

2024/2025

Engenharia da Biorreação e Engenharia Bioquímica **Bioreaction Engineering and Biochemical Engineering**

Prof. Filomena Freitas

Prof. Maria Ascensão Reis

Objetivos / Objectives

- Desenvolver processos em reatores onde a velocidade da reação é controlada por cinética bioquímica.
Develop processes in reactors where the reaction speed is controlled by biochemical kinetics.
- Desenvolver e operar processos industriais de base biotecnológica.
Develop and operate biotechnology-based industrial processes.

I- Bioreactor analysis and operation

- 1.1- Determination of stoichiometric and kinetic parameters.
 - 1.1.1- Stoichiometry coefficients for cell growth and product formation (elemental and electron balances, biomass yield and oxygen demand)
 - 1.1.2- Microbial growth kinetics
 - 1.1.3- Product formation and substrate consumption;
- 1.2- Batch reactor, stirred tank reactor (CSTR), fed-batch and plug flow (PFR)
 - 1.2.1- Material balances;
 - 1.2.2- Steady state reactor operation;
 - 1.2.3- Design and optimization of reactor operation;

II- Mass transfer in aerated bioreactors

- 2.1- Principles of gas-liquid mass transfer;
- 2.2- Material balances in aerated bioreactors;
- 2.3- Type of aerated bioreactors;
 - 2.3.1- Bubble columns
 - 2.3.2- Mechanical agitated bioreactors;
- 2.4- Determination of hold up and interfacial area;
- 2.5- Experimental determination of gas-liquid transfer coefficient; use of correlations.

III- Heat transfer in bioreactors

- 3.1- Heat balances and determination of heat transfer coefficient
- 3.2- Media sterilization. Batch and continuous sterilization.

IV- Examples of Industrial bioprocesses

Bibliografia / Bibliography

Bailey J.E. and Ollis D.F. (1986) Biochemical Engineering Fundamentals. McGraw-Hill, New York, USA.

Nielsen J. and Villadsen J. (2011) Bioreaction Engineering Principles. Plenum Press. New York, USA

Doran P.M. (2012) Bioprocess Engineering Principles, Academic press, London

Metodologias de ensino / Teaching methodologies

- **Aulas teóricas** (2× 1 h semanais)
Theory classes (2× 1 h per week)
- **Aulas teórico-práticas** (resolução de problemas) (2 turnos EB + 1 turno EBq)
Theoretical-practical classes (problems solving) (2 shifts EB + 1 Shift EBq)
- **Aulas práticas, uma aula de laboratório, 4 horas**
Practical classes, one laboratory work, 4 hours

Aulas teórico-práticas / Theoretical-practical classes

	2ª	3ª	4ª	5ª
8:00				
9:00				
9:00		EB tp.1 Ed 7: 3.4/Ed.VII	EB tp.2 ED 3: 102/Ed.III	
10:00				
10:00				
11:00				
11:00				
12:00				
12:00				
13:00				EBq t.1 Ed 7: 1C/Ed.VII
13:00				EB t.1 Ed 7: 1C/Ed.VII
14:00				
14:00	EBq t.1 Ed D: 2.2/Ed.Depart.	EB t.1 Ed D: 2.2/Ed.Depart.	EBq tp.1 Ed 4: 110/Ed.IV	
15:00				
15:00				
16:00				
16:00				
17:00				

- **Resolução de Problemas**
Problem solving
- **Folhas de Problemas e respetivas soluções disponibilizadas no CLIP**
Problem Sheets and respective solutions available in CLIP

Aulas práticas / Practical classes

- Aulas decorrem entre **25 de outubro e 8 de novembro**
Between 25 October and 8 November
- Cada aluno realiza **1 trabalho experimental**, integrado num grupo de 3/**4 alunos**
Each student does 1 laboratory work, in a group of 4 students
- EB: 8 turnos + EBq: 2 turnos
EB: 8 shifts + Ebq: 2 shifts
- Cada turno: 9-12 alunos
Each Shift: 9-12 students

Aulas práticas / Practical classes

Shifts:

EB

P1 - 28 oct (8-12H)

P2 – 4 nov (8-12H)

P3 - 30 oct (14-18H)

P4 – 6 nov (14-18H)

P5 - 30 oct (8-12H)

P6 – 6 nov (8-12H)

P7 - 31 oct (8-12H)

P8 – 7 nov (8-12H)

EBq

P1 – 25 oct (8-12H)

P2 – 8 nov (8-12H)

Questions?

Contact Prof. Filomena Freitas

a4406@fct.unl.pt

Métodos de avaliação / Evaluation methods

- Execução de um **trabalho experimental**, elaboração e **discussão** de um **relatório**
Execution of experimental work, preparation and discussion of a report

- Realização de **dois testes** / two tests
ou / or

Exame final / final exam

Tests :

Test 1 – 28 October (14:00 – 15:00)

Test 2 - 28 November (12:30 – 13:30)

Aprovação à disciplina tem de obedecer simultaneamente aos seguintes 3 critérios:

Approval of the course must simultaneously meet the following 3 criteria:

- 1- A média aritmética dos 2 testes (ou a nota do exame) tem de ser maior ou igual a 9,5 valores

The average of the 2 tests (or the exam grade) must be greater than or equal to 9.5 values

- 2- Realização do trabalho de laboratório, avaliação e discussão do relatório com nota maior ou igual a 9,5 valores

Carrying out laboratory work, evaluation and discussion of the report with a grade greater than or equal to 9.5

- 3- A nota final ponderada (60% dos testes + 40% do trabalho de laboratório) tem de ser maior ou igual a 9,5 valores

The weighted final grade (60% of the tests + 40% of the laboratory work) must be greater than or equal to 9.5 values