

Course Unit	Bioreactors	Field of study	Chemical Processes Technologies
Master in	Environmental Technology	School	School of Agriculture
Academic Year	2023/2024	Year of study	1
Type	Semestral	Semester	1
Workload (hours)	162	Contact hours	T - TP - PL - TC - S - E - OT - O -
		Level	2-1
		ECTS credits	6.0
		Code	1076-809-1101-00-23

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, Maria da Conceição Constantino Fernandes

#### Learning outcomes and competences

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

1. Identify the different phases through microbial growth in batch operation conditions, in the presence of one or multiple substrates;
2. To understand the effects of dilution rate in continuous operation;
3. Determine productivities of batch and continuous cultures;
4. Identify operation conditions for different products produced by microorganisms;
5. Knowing different types of reactors;
6. Identify operation conditions in terms of ideal conditions;
7. Recognize potentials uses of microorganisms in bioremediation, biotransformation and biodegrading

#### Prerequisites

Before the course unit the learner is expected to be able to:

concepts of Microbiology, Transfer Phenomena and Chemical Reaction Engineering.

#### Course contents

Part I – Microbiology Topics; Parte II- Bioreactors.

#### Course contents (extended version)

1. Module I Microbiology Topics:
  - Growing, physical-chemical factors, nutritional requirements.
  - Exponential growth, time of duplication, n<sup>o</sup> of generations
  - Microbiology of air, soil and water
  - Bioremediation, biodegradation, biotransformation: concepts and examples.
2. Module II Bioreactors:
  - Evolution of fermentation processes, flow diagrams, mode-operation bioreactors.
  - Material balance, kinetic of product, biomass formation and substrate consumption, yields
  - Monod equation
  - Operating modes: batch cultures, chemostat and "fed-batch"
  - Major types and comparison of biological reactors
  - Agitation and Aeration: Types of agitator, oxygen transfer
  - Scale-up
  - Residence time distribution: by-pass and dead-volume issues

#### Recommended reading

1. M. Nunes dos Santos, 1990, "Reactores Químicos", Fundação Calouste Gulbenkian;
2. Lima N, Mota M, 2003, "Biotecnologia- Fundamentos e Aplicações, Parte II- Biotecnologia Ambiental", Lidel;
3. Hurst CJ, Kmudsen GR, Mcherney MJ, Stetzenbach LD, Walter MV, 1997, "Manual of Environmental Microbiology", ASM Press. Washington;
4. Stanbury, P. F. and Whitaker, A. , 1984, "Principles of Fermentation Technology", Pergamon Press;
5. Bailey, J. E. and Ollis, D. F. , 1987, "Biochemical Engineering Fundamentals", McGraw;

#### Teaching and learning methods

Theoretical lessons - the professor will present the diverse subjects, using the expositive method and in diverse situations the demonstrative method; Practical lessons - resolution of exercises

#### Assessment methods

1. Intermediate written tests, - (Regular, Student Worker) (Final)
2. Final written exam. - (Regular, Student Worker) (Supplementary, Special)

#### Language of instruction

1. Portuguese
2. Spanish

#### Electronic validation

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16-01-2024	16-01-2024	22-01-2024	22-01-2024