi: 10.1016/j.materresbull.2017.12.027. [COBISS.SI-ID 4979195].

2. BADASYAN, Artem, MAVRIČ, Andraž, KRALJ CIGIĆ, Irena, BENCIK, Tim, VALANT, Matjaž. Polymer nanoparticle sizes from dynamic light scattering and size exclusion chromatography : the case study of polysilanes. *Soft matter*, ISSN 1744-6848, 2018, vol. 14, issue 23, str. 4735-4740, doi: 10.1039/C8SM00780B. [COBISS.SI-ID 5150715].

3. MAVRIČ, Andraž, BADASYAN, Artem, MALI, Gregor, VALANT, Matjaž. Growth mechanism and structure of electrochemically synthesized dendritic polymethylsilane molecules. *European Polymer Journal*, ISSN 0014-3057. 2017, vol. 90, str. 162-170, doi: 10.1016/j.eurpolymj.2017.03.018.

4. MAVRIČ, Andraž, BADASYAN, Artem, FANETTI, Mattia, VALANT, Matjaž. Molecular size and solubility conditions of polysilane macromolecules with different topology. *Scientific reports*,

ISSN 2045-2322, 2016, vol. 6, str. 1-8, doi: 10.1038/srep35450. [COBISS.SI-ID 4549883].

5. ŠKRBIĆ, Tatjana, BADASYAN, Artem, HOANG, Trinh Xuan, PODGORNIK, Rudolf, GIACOMETTI, Achille. From polymers to proteins: the effect of side chains and broken symmetry on the formation of secondary structures within a Wang-Landau approach. *Soft matter*, ISSN 1744-683X, 2016, vol. 12, iss. 21, str. 4783-4793, ilustr., doi: 10.1039/C6SM00542J. [COBISS.SI-ID 2954852]**.**