UČNI NAČRT PREDMETA / COURSE SYLLABUS	
Predmet:	SINTEZNA BIOLOGIJA
Course Title:	SYNTHETIC BIOLOGY

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: BI2T01

Predavanja Lectures	Seminar Seminar	Vaje Tutorial	Klinične vaje Work	Druge oblike študija	Samost. delo Individual Work	ECTS
30	**25**	**20 LV**	**/**	**/**	**75**	**5**

Nosilec predmeta / Lecturer: izr. prof. dr. Marko Dolinar / Dr. Marko Dolinar, Associate 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):
1. Sintezna biologija, biološko inženirstvo, biologija sistemov. “Synthetic Society”. 2. Inženirski cikel in načela v sintezni biologiji. 3. Regulacijski sistemi za izražanje genov v sintezni biologiji. 4. Biološki deli in struktura Registra bioloških delov. 5. Standardi za sestavljanje bioloških delov. 6. Koncept logičnih vezij in njihova izvedba v sintezni biologiji. 7. Sinteznobiološke naprave. 8. Sinteznobiološki sistemi. 9. Biološka vezja in metabolično inženirstvo. 10. Bioinformatska orodja v sintezni biologiji. 11. Modeliranje in karakterizacija sistemov.	1. Synthetic biology, biological engineering, systems biology. “Synthetic Society”. 2. The engineering cycle and governing principles in synthetic biology. 3. Gene expression regulatory systems in synthetic biology. 4. Biological parts and the structure of the Registry. 5. Assembly standards for composed biological parts. 6. The concept of logic networks and execution in synthetic biology. 7. Synthetic biology devices. 8. Synthetic biology systems. 9. Biological networks and metabolic

12. Poustvarjanje genomov in sintezna genomika. 13. Sintezna biologija mikrobnih združb. 14. Značilne aplikacije sintezne biologije (zdravje, materiali, biogoriva, reagenti,…). 15. Biološka varnost, etika in družbena sprejemljivost sintezne biologije. Laboratorijski vaji: 1.Kloniranje inserta v vektor pSB. 2.Merjenje relativne moči promotorjev. Računalniški vaji: 1.Bioinformatska orodja v sintezni biologiji. 2.Modeliranje bioloških procesov. Seminarji: Aktualni primeri aplikacij v sintezni biologiji.	engineering. 10. Bioinformatic tooks in synthetic biology. 11. Systems modelling and characterization. 12. Genome rewriting / refactoring and synthetic genomics. 13. Synthetic biology of microbial communities. 14. Typical applications of synthetic biology (health, materials, biofuels, reagents,…). 15. Biosafety, biosecurity, bioethics and public acceptance of synthetic biology. Laboratory practicals: 1. Insert cloning in pSB vectors. 2. Determination of relative promoter strength. Computer tutorials: 1. Bioinformatic tools in synthetic biology. 2. Modelling biological processes. Seminars: Current examples of applications in synthetic biology.

Temeljna literatura in viri / Readings:

- Baldwin, Bayer, Dickinson, Ellis, Freemont, Kitney, Polizzi, Stan: Synthetic biology – A primer. London: Imperial College Press, 2012 (179 str./pages).

Dodatno gradivo / Additional literature:

- H. Zhao: Synthetic Biology. Tools and Applications. London: Academic Press, 2013

Cilji in kompetence:	**Objectives and Competences:**
Vsak študent mora po opravljenem izpitu razumeti razlike med molekularno in sintezno biologijo in poznati metode, ki jih sintezna biologija uporablja. Poznal bo princip kloniranja v sintezni biologiji in njegove prednosti. Vedel bo, katere so kategorije standardnih bioloških delov in razumel stopnje njihove kompleksnosti. Znati mora sestaviti preprosta biološka vezja in jih računalniško modelirati, ob tem pa poznati elemente vezij in njihove značilnosti. Predstaviti mora znati primere uporabe sintezne biologije za reševanje različnih	Students will understand differences between molecular and synthetic biology and they will become familiar with methods used in synthetic biology. They will understand the principle of standardized gene cloning and its advantages, recognize categories in the Registry of biological parts and understand their levels of complexity. Students will be able to assemble basic biological circuits and to model them on the computer by simultaneously knowing circuit elements and their properties. In addition, they will know examples of some synthetic biology solutions to a range of major problems of the humankind. The objective is also that students will be able

perečih problemov. Znal bo kompetentno razpravljati o varnostnih in etičnih vidikih spreminjanja celičnih sistemov z metodami sintezne biologije.	to discuss with arguments biosafety and ethical issues of modifying cellular systems using synthetic biology methods.

Predvideni študijski rezultati:	**Intended Learning Outcomes:**
Znanje in razumevanje **Znanje**: Pojem poustvarjanja genomov in organizmov. Vsebina registra bioloških delov – kaj je mogoče uporabiti in za kaj. Značilnosti bioloških vezij in njihovo načrtovanje/modeliranje. Primeri uporabe sinteznobioloških pristopov v medicini, pri varovanju okolja, razvoju novih materialov ipd. **Razumevan**je: Digitalizacija življenja in uporaba podatkov za nove lastnosti organizmov. Organiziranost sintezne biologije: register delov, elementi vezij in njihovo povezovanje. Postopek kloniranja s standardiziranim pristopom; priprava biološkega vezja na osnovi biokock; potreba po poustvarjanju genomov in način priprave; pomen odgovornosti pri uporabi sintezne biologije (etični in varnostni vidiki).	Knowledge and Comprehension **Knowledge:** The term 'rewriting and refactoring' of genomes and organisms. Contents of the Registry of biological parts – what can be used and with what purpose. Properties of biological circuits and their design/modelling. Examples of synthetic biology applications in medicine, environment protection, development of novel materials etc. **Comprehension:** Digitalization of life and data utilization for designing novel properties of organisms. Organisation levels in synthetic biology: Registry of parts, circuit elements and the mode of their interconnection. Cloning procedure using the standardized approach. Preparation of a genetic circuit based on biobricks. The need to refactor genomes and modes of preparation. Importance of responsible implementation of synthetic biology (ethical and safety issues).
Uporaba Princip poenotenega kloniranja v sintezni biologiji. Metoda za določanje moči promotorskih zaporedij. Nova orodja v bioinformatiki za simuliranje celičnih biokemijskih procesov. Vpisovanje strokovnih vsebin v formatu wiki.	Application Principle of standardized cloning in synthetic biology. A method to determine promoter strengths. New bioinformatics tools for simulating biochemical processes in a cell. Wiki format of professional content input.
Refleksija Identifikacija konkretnih problemov človeštva in možnosti uporabe najzmogljivejših tehnologij. Sinergija biologije in inženirstva. Ali lahko funkcionalne elemente elektronskih vezij prevedemo v biološke komponente? Wikipedija in druge wiki strani: vprašanje zanesljivosti in dostopnosti podatkov. Inženirski pristopi niso omejeni na stroje, pač	Analysis Identification of major problems of the humankind and possibilities that high performance technologies offer for solving them. Synergy of biology and engineering. Can functional elements of electronic circuits be applied to biological components? Wikipedia and other wiki pages: are easily accessible data reliable? Engineering principles apply not only

pa so možni na živih sistemih; vzporednice celica/stroj. Vprašanje omejevanja dostopa do virov kot način zagotavljanja varnosti.	to machines but also to living systems. Parallels between a cell and a machine. Is restriction to resources a reasonable way of ensuring safety?
Prenosljive spretnosti Razumevanje raziskovalnih poročil in člankov. Priprava in predstavitev seminarja. Urejanje wiki-strani. Načela varnosti pri laboratorijskem delu z DNA in genetsko spremenjenimi mikroorganizmi.	Skill-transference Ability Understanding research reports and articles; seminar preparation and presentation; editing wiki pages. Principles of biosafety in laboratory experimental work with GM microorganisms.

Metode poučevanja in učenja:	**Learning and Teaching Methods:**
Predavanja, dve laboratorijski vaji in dve računalniški vaji, seminarji (primeri uporabe) in individualno delo pri pripravi seminarja. Sodelovanje na spletu (wiki). Spletna gradiva za določena poglavja.	Lectures, two laboratory practicals and two computer practicals, seminars (application examples) and individual work for preparation of the seminar. Web cooperation (wiki). Web-based materials for some topics.

Načini ocenjevanja:	Delež (v %) / Weight (in %)	**Assessment:**
Pisni izpit in seminarska naloga. Opravljene vaje so pogoj za pristop k izpitu.		Written examination and seminary presentation. Access to examination only with completed laboratory practicals.

Reference nosilca / Lecturer's references:

- ŠKRLJ, Nives, VIDRIH, Zlatko, **DOLINAR, Marko**. A universal approach for promoter strength evaluation supported by the web-based tool PromCal. Analytical biochemistry, ISSN 0003-2697, 2010, vol. 396, no. 1, str. 83-90, doi: 10.1016/j.ab.2009.08.033. [COBISS.SI-ID 33430789]
- ŠKRLJ, Nives, ERČULJ, Nina, **DOLINAR, Marko**. A versatile bacterial expression vector based on the synthetic biology plasmid pSB1. Protein expression and purification, ISSN 1046-5928, 2009, vol. 64, no. 2, str. 198-204, doi: 10.1016/j.pep.2008.10.019. [COBISS.SI-ID 30190085]
- AVBELJ, Monika, FEKONJA, Ota, KOVAČ, Jernej, OBLAK, Alja, POHAR, Jelka, SKOČAJ, Matej, TKAVC, Rok, BENČINA, Mojca, PANTER, Gabriela, MANČEK KEBER, Mateja, **DOLINAR, Marko**, JERALA, Roman. Engineered human cells: say no to sepsis. IET synthetic biology, ISSN 1752-1394. [Print ed.], 2007, vol. 1, no. 1/2, str. 13-16. [COBISS.SI-ID 3769882]