

UČNI NAČRT PREDMETA / COURSE SYLLABUS

Predmet:	BIOTRANSFORMACIJE
Course Title:	BIOTRANSFORMATIONS

Študijski program in stopnja Study Programme and Level	Študijska smer Study Field	Letnik Academic Year	Semester Semester
MAG Kemijsko inženirstvo, 2. stopnja	/	2.	3.
USP Chemical Engineering, 2 nd Cycle	/	2 nd	3 rd

Vrsta predmeta / Course Type: izbirni strokovni / Elective Professional

Univerzitetna koda predmeta / University Course Code: IN2I12

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: slovenski / Slovenian
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:

Temeljna vsebinska področja predmeta so:
 - uvod v encimsko tehnologijo in biotransformacije, encimi, mikroorganizmi kot biokatalizatorji;
 - kinetika encimsko kataliziranih reakcij, stabilnost encimov, izboljšanje encimov;
 - proizvodnja in izolacija encimov, encimi v organski kemiji, uporaba encimov v raztopinah;
 - imobilizacija encimov, imobilizacija mikroorganizmov in celic; specifični reaktorji
 - karakterizacija imobiliziranih biokatalizatorjev, prenos snovi in reakcija, določanje kinetike imobiliziranih biokatalizatorjev;

Content (Syllabus outline):

The primary subject areas of the course are:
 - Introduction to enzyme technology and biotransformations, enzymes, microorganisms as biocatalysts;
 - Kinetics of enzyme catalyzed reactions, enzyme stability, improvement of enzymes;
 - The production and isolation of enzymes, enzymes in organic chemistry, the use of enzymes in solution;
 - Immobilization of enzymes, immobilization of microorganisms and cells; specific reactors
 - Characterization of immobilized biocatalysts, mass transfer and reaction, kinetic characterization of immobilized biocatalysts;
 - Selected examples of industrial

- izbrani primeri industrijskih biotransformacij
- integrirani procesi biotransformacij, biotransformacije v mikroreaktorjih, biotransformacije v nekonvencionalnih medijih

biotransformations
- An integrated bioprocesses, biotransformations in microreactors, biotransformations in non-conventional media

Temeljna literatura in viri / Readings:

- Buchholz, K., Kasche, V., Bornscheuer, U.T. Biocatalysts and Enzyme Technology, 2nd Edition. Wiley-VCH Verlag GmbH & Co. KGaA, Weinheim. 2012. 626 str. (70%)
- Liese, A., Seelbach, K., Wandrey, C. Industrial Biotransformations. Wiley-VCH Verlag GmbH & Co. KGaA, 2005. (20 %)
- Žnidaršič Plazl, P., Podgornik, H. Vaje iz biotehnologije, 2. Izd. Fakulteta za kemijo in kemijsko tehnologijo, Ljubljana. 2011. 96 p. (15 %)

Cilji in kompetence:

Cilj predmeta je seznaniti študente z možnostmi uporabe biotransformacij z encimi ali celotnimi celicami v industriji, razvijati zavest o pomenu biotransformacij pri načrtovanju okoljsko sprejemljivih procesov in uporabljati inženirske principe za analizo, načrtovanje in razvoj procesov z biokatalizatorji, pri čemer izhajajo iz znanj o molekularnih osnovah ved o življenju ter termodinamike in kinetike reakcije. Študent si pri predmetu pridobi naslednje specifične kompetence:

- poznavanje uporabe biotransformacij v industrijskih procesih, kmetijstvu in okoljevarstvu
- razumevanje delovanja biokatalizatorjev (celic/encimov) z inženirskega vidika
- sposobnost pridobivanja potrebnih podatkov za izračune v biokemijskem inženirstvu
- sposobnost analiziranja bioloških dejavnikov, ki so pomembni za načrtovanje, delovanje, obnašanje in spremljanje procesov z biokatalizatorji
- osvajanje nekaterih izbranih laboratorijskih tehnik: vodenje in analiza procesa biotransformacije v laboratorijskem merilu, analiza encimske kinetike v mikroreaktorju

Objectives and Competences:

Objectives: To acquaint students with the opportunities to use biotransformations with enzymes or whole cells in the industry, to develop an awareness of the importance of biotransformations in the planning of environmentally acceptable processes and to apply engineering principles to the analysis, design and development of processes with biocatalysts, deriving from knowledge about the fundamental concepts of life sciences, biotransformation thermodynamics and reaction kinetics.

Students obtain the following specific competencies:

- Knowledge of the use of biotransformations in industrial processes, agriculture and environmental engineering
- Understanding of biocatalysts (cells / enzymes) from the engineering point of view
- Ability to obtain necessary data for calculations in biochemical engineering
- The ability to analyze the biological factors that are important for the planning, operation, performance and monitoring of processes with biocatalysts
- Bring in some selected laboratory techniques: management and analysis of the process of biotransformation at the laboratory-scale, analysis of enzyme kinetics in a microreactor

Predvideni študijski rezultati:

Znanje in razumevanje
Študent nadgradi osnovna znanja iz ved o

Intended Learning Outcomes:

Knowledge and Comprehension
Student will advance the basic knowledge in life

<p>življenju z inženirskega vidika in osvoji specifičnosti načrtovanja, vodenja in analize procesov z biokatalizatorji. Razume zakonitosti delovanja encimov oz. celic kot biokatalizatorjev, kar omogoča razumevanje njihove uporabe v biotehnologiji.</p>	<p>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.</p>
<p><u>Uporaba</u> Pridobljena znanja je študent sposoben uporabljati pri razvijanju, vodenju in analizi procesov z biokatalizatorji.</p>	<p><u>Application</u> Student will develop the ability to participate in the development, control and analysis of processes with biocatalysts.</p>
<p><u>Refleksija</u> Študent bo interpretiral ter pred kolegi analiziral lastno razumevanje izbranih procesov biotransformacij. Pri tem bo uporabil pridobljena teoretična znanja ter jih vrednotil s praktičnimi izkušnjami.</p>	<p><u>Analysis</u> Student will interpret and analyse the knowledge on selected biocatalytic processes.</p>
<p><u>Prenosljive spretnosti</u> Računalniška obdelava eksperimentalnih podatkov, uporabljanje spletnih virov, pisanje poročil, priprava računalniške predstavitve seminarja, timsko delo</p>	<p><u>Skill-transference Ability</u> 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:

Predavanja, laboratorijske vaje, individualno in skupinsko delo pri pripravi seminarjev. Spletna gradiva za določena poglavja.

Learning and Teaching Methods:

Lectures, seminars, practical training.

Delež (v %) /

Načini ocenjevanja:

Weight (in %) **Assessment:**

<p>Vaje: Oceno vaj sestavljajo sprotno preverjanje znanja in ocene poročil. 15% Seminarji 15% Pisni in ustni izpit 70%</p>		
----------------------------------------------------------------------------------------------------------------------------------------	--	--

Reference nosilca / Lecturer's references:

- **ŽNIDARŠIČ PLAZL, Polona.** Enzymatic microreactors utilizing non-aqueous media. *Chimica Oggi – Chem. Today*, 2014, 32, 54-61.
- **STOJKOVIČ, Gorazd, PLAZL, Igor, ŽNIDARŠIČ PLAZL, Polona.** L-Malic acid production within a microreactor with surface immobilised fumarase. *Microfluidics and Nanofluidics*, 2011, 10, 627-635.
- **POHAR, Andrej, PLAZL, Igor, ŽNIDARŠIČ PLAZL, Polona.** Lipase-catalyzed synthesis of isoamyl acetate in an ionic liquid/*n*-heptane two-phase system at the microreactor scale. *Lab on a Chip*, 2009, 9, 3385-3390.