

UČNI NAČRT PREDMETA / COURSE SYLLABUS

Predmet: BIOFIZIKALNA KEMIJA
Course Title: BIOPHYSICAL CHEMISTRY

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

Vrsta predmeta / Course Type:

izbirni strokovni / Elective Professional

Univerzitetna koda predmeta / University Course Code:

K2I21

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.

Prerequisites:

The course has to be assigned to the student.

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 polielektroliti. Topnost in kristalizacija proteinov. Tvorba in funkcija bioloških membran.

Termodinamika biomolekularnih sistemov

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. Protein solubility and crystallization. Form and function of biological membranes.

Thermodynamics of biomolecular systems

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.

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.

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:

Cilj predmeta: Spoznavanje, razumevanje in obravnavanje 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.

Objectives and Competences:

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:

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

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 biochemical processes at the molecular level.

molekularnem nivoju.	
<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:

Predavanja, seminarji: z uporabo različnih učnih pripomočkov (kreda in tabla, Power Point, prosojnice).
Vaje: skripta, teoretična navodila in praktične laboratorijske vaje.

Learning and Teaching Methods:

Lectures, seminars, laboratory exercises.

Delež (v %) /

Weight (in %)

Načini ocenjevanja:

Assessment:

Pisni izpit po uspešno opravljenih laboratorijskih vajah.

Written examination after successful completion of laboratory exercises.

Reference nosilca / Lecturer's references:

- Lah, J., Drobnak, I., Dolinar, M., Vesnaver, G. What drives the binding of minor groove-directed ligands to DNA hairpins?. *Nucleic Acids Res.*, **2008**, *36*, 897-904.
- Lah, J., Šimić, M., Vesnaver, G., Marianovsky, I., Glaser, G., Engelberg-Kulka, H., Loris, R. Energetics of structural transitions of the addiction antitoxin MazE. Is a programmed bacterial cell death dependent on the intrinsically flexible nature of the antitoxins?. *J. Biol. Chem.*, **2005**, *280*, 17397-17407.
- Lah, J., Bešter-Rogač, M., Perger, T. M., Vesnaver, G. Energetics in correlation with structural features: the case of micellization. *J. Phys. Chem, B* **2006**, *110*, 23279-23291.