

Course Unit	Biotechnological processes		Field of study	Engineering and related technics	
Bachelor in	Biology and Biotechnology		School	School of Agriculture	
Academic Year	2019/2020	Year of study	2	Level	1-2
Type	Semestral	Semester	2	ECTS credits	6.0
Code	9029-510-2205-00-19				
Workload (hours)	162	Contact hours	T 30	TP -	PL 30
			TC -	S -	E -
			OT 4	O -	

T - Lectures; TP - Lectures and problem-solving; PL - Problem-solving, project or laboratory; TC - Fieldwork; S - Seminar; E - Placement; OT - Tutorial; O - Other

Name(s) of lecturer(s) António Manuel Coelho Lino Peres

Learning outcomes and competences

At the end of the course unit the learner is expected to be able to:

1. Identify and understand the processes involved in heat and mass transfer;
2. Determine the kinetic equation and its relation to microbial processes kinetics;
3. Identify batch reactors, steady-state flow reactors – mixed and plug flow reactors - and fed batch reactors;
4. Identify and understand the microbial growth stages in batch mode in the presence of one or multiple substrates;
5. Identify growth kinetics with substrate inhibition and/or product inhibition and/or toxics inhibition;
6. Identify the different types of products produced by microorganisms;
7. Calculate yields of batch cultures;
8. Know the main unit operations used for separation/purification of biotechnological products.

Prerequisites

Before the course unit the learner is expected to be able to:
Perform integral and differential calculus.

Course contents

Fundamentals of Heat and Mass Transfer; Chemical kinetics; Operation modes of reactors; Introduction to the Fermentation Process: stoichiometry and microbial processes kinetics, growth kinetics, type of products; yields; Separation processes.

Course contents (extended version)

1. Fundamentals of Heat and Mass Transfer;
2. Chemical kinetics:
 - Kinetic equations;
 - Order concept;
 - Kinetic constants.
3. Operation modes of reactors:
 - Batch reactors;
 - Steady-state flow reactors – mixed and plug flow reactors;
 - Fed batch reactors.
4. Introduction to the Fermentation Process:
 - Stoichiometry and processes kinetics taking place in the presence of one or multiple substrates;
 - Growth kinetics with substrate inhibition and product inhibition, or by toxic compounds;
 - Primary and secondary products;
 - Yields calculation.
5. Separation processes:
 - Filtration;
 - Centrifugation;
 - Lyophilization.

Recommended reading

1. Octave Levenspiel, 1999, "Chemical Reaction Engineering", 3rd Edition, John Wiley.
2. Fogler, H. S. , 1999, "Elements of Chemical Reaction Engineering", Prentice – Hall;
3. Stanbury, P. F. , Whitaker, A. and Hall, S. J. 1995, "Principles of Fermentation Technology", 2nd Edition, Elsevier Science Ltd. ;
4. Fonseca, M. M. e Teixeira, J. A. , 2007, "Reactores Biológicos: Fundamentos e Aplicações", Lidel;
5. Gomes de Azevedo, E. e Alves, A. M. , 2009, "Engenharia de Processos de Separação", Coleção Ensino da Ciência e da Tecnologia, IST Press.

Teaching and learning methods

Theoretical classes: exposure of the topics related to the program of the course; Practical classes: it is intended to solve exercises; Laboratory classes: several practical works will be performed.

Assessment methods

1. Final Evaluation - (Student Worker) (Final, Supplementary, Special)
 - Final Written Exam - 100%
2. Continuous Evaluation - (Regular, Student Worker) (Final, Supplementary)
 - Final Written Exam - 85%
 - Practical Work - 15%

Language of instruction

1. Portuguese
2. Portuguese, with additional English support for foreign students.

Electronic validation

António Manuel Coelho Lino Peres	Maria da Conceição Constantino Fernandes	Joaquina Teresa Gaudêncio Dias	José Alberto Cardoso Pereira
12-11-2019	12-11-2019	12-11-2019	17-11-2019