GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	Bioreactors, PG_00036863		
Field of study	Biotechnology		
Date of commencement of studies	October 2020	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	4	Language of instruction	Polish
Semester of study	7	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		

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	2.0	18.0	50

Subject objectives

Education in the field of biochemical reaction kinetics. Education in the field of bioreactor construction and techniques of microbial culture in a bioreactor. Mass exchange calculations. Scale up of bioreactors. Education in the scope of selected unit operations necessary to carry out the process in the bioreactor.

Learning outcomes

Course outcome	Subject outcome	Method of verification
K6_W08		
K6_U08	The student is able to select a bioreactor and analyze the course of industrial processes involving microorganisms.	
K6_U10	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).	

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 ofstatistics. 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 redakcj W.Bednarskiego i J.Fiedurka, WNT, Warszawa, 2006 In ynieria biochemiczna, S. Aiba, A. Humphrey, N. Millis, WNT, Warszawa, 1977 Obliczenia w in ynierii bioreaktorów. J. Bałdyga, M. Henczka, W. Podgórska, Oficyna Wydawnicza PW, 2012 Podstawy in ynierii 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	

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