UČNI NAČRT PREDMETA / COURSE SYLLABUS	
Predmet:	BIOPROCESNO INŽENIRSTVO
Course Title:	BIOPROCESS ENGINEERING

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

Vrsta predmeta / Course Type: obvezni / Mandatory

Univerzitetna koda predmeta / University Course Code: IN213

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: izr. prof. dr. Polona Žnidaršič Plazl / Dr. Polona Žnidaršič Plazl, 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):
-Pomen bioprocesnega inženirstva in biotehnologije. Razvoj bioprocesov: zgodovina proizvodnje penicilina. - Struktura in delovanje celice. Raznolikost živega sveta. Mikrobiološke zbirke. Prenos snovi med celico in okolico. Hranila. - Kinetika rasti celic. Nestrukturni in strukturni modeli rasti. Specifike rasti nitastih gliv. - Načini vodenja bioprocesov. Šaržno gojenje, šaržno gojenje z dohranjevanjem. Kontinuirno gojenje, kemostat. Simulacije procesov. - Biotransformacije. Imobilizacija encimov. - Bioreaktorji. Instrumentacija in vodenje bioreaktorjev. Prenos toplote in snovi v	- The role of bioprocess engineering and biotechnology. Bioprocess development: a history of penicillin production. - Characteristics of biological systems. The diversity of the living world. Microbial collections. Material exchange between cells and environment. Substrates. - Cell growth kinetics. Unstructured and structured growth models. Specifics of growth of filamentous fungi. - Bioprocess operation. Batch, fed-batch and continuous bioprocess simulations. - Biotransformations. Enzyme immobilization. - Bioreactors. Instrumentation and control. Heat

bioreaktorjih. - Pripravljalni in zaključni procesi. -Integrirani procesi. Mikroreaktorji in »lab on a chip« sistemi. Nekonvencionalni mediji. - Specifičnosti bioprocesov z živalskimi in rastlinskimi celicami. Uporaba bioinženirstva v medicini.	and mass transfer in bioreactors. - Upstream and downstream processes. -Integrated processes. Microreactors and "lab-on-a-chip" systems. Non-conventional media. - Bioprocesses with plant and animal cells. Bioengineering in medicine.

Temeljna literatura in viri / Readings:

Doran, P.M. Bioprocess Engineering Principles, 2nd Ed., Elsevier, Amsterdam [etc.], 2013. 919 p. (30 %)

Shuler, M.L., Kargi F. Bioprocess Engineering: Basic Concepts. 2nd Ed., Prentice Hall, Upper Saddle River, 2002. 553 p. (10 %)

Nielsen J., Villadsen J., Liden G. Bioreaction Engineering Principles, 2nd Ed. Kluwer Academic/ Plenum Press, New York, 2002. 456 p. (10 %)

Raspor, P. (ur.) Biotehnologija. Bia, d.o.o., Ljubljana. 1996. 815 p. (20 %)

Žnidaršič Plazl, P., Pavko, A. Praktikum iz biokemijskega inženirstva. Fakulteta za kemijo in kemijsko tehnologijo, Ljubljana. 2005. 89 p. (90 %)

Cilji in kompetence:	**Objectives and Competences:**
Cilj predmeta je, da se študentje naučijo uporabljati inženirske principe za analizo, načrtovanje in razvoj bioprocesov, pri čemer izhajajo iz znanj o molekularnih osnovah ved o življenju, termodinamike in kinetike. Študent si pri predmetu pridobi naslednje specifične kompetence: - sposobnost pridobivati in analizirati podatke za načrtovanje, spremljanje in nadzor bioprocesov - osvajanje nekaterih izbranih laboratorijskih tehnik: vodenje in analiza bioprocesa v laboratorijskem bioreaktorju, določanje koeficienta prenos kisika v kapljevino, mikrofiltracija	Objectives: To acquaint students to apply engineering principles to Student will advance the basic knowledge in life sciences from the engineering perspectives and gain the comprehension of specificities of the development, operation, performance and monitoring of processes with biocatalysts. Principles of enzyme function and mechanisms, as well as the use of whole cells as biocatalysts will be adopted., deriving from knowledge about the fundamental concepts of life sciences, thermodynamics and reaction kinetics. Students obtain the following specific competencies: - ability to obtain an analyze quantitative data necessary data development, monitoring and control of bioprocesses - Knowledge of some selected laboratory techniques: management and analysis of a bioprocess in a laboratory bioreactor, oxygen transfer coefficient determination, microfiltration

Predvideni študijski rezultati:	**Intended Learning Outcomes:**

Znanje in razumevanje Študent nadgradi osnovna znanja iz ved o življenju z inženirskega vidika in osvoji specifičnosti vodenja in analize bioprocesov. Razume zakonitosti delovanja encimov in celic ter osnovne principe industrijskih bioprocesov.	Knowledge and Comprehension Student will advance the basic knowledge in life sciences from the engineering perspectives and gain the comprehension of specificities of the development, operation, performance and monitoring of bioprocesses. Principles of enzymes and cell function, and basics of industrial bioprocesses will be adopted.
Uporaba Pridobljena znanja je študent sposoben uporabljati pri razvoju, vodenju in analizi bioprocesov.	Application Student will be capable of using gained knowledge for development, analysis and control of bioprocesses.
Refleksija Študent bo interpretiral ter pred kolegi analiziral lastno razumevanje izbranih bioprocesov.	Analysis Student will interpret and analyse the knowledge on selected bioprocesses.
Prenosljive spretnosti Računalniška obdelava eksperimentalnih podatkov, uporabljanje spletnih virov, pisanje poročil, priprava računalniške predstavitve seminarja, timsko delo.	Skill-transference Ability Analysis of experimental data, the use of internet as a data source, writing of reports, a seminar preparation and oral presentation, team work.p

Metode poučevanja in učenja:	**Learning and Teaching Methods:**
Predavanja, projektno-tehnoloških študije – seminarji, praktične vaje.	Lectures, seminars, practical training.

Načini ocenjevanja:	Delež (v %) / Weight (in %)	**Assessment:**
Vaje: Oceno vaj sestavljajo sprotno preverjanje znanja in ocene poročil.	15 %	Practical training: Final grade consists of the preparation for the lab work and reports.
Seminarji	15 %	Seminars
Pisni in ustni izpit	70 %	Written and oral exam

Reference nosilca / Lecturer's references:

- NOVAK, Uroš, **ŽNIDARŠIČ PLAZL, Polona**. Integrated lipase-catalyzed isoamyl acetate synthesis in a miniaturized system with enzyme and ionic liquid recycle. *Green Processing and Synthesis*, 2013, 2, 561-568.
- STOJKOVIČ, Gorazd, **ŽNIDARŠIČ PLAZL, Polona**. Continuous synthesis of L-malic acid using whole-cell microreactor. *Process Biochemistry*, 2012, 47, 1102-1107.
- MARQUES, M. P. C., FERNANDES, P., CABRAL, Joaquim M. S., **ŽNIDARŠIČ PLAZL, Polona,** PLAZL, Igor. On the feasibility of *in-situ* steroid biotransformation and product recovery in microchannels. *The Chemical Engineering Journal*, 2010, 160, 708-714.