UČNI NAČRT PREDMETA / COURSE SYLLABUS	
Predmet:	BIOFIZIKALNA KEMIJA 1
Course Title:	BIOPHYSICAL CHEMISTRY 1

Študijski program in stopnja Study Programme and Level	Študijska smer Study Field	Letnik Academic Year	Semester Semester
MAG Biokemija, 2. stopnja	**/**	**1.**	**1.**
USP Biochemistry, 2nd Cycle	**/**	**1st**	**1st**

Vrsta predmeta / Course Type: obvezni / Mandatory

Univerzitetna koda predmeta / University Course Code: BI213

Predavanja Lectures	Seminar Seminar	Vaje Tutorial	Klinične vaje Work	Druge oblike študija	Samost. delo Individual Work	ECTS
45	**10**	**20 LV**	**/**	**/**	**75**	**5**

Nosilec predmeta / Lecturer: prof. dr. Jurij Lah / Dr. Jurij Lah, Full Professor

Jeziki / Languages:

Predavanja / Lectures:	**slovenski / Slovenian**
Vaje / Tutorial:	**slovenski / Slovenian**

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:	**Prerequisites:**
Študent oz. kandidat mora imeti predmet opredeljen kot študijsko obveznost.	The course has to be assigned to the student.

Vsebina:	**Content (Syllabus outline):**
Molekulska interpretacija termodinamskih količin: Boltzmannova porazdelitev in statistična definicija entropije v povezavi s termodinamiko konformacijskih sprememb bioloških makromolekul. **Termodinamika raztopin bioloških makromolekul**: Osnove termodinamike raztopin, virialna enačba za kemijski potencial topila. Membransko ravnotežje, Donnansko ravnotežje, Prenos snovi preko bioloških membran. **Interakcije v raztopinah bioloških makromolekul**: Interakcije topljenec-topilo, topilo-topilo in topljenec-topljenec opredeljene s pomočjo elementarnih interakcij (Coulombske, van der Waalsove, vodikove	***Molecular interpretation of thermodynamic quantities*** Boltzmann distribution, statistical definition of entropy and the corresponding interpretation of folding/unfolding of biological macromolecules. ***Thermodynamics of solutions of biological macromolecules*** Fundamentals of solution thermodynamics, virial equation for the chemical potential of the solvent membrane equilibria, Donnan equilibrium. Transport across biological membranes. ***Interactions in solutions of biological macromolecules*** Solute-solvent, solvent-solvent and solute-

vezi). Lastnosti vode in hidrofobne interakcije. **Konformacijska ravnotežja**: Intra- in intermolekularne interakcije, ki določajo stabilnost proteinov in nukleinskih kislin. Opis termodinamike denaturacije proteinov in nukleinskih kislin z modelom dveh stanj. Odvisnost stabilnosti od temperature, koncentracije denaturanta, pH, ionske moči… Določanje termodinamskih parametrov denaturacije. **Vezanje bioloških makromolekul**: Vezava na eno vezno mesto, na več med seboj neodvisnih in ekvivalentnih veznih mest ter vezava na neekvivalentna vezna mesta. Določanje ravnotežnih konstant vezanja. Vezanje protonov, Henderson-Hasselbalchova enačba.	solute interactions interpreted in terms of non-covalent interactions (electrostatic, van der Waals, H-bonds). Properties of water and hydrophobic interactions. ***Conformational equilibria*** Interactions determining protein and nucleic acid thermodynamic stability. Thermodynamic description of protein and nucleic acid unfolding by the two-state model. Thermodynamic stability as a function of temperature, denaturant concentration, pH and salt concentration. ***Binding of biological macromolecules*** Binding to a single binding site and to several mutually independent and equivalent binding sites. Binding to nonequivalent binding sites. Determination of equilibrium binding constants. Allosteric effects. Binding of protons, Henderson-Hasselbach equation.

Temeljna literatura in viri / Readings:

- Principles of Physical Biochemistry, K.E. van Holde Prentice Hall (1998), 657 str., (30 %)
- Biophysical Chemistry, A. Cooper, RSC, Cambridge (2004), 184 str., (50%)

Dopolnilna literatura:

- Thermodynamics and Kinetics for the Biological Sciences, G.G. Hammes, J. Wiley & Sons (2000), 158 str.

Cilji in kompetence:	**Objectives and Competences:**
Cilj predmeta: Spoznavanje, razumevanje in obravnava fizikalno-kemijskih lastnosti bioloških makromolekul ter zakonitosti, ki te lastnosti določajo in povezujejo. **Predmetno specifične kompetence**: Sposobnost osnovne fizikalno-kemijske karakterizacije raztopin bioloških makromolekul, njihovega vezanja in strukturnih sprememb.	Knowledge and understanding of the basic physico-chemical properties of biological macromolecules in solution and understanding of physical laws that determine these properties and link them together. Ability to accomplish basic physico-chemical interpretation of properties of biological macromolecules in the solution, their binding and structural alterations.

Predvideni študijski rezultati:	**Intended Learning Outcomes:**
Znanje in razumevanje Predmet daje študentu teoretično (predavanja, seminar) in praktično (laboratorijske vaje) znanje iz osnov biofizikalne kemije. Pridobljeno znanje je nujno potrebno pri razumevanju osnov termodinamike biokemijskih procesov na molekularnem nivoju.	Knowledge and Comprehension The subject gives students the theoretical (lectures, seminars) and practical (lab exercises) knowledge of basic biophysical chemistry. The acquired knowledge is necessary to understand basics thermodynamics of biochemical processes at the molecular level

Uporaba Pridobljeno teoretično in praktično znanje je potrebno ne samo za uspešen študij drugih predmetov na magistrski stopnji ampak tudi za uspešno teoretično in praktično raziskovalno delo na področju biokemije.	Application Acquired theoretical and practical knowledge is necessary not only for successful study of other subjects at the MSc level but also for a successful theoretical and practical research in the field of biochemistry and chemistry.
Refleksija Študent bo pridobil občutek, kako s pomočjo osnov termodinamike lahko opišemo relativno zapletene biokemijske procese. S pridobljenim znanjem bo lahko kritično ovrednotil rezultate laboratorijskih vaj in ga uporabil v praksi.	Analysis Students will find out how to use thermodynamics in description of relatively complex biochemical processes. With the knowledge gained they will be able to critically evaluate the results of laboratory work and use it in biochemical and chemical practice.
Prenosljive spretnosti Študent se nauči nekaterih teoretičnih in eksperimentalnih pristopov, ki so osnova pri načrtovanju, spremljanju in vodenju eksperimentov v biokemiji.	Skill-transference Ability Students will learn some of the theoretical and experimental approaches, which set the basis for planning and monitoring experiments in biochemistry and chemistry.

Metode poučevanja in učenja:	**Learning and Teaching Methods:**
Predavanja, seminarji, laboratorijake vaje.	Lectures, seminars, laboratory exercises.

Načini ocenjevanja:	Delež (v %) / Weight (in %)	**Assessment:**
Pisni in ustni izpit. Opravljene vaje so pogoj za pristop k pisnemu izpitu. Opravljen pisni izpit je pogoj za pristop k ustnemu izpitu. Ocene: pozitivno (6-10); negativno (1-5).		Written and oral exam. Tutorials are a prerequisite for taking the exam. Written exam is a prerequisite for taking the oral exam. Grades: (6-10) pass, (1-5) fail.

Reference nosilca / Lecturer's references:

- DROBNAK, Igor, VESNAVER, Gorazd, **LAH, Jurij**. Model-based thermodynamic analysis of reversible unfolding processes. J. Phys. Chem. B, 2010, 114, 8713-8722.
- DROBNAK, Igor, DE JONGE, Natalie, HAESAERTS, Sarah, VESNAVER, Gorazd, LORIS, Remy, **LAH, Jurij**. Energetic basis of uncoupling folding from binding for an intrinsically disordered protein. J. Am. Chem. Soc., 2013, 135, 1288–1294.
- **LAH, Jurij**, DROBNAK, Igor, DOLINAR, Marko, VESNAVER, Gorazd. What drives the binding of minor groove-directed ligands to DNA hairpins? Nucleic Acids Res. 2008, 36, 897-904.