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 Kem. izobraževanje, 2. stopnja	**/**	**1.**	**1.**
USP Chemical Education, 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	**15**	**15 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:

Študent oz. kandidat mora imeti predmet opredeljen kot študijsko obveznost.
Dodatnih pogojev za vključitev ni.
Opravljene vaje so pogoj za pristop k pisnemu izpitu.

Prerequisites:

The course has to be assigned to the student.
There are no additional prerequisites for enrollment.
Tutorials are a prerequisite for taking the exam.

Vsebina:

Biološko pomembne molekule
Proteini, nukleinske kisline, polisaharidi, lipidi, maščobe, surfaktanti. Struktura, funkcija in njihovo okolje v celici.

Proteini, nukleinske kisline in lipidi v vodni raztopini
Voda : Vodikove vezi , struktura ledu in tekoče vode. Hidratacija: Bornov model hidratacije ionov, solvatacija polarnih in nepolarnih topljencev, hidrofobni efekt. Interakcije, ki stabilizirajo strukturo proteinov in nukleinskih kislin. Proteini in nukleinske kisline kot

Content (Syllabus outline):

Biologically important molecules
Proteins, nucleic acids, polysaccharides, fats, lipids, surfactants. Structure, function and their environment in the cell.

Proteins, nucleic acids and lipids in aqueous solution
Water: Hydrogen bonds, structure of crystalline and liquid water. Solvation: The Born model of ion solvation, solvation of polar and non-polar solutes. The hydrophobic effect. Interactions stabilizing protein and nucleic acids structure. Proteins and nucleic acids as polyelectrolytes.

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polielektroliti. Topnost in kristalizacija proteinov. Tvorba in funkcija bioloških membran. *Termodinamika biomolekularnih sistemov* Energija, informacije in življenje. Termodinamska analiza fotosinteze, glikolize, cikla citronske kisline, oksidativne fosforilacije in hidrolize ATP, osmoze, dialize, membranskega transporta, stabilnosti proteinov in nukleinskih kislin. Termodinamika medsebojnega prepoznavanja bioloških makromolekul : osnove, uporaba pri načrtovanju zdravil. *Kinetika* Hitrost reakcije in njena odvisnost od temperature. Mehanizmi zvitja in vezanja proteinov in nukleinskih kislin. Napačno zvitje proteinov in s tem povezane bolezni. Tehnike za spremljanje zelo hitrih procesov, relaksacijske metode, izmenjava vodika, površinska plazmonska resonanca. *Predvideni študijski rezultati:* *Znanje in razumevanje:* Predmet daje študentu teoretično (predavanja, seminar) in praktično (laboratorijske vaje) znanje osnov biofizikalne kemije. Pridobljeno znanje je potrebno za razumevanje bioloških procesov na molekularni ravni. *Uporaba:* Pridobljeno teoretično in praktično znanje je potrebno za uspešno poučevanje kemije. *Refleksija:* Študent bo pridobil občutek, kako lahko s pomočjo fizikalnih zakonov opišemo relativno zapletene biokemijske procese. S pridobljenim znanjem bo lahko kritično ovrednotil rezultate laboratorijskih vaj in ga uporabil v praksi. *Prenosljive spretnosti:* Študent se nauči teoretičnih in eksperimentalnih pristopov, ki so osnova pri načrtovanju, spremljanju in vodenju eksperimentov v kemiji in biokemiji.	Protein solubility and crystallization. Formation and function of biological membranes. *Thermodynamics of biomolecular systems* Energy, information, and life. Thermodynamic analysis of photosynthesis, glycolysis, and the citric acid cycle, oxidative phosphorylation and ATP hydrolysis, osmosis, dialysis, membrane transport, protein stability and nucleic acids stability. Thermodynamics of recognition of biological macromolecules: introduction, application in drug design. *Kinetics* Rate of reaction and its temperature dependence. Mechanisms of protein and nucleic acids folding and binding. Protein folding and pathological misfolding. Rapid reaction techniques, relaxation methods, hydrogen exchange, surface plasmon resonance. *Intended Learning Outcomes:* *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 biological processes at the molecular level. *Application:* Acquired theoretical and practical knowledge is necessary for successful teaching of chemistry. *Analysis:* Students will find out how to use laws of physics s 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 practice. *Skill-transference Ability:* Students will learn some of the theoretical and experimental approaches, which set the basis for planning and monitoring experiments in chemistry and biochemistry.

Temeljna literatura in viri / Readings:

- Principles of Physical Biochemistry, K.E. van Holde Prentice Hall (1998), 657 str., (30 %)

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- 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:**
<u>Znanje in razumevanje</u> 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.	<u>Knowledge and Comprehension</u> 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
<u>Uporaba</u> 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.	<u>Application</u> 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.
<u>Refleksija</u> 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.	<u>Analysis</u> 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.
<u>Prenosljive spretnosti</u> Študent se nauči nekaterih teoretičnih in eksperimentalnih pristopov, ki so osnova pri načrtovanju, spremljanju in vodenju eksperimentov v biokemiji.	<u>Skill-transference Ability</u> 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.

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Načini ocenjevanja:	Delež (v %) / Weight (in %)	Assessment:
Pisni izpit po uspešno opravljenih laboratorijskih vajah. Ocene: pozitivno (6-10); negativno (5).		Written exam after successfully completed laboratory work. Grades: (6-10) pass, (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.

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