(*faculty stamp*)

Z1-PU7	WYDANIE N1	Strona 1 z 3

COURSE DESCRIPTION

1. Course title: BIOTECHNOLOGY	**2. Course code**
3. Validity of course description: 2019/2020	
4. Level of studies: 1st cycle	
5. Mode of studies: intramural studies	
6. Field of study: INDUSTRIAL AND ENGINEERING CHEMISTRY	(FACULTY SYMBOL) RCH
7. Profile of studies: academic	
8. Programme: common	
9. Semester: 5	
10. Faculty teaching the course: Faculty of Chemistry, Department of organic Chemistry, Bioorganic Chemistry and Biotechnology	
11. Course instructor: Danuta Gillner, PhD, DSc. Associate Professor; Katarzyna Szymańska, PhD, DSc, Associate Professor	
12. Course classification: fundamental	
13. Course status: compulsory	
14. Language of instruction: English	
15. Pre-requisite qualifications: Fundamental knowledge of organic chemistry and biology; basics of process and bioprocess engineering	

16. Course objectives:

The objective is to introduce the basic knowledge within biochemistry and biotechnology areas. Based on that knowledge it will be possible to analyze biotechnological processes, their kinetics and rules as well as to learn chosen problems from genetic engineering. The main attention will be paid to the biotechnological processes of great economic value. Main legislation, economic and ethical aspects of biotechnology are also objective of this course. The course will also focus on fundamentals of bioprocess engineering: aims, principles, methods and tools devised for the processes carried out with microorganisms and enzymes.

17. Description of learning outcomes:

Nr	Learning outcomes description	Method of assessment	Teaching methods	Learning outcomes reference code
1.	Theoretically underpinned knowledge in the field of inorganic chemistry, organic chemistry, physical and analytical chemistry. Knowledge about biological science and bioorganic macromolecules useful for description of appropriate biotechnological processes in chemical industry. Knowledge about raw materials, products and processes applied in chemical industry . Knowledge of the directions of development for national and world chemical industry; Knowledge of environmental protection rules in interrelationship with chemical production and waste disposal	Test and presentation	Lecture	K1A_W06 (++) K1A_W07 (++) K1A_W08 (++)
2.	Student is familiarized with basic concepts of bioprocess engineering: bioreactor engineering, balancing of mass, enzymatic and microbial kinetics, bioreactors design, modeling and analysis, and process scale up. Student can write mass balances for basic bioprocess/reactor arrangements. Student has the knowledge and skills to carry out dimensioning for typical bioreactors.	Tests	Lecture/classes	K1A_W09 ++ K1A_U07+ K1A_W11+ K1A_U24+ K1A_W14+
3.	Student knows the governing principles of microbial growth and enzymatic kinetics and the skills to evaluate it from experimental data.	Tests	Lecture/classes	K1A_W12 ++
4.	Skill of application of know-how enquired in the field of chemical science in the relative scientific domains. Skill of communications using different techniques in professional and other surroundings, also in English. Skill of self-education	Test and presentation	Lecture	K1A_U03 (+) K1A_U04 (++) K1A_U08 (+)
5.	Student understands the need for a continual updating of both knowledge and skills and encourages its associates in doing the same. Student understands the need to give the information about the new way of developing biochemistry for the society.	Discussion	Lecture/classes	K1A_K04+ K1A_K06+

18. Teaching modes and hours

Lectures 45 h; Classes 15 h

19. Syllabus description:

Lectures:

1. Basic nomenclature and rules in biotechnology.
2. Legislation, ethical and economic aspects of biotechnology; public awareness and opinion.
3. Metabolism as well as kinetics of microorganisms growth. Primary and secondary metabolism.
4. Basic information from genetic engineering; mutagenesis and genetic engineering.
5. Enzymes as biocatalysts in biochemical and biotechnological processes.
6. Screening, selection, characteristics and enhancement of microorganisms used in biotechnology. Adaptation mechanisms.
7. Optimization of bioprocesses; unit operations. Upstream and downstream processes; fermentation, isolation and purification: bioreactors – types, selection; scale-up.
8. Detailed analysis and discussion of chosen biotechnological processes of great economic importance (production of amino acids, organic acids, polysaccharides, pharmaceuticals, enzymes, recombinant proteins; biotransformations used on industrial scale; application of biotechnology in environment protection).
9. Bioreactors – types, characteristics, mass balance equations, productivity. Elemental balance of microbial growth, concept of yield coefficients. Mass balancing for aerobic and anaerobic processes. Kinetics of biomass/microorganisms growth (Monod and related, structured and physiological/population models). Endogeneous metabolism, it effect and quantification.
10. Kinetics of enzymatic reactions (Michaelis-Menten, triple complex and bi-bi ping-pong models). Inhibition and inactivation of biocatalysts. Determination of reaction kinetics and its discriminations (Hofstee and Lineweaver-Burk plots). Chemostate/CSTR – properties and application.
11. Model and analysis of the fermentor-settler system. Integrated – macro kinetics for heterogeneous biocatalysts – concept of catalyst efficiency(ies) and its determination.

Classes:
Calculations of enzymatic kinetics, microbial growth kinetics, mass balance of biotechnological process.

20. Examination: NO

21. Primary sources:

1. Colin Ratledge, Bjorn Kristiansen, Basic Biotechnology, Cambridge University Press, 5th Ed., New York 2013
2. Basic and Applied Aspects of Biotechnology, Varsha Gupta, Manjistha Sengupta, Jaya Prakash, Baishnab Charan Tripathy, Springer Science+Business Media Singapore 2017 file:///C:/Users/Oem/Downloads/2017_Book_BasicAndAppliedAspectsOfBiotec%20(1).pdf
3. Biocatalysts and Enzyme Technology, K. Buchholz, V. Kasche, U.T. Bornscheuer, II ed., Wiley-Blackwell, Weinheim, Germany, 2012
4. Artykuły przeglądowe z ostatnich lat w czasopismach:
- Trends in biotechnology;
- Chem. Soc Rev. (The Royal Society of Chemistry);
- Current Opinion in Biotechnology
- Current Opinion in Chemical Biology;
- Bioresource Technology

5. Julio Polaina, Andrew P. McCabe Ed., Industrial Enzymes. Structure, function and Applications, Springer, 2007, Netherlands
6. S. Liu, Bioprocess Engineering. Kinetics, Biosystems, Sustainability, and Reactor Design, Elsevier 2013.
7. J.E. Bailey, D.F. Olis, Biochemical Engineering Fundamentals, Mc-Graw 1986.
8. K.van't Riet, J. Tramper, Basic Bioreaktor Design, Marcel-Dekker 1991
9. K. Szewczyk, Bilansowanie i kinetyka procesów biochemicznych, Ofic. Wyd. Pol. Warszawskiej (OWPW) 1997 – także wydanie II

22. Secondary sources:

1. Organic Chemistry Handbook (student's choice)
2. Biochemistry Handbook (student's choice)
3. Klaus Buchholz, Volker Kasche, Uwe T. Bornscheuer, Biocatalysts and Enzyme Technology, 2nd Ed. Wiley Blackwell, 2012, Weinhem, Germany
4. . J. Bałdyga, M. Henczka, W Podgórska, Obliczenia w inżynierii bioreaktorów, OWPW 1996
5. H.-J. Rehm, G. Reed (Eds) Biotechnology, Vol 11a, Environmental processes, VCH 1999.

23. Total workload required to achieve learning outcomes

Lp.	Teaching mode :	Contact hours / Student workload hours
1	Lecture	45/30
2	Classes	15/15
3	Laboratory	/
4	Project	/
5	BA/ MA Seminar	/
6	Other (Consultations)	15
	Total number of hours	120

24. Total hours: 120

25. Number of ECTS credits: 3

26. Number of ECTS credits allocated for contact hours: 2

27. Number of ECTS credits allocated for in-practice hours (laboratory classes, projects):0,5

26. Comments:

Approved:

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(date, Instructor's signature) (*date , the Director of the Faculty Unit signature)*