UČNI NAČRT PREDMETA / COURSE SYLLABUS	
Predmet:	BIONANOTEHNOLOGIJA
Course Title:	BIONANOTECHNOLOGY

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

Vrsta predmeta / Course Type: obvezni / Mandatory

Univerzitetna koda predmeta / University Course Code: BI2I19

Predavanja Lectures	Seminar Seminar	Vaje Tutorial	Klinične vaje Work	Druge oblike študija	Samost. delo Individual Work	ECTS
30	**30**	**15 LV**	**/**	**/**	**75**	**5**

Nosilec predmeta / Lecturer: doc. dr. Gregor Gunčar / Dr. Gregor Gunčar, Assistant 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:

Uvod- kaj je bionanotehnologija

Delovanje in lastnosti nanostrojev v celici, biomateriali iz katerih so sestavljeni: proteini, DNK, polisaharidi in lipidi in njihove lastnosti povezane z uporabo v nanonapravah

Biomolekularno načrtovanje: uporaba tehnik rekombinantne DNA, mutageneza, fuzijski proteini, protitielesa, uporaba metod za določevanje tridimenzionalnih struktur pri načrtovanju, molekulsko modeliranje, zvijanje proteinov, predikcija interakcij med molekulami, načrtovanje novih oblik/lastnosti z uporabo računalniških metod

Strukturni principi bionanotehnologije: sile med molekulami, šaperoni, rigidnost/fleksibilnost molekul,

Content (Syllabus outline):

Introduction- what is bionanotechnology

Bionanomachines in action, modern biomaterials: proteins, DNA, polysaccharides, lipids and their properties useful for their application in nanodevices.

Biomolecular design: use of recombinant DNA technology, mutagenesis, fusion proteins, antibodies, use of methods for 3D structure determination, molecular modeling, protein folding, protein interaction prediction in designing new biomolecules with different folds/properties

Structural principles of bionanotechnology: biomoleclar structure and stability, chaperones, rigidity/flexibility of proteins, self-assembly, symmetry, molecular recognition, structures of

samoorganizacija molekul in simetrija, molekulsko prepoznavanje, tridimenzionalne strukture proteinov, DNA, RNA, ter kompleksov med njimi Funkcionalni principi bionanotehnologije: samoorganizacija molekul, prenos energije na nivoju molekul, encimsko katalizirane transformacije, regulatorni elementi, biomateriali, biomolekularni motorji, prenos preko membrane, biosenzorji, povezava med strukturo in funkcijo Bionanotehnologija danes: načrtovanje novih proteinov, DNA, RNA, nanomedicina, uporaba molekularnih motorjev, DNA računalniki, molekularno načrtovanje z biološko selekcijo, umetno življenje, hibridni materiali, bionanosenzorji Prihodnost bionanotehnologije: novi primeri uporabe, etika uporabe, nevarnosti Seminar: teoretično načrtovanje bionanotehnološkega projekta Laboratorijske vaje: izvedba najboljšega in najbolj izvedljivega predlaganega seminarskega projekta ali posameznih delov predlaganih projektov	proteins, DNA, RNA and their complexes. Functional principles of bionanotechnology: self-organization, molecular energy transfer, enzymatic transformation, regulatory elements, biomaterials, biomolecular motors, traffic across membranes, biomolecular sensing, structure-function relationship. Bionanotechnology today: design of novel proteins, DNA, RNA, nanomedicine, harnessing molecular motors, DNA computers, molecular design using biological selection, artificial life, hybrid materials, bionanosensors. The future of bionanotechnology: new examples of use, ethical considerations, biohazard. Seminar: bionanotechnology project Laboratory practicals: practical implementation of the most feasible seminar project or parts of the projects.

Temeljna literatura in viri / Readings:

Osnovni vir/basic reading:
- Goodsell, D.S. (2004) “Bionanotechnology: Lessons from Nature”, Wiley-Liss, Hoboken.

Druga literatura/additional readings:
- Mirkin, C.A., Niemeyer, C.M. (2007) “Nanobiotechnology II”, Wiley-VCH
- Roux, B., (2011) “Molecular Machines”, World Scientific Pub. Co. Inc.
- tekoča znanstvena literatura s tega področja / current scientific literature in the field of bionanotechnology

Cilji in kompetence:	**Objectives and Competences:**
Cilj predmeta je študente spoznati z bionanotehnologijo in jih naučiti osnov delovanja, načrtovanja, izdelave, karakterizacije in uporabe bioloških materialov in naprav v nanomerilu ter spodbuditi inovativno razmišljanje o možnostih uporabe in modifikacijah že znanih	Students will learn what bionanotechnology is, principles of use, design and characterization of biological materials and nanodevices. The course will encourage innovative thinking about the use and modifications of biological nanomaterials and cellular nanodevices.

bioloških nanomaterialov in celičnih nanonaprav. Predmet usmerja študente k interdisciplinarnemu povezovanju znanja, ki so ga že osvojili in h kvalitativni nadgradnji, ki je potrebna za uspešno povezovanje tega znanja. Spodbuja kreativno in inovativno razmišljanje študentov izven okvirov posameznih temeljnih ved, ki se povezujejo v nanobiotehnologijo.	The course directs students towards interdisciplinary knowledge integration and qualitative upgrade of their current knowledge in order to achieve that. It promotes creative and innovative thinking outside the scope of the basic knowledge that is integrated in bionanotechnology.

Predvideni študijski rezultati:	**Intended Learning Outcomes:**
Znanje in razumevanje Študenti bodo pri predmetu pridobili znanje, ki je potrebno za povezovanje temeljnih ved, ki so osnova bionanotehnologije. Razumeli bodo osnove delovanja, načrtovanja, izdelave, karakterizacije in uporabe bioloških materialov in naprav v nanomerilu.	Knowledge and Comprehension Students will gain knowledge that is required for integration of the basic disciplines that make bionanotechnology. They will understand the basic principles of action, design, manufacturing, characterization and use of the biological materials and nanodevices.
Uporaba Bionanotehnologija je tehnologija prihodnosti. Študenti bodo spoznali tudi praktične primere uporabe in načrtovanja novih bioloških naprav in materialov v nanomerilu in njihovo uporabo, seznanili pa se bodo tudi z metodami, ki so potrebne za njihovo analizo. Predvsem se bodo naučili, kako lahko uporabimo čudovite materiale in nanonaprave, ki jih je ustvarila narava, jih spremenimo in izboljšamo ter uporabimo v korist človeka.	Application Students will gain knowledge that is required for integration of the basic disciplines that make bionanotechnology. They will understand the basic principles of action, design, manufacturing, characterization and use of the biological materials and nanodevices.
Refleksija Študenti bodo lahko svoje znanje in nekatere ideje, ki jih bodo predstavili tudi v obliki seminarja, preizkusili na laboratorijskih vajah in jih s tem kritično ovrednotili ter s tem dobili občutek za povezovanje teoretičnih idej in njihove implementacije v praksi.	Analysis Students will be able to apply their knowledge and some ideas, presented in the project seminar in lab practical courses. They will be able to critically access their ideas by implementing them in the lab practical courses.
Prenosljive spretnosti Inovativno reševanje problemov in rešitev, uporaba znanstvene literature in uporaba protokolov objavljenih v znanstveni literaturi v praksi, zasnova in razvoj nove ideje, načrt kako to idejo uresničiti in izvedba v praksi, pisanje projekta, javno nastopanje (predstavitev ideje), poročanje o rezultatih.	Skill-transference Ability Innovative problem solving, use of scientific literature and laboratory protocols, project development and its implementation, project writing, public presentation, scientific results presentation.

Metode poučevanja in učenja:	**Learning and Teaching Methods:**
- Predavanja - Seminarji - Laboratorijske vaje	Lectures, seminars, laboratory practical courses.

Načini ocenjevanja:	Delež (v %) / Weight (in %)	**Assessment:**
Opravljene vaje so pogoj za pristop k izpitu		Laboratory practicals completion is required to attend written exam.
Seminarska naloga		Seminar work
Pisni izpit		Written exam

Reference nosilca / Lecturer's references:

1. **GUNČAR, Gregor**, PUNGERČIČ, Galina, KLEMENČIČ, Ivica, TURK, Vito, TURK, Dušan. Crystal structure of MHC class II-associated p41 Ii fragment bound to cathepsin L reveals the structural basis for differentiation between cathapsins L and S. EMBO, 1999, vol. 18, str. 793-803. [COBISS.SI-ID 14007335]

2. WANG, Ching-I. A.*, **GUNČAR, Gregor***, FORWOOD, Jade K., TEH, Trazel, CATANZARITI, Ann-Maree, LAWRENCE, Gregory J., LOUGHLIN, Fionna E., MACKAY, Joel P., SCHIRRA, Horst Joachim, ANDERSON, Peter A., ELLIS, Jeffrey G., DODDS, Peter N., KOBE, Boštjan. Crystal structures of flax rust avirulence proteins AvrL567-A and -D reveal details of the structural basis for flax disease resistance specificity. Plant cell, 2007, vol. 19, no. 9, str. 2898-2912. [COBISS.SI-ID 3814170]
*enakovredna prva avtorja

3. KOBE, Boštjan, **GUNČAR, Gregor**. Crystallography and protein-protein interactions : biological interfaces and crystal contacts. Biochem Soc Trans, 2008, vol. 36, no. 6, str. 1438-1441. [COBISS.SI-ID 22235175]