



Subject card

Subject name and code	Bioreactors, PG_00054726						
Field of study	Biotechnology						
Date of commencement of studies	October 2021		Academic year of realisation of subject			2023/2024	
Education level	first-cycle studies		Subject group			Obligatory subject group in the field of study Subject group related to scientific research in the field of study	
Mode of study	Full-time studies		Mode of delivery			at the university	
Year of study	3		Language of instruction			Polish	
Semester of study	6		ECTS credits			2.0	
Learning profile	general academic profile		Assessment form			assessment	
Conducting unit	Department of Process Engineering and Chemical Technology -> Faculty of Chemistry						
Name and surname of lecturer (lecturers)	Subject supervisor		dr inż. Iwona Hołowacz				
	Teachers		dr inż. Iwona Hołowacz dr inż. Karolina Kucharska				
Lesson types and methods of instruction	Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
	Number of study hours	15.0	0.0	15.0	0.0	0.0	30
	E-learning hours included: 0.0						
Learning activity and number of study hours	Learning activity	Participation in didactic classes included in study plan		Participation in consultation hours		Self-study	SUM
	Number of study hours	30		5.0		15.0	50
Subject objectives	Education in the field of balancing the growth of microorganisms and the kinetics of biochemical reactions. Education in the field of bioreactor design and techniques of microbial culture in a bioreactor. Models of ideal and real bioreactors. Conditions for mixing and mass exchange in bioreactors.						
Learning outcomes	Course outcome		Subject outcome			Method of verification	
	K6_U01		The student knows how to: - perform heat and mass balance of microorganism growth reactions - write the mass exchange kinetics equation for the basic bioreactor operating modes - choose mixing and aeration conditions in the bioreactor - determine theoretically and experimentally the residence time distribution functions for the reactor model with perfect mixing, the plug flow reactor and the reactor model with mass dispersion -determine the theoretical and experimental values of the basic parameters of the reactor (gas hold-up, mixing time, circulation time, mass transfer coefficient, dispersion coefficient).			[SU5] Assessment of ability to present the results of task [SU4] Assessment of ability to use methods and tools [SU2] Assessment of ability to analyse information [SU1] Assessment of task fulfilment	
	K6_W10		The student has knowledge of the structure and principles of operation of the basic types of bioreactors			[SW3] Assessment of knowledge contained in written work and projects	

Subject contents	Mass and heat balances and microbial growth models. Mass exchange kinetics in batch, semi - continuous, continuous and continuous culture with biomass recirculation. Construction and operation of basic types of bioreactors. Deep and solid culture techniques. Residence time distribution functions in bioreactors. Mixing and aeration conditions in bioreactors. Sterilization methods. Foaming medium and foam removal methods. Principles of scal-up of bioreactors. Control of biotechnological processes.		
Prerequisites and co-requisites	Chemical and process engineering. Differential and integral calculus of probability . Selected problems of statistics. Gas and liquid properties. Physical chemistry. Process thermodynamics		
Assessment methods and criteria	Subject passing criteria	Passing threshold	Percentage of the final grade
	tests and reports	60.0%	50.0%
	Final test of the lecture	60.0%	50.0%
Recommended reading	Basic literature	Podstawy biotechnologii, C. Ratledge, B. Kristiansen, PWN, Warszawa, 2011 Podstawy biotechnologii przemysłowej, pr. zb. pod redakcją W.Bednarskiego i J.Fiedurka, WNT, Warszawa, 2006 Inżynieria biochemiczna, S. Aiba, A. Humphrey, N. Millis, WNT, Warszawa, 1977 Obliczenia w inżynierii bioreaktorów. J. Bałdyga, M. Henczka, W. Podgórska, Oficyna Wydawnicza PW, 2012 Podstawy inżynierii reaktorów chemicznych, J. Szarawara, WNT, Warszawa, 1991	
	Supplementary literature	Biochemical engineering, S. Katoh, J. Horiuchi, F. Yoshida , Wiley-VCH Verlag GmbH & Co., 2015 Chemical reaction engineering, O. Levenspiel, Wiley&Sons (3rd ed.), 1999	
	eResources addresses	Adresy na platformie eNauczanie: Bioreaktory Wykład 2023/24 - Moodle ID: 29900 https://enauczanie.pg.edu.pl/moodle/course/view.php?id=29900 Bioreaktory Wykład 2023/24 - Moodle ID: 29900 https://enauczanie.pg.edu.pl/moodle/course/view.php?id=29900	
Example issues/ example questions/ tasks being completed	1. Sketch a bioreactor with a mechanical agitator, thermostated by means of internal coils (water heating, water cooling) and with accessories ensuring the implementation of the basic functions of the bioreactor; Name the elements / modules and briefly describe their functions. Which performance parameters of a stirred tank bioreactor should be measured and automatically adjusted? 2. Write down the equation of the mass balance of biomass and the substrate limiting the growth of biomass for batch and fed-batch cultures with a constant nutrient supply. Present the course of balance equations on a suitable graph, justify their course. 3. Compare the course of the responses curve on the pulse input of tracer in the case of a reactor with ideal mixing reactor and a real signal response measured at the reactor outlet. Give the physical meaning of the function. Explain the reasons for the deviation of the experimental curve from its theoretical course.		
Work placement	Not applicable		