# Course guide
# 330455 - BI - Biotechnology

**Last modified:** 04/05/2023

**Unit in charge:** Manresa School of Engineering
**Teaching unit:** 750 - EMIT - Department of Mining, Industrial and ICT Engineering.

**Degree:** **Academic year:** 2023 **ECTS Credits:** 6.0
**Languages:** Catalan

## LECTURER

**Coordinating lecturer:** Dorado Castaño, Antonio David

**Others:** Gamisans Noguera, Xavier

## DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

**Specific:**
1. Understand the biochemical and microbiological bases of industrial biotechnological processes.
2. Use and solve enzymatic kinetic equations and microbial growth
3. Distinguish the differential characteristics of bioreactors.

**Transversal:**
4. EFFICIENT ORAL AND WRITTEN COMMUNICATION - Level 3. Communicating clearly and efficiently in oral and written presentations. Adapting to audiences and communication aims by using suitable strategies and means.
5. SELF-DIRECTED LEARNING - Level 3. Applying the knowledge gained in completing a task according to its relevance and importance. Deciding how to carry out a task, the amount of time to be devoted to it and the most suitable information sources.
6. EFFECTIVE USE OF INFORMATI0N RESOURCES - Level 3. Planning and using the information necessary for an academic assignment (a final thesis, for example) based on a critical appraisal of the information resources used.

## TEACHING METHODOLOGY

Explanatory classes in which the contents of the subject will be treated with the support of PowerPoint presentations. The active participation of the students in class will be encouraged in various ways: inviting students to highlight the most relevant points discussed in class or to answer questions related to the contents explained. In the exercises and problems classes, problems and exercises will be solved that the student will have previously available the statement and will have tried to solve independently. The students will be able to comment on the doubts that have arisen in the realization of the same ones. On some occasions the students will be asked to develop the problems on the board.

Problems or exercises related to the specific objectives of the content will be proposed, which the student will have to solve individually outside of class and deliver to the teacher. These will be part of the continuous evaluation (Activity 1: evaluable problems / exercises). Once the problems have been corrected by the teacher, they will be returned, they will be solved in class and the debate will be promoted among the students with the aim of creating learning situations (analysis, discussion, synthesis), improving the communicative capacity provided at the same time a more effective feedback than that obtained only with the delivery of the problems corrected by the teacher.

## LEARNING OBJECTIVES OF THE SUBJECT

After taking the subject of Biotechnology Fundamentals, the student must be able to:
- Differentiate the types of microorganisms involved in biotechnological processes and distinguish their metabolic characteristics.
- Understand the growth of microbial populations.
- Apply the enzymatic kinetic equations and bacterial growth.
- Calculate material and energy balances in biological processes.
- Distinguish the types of bioreactors and evaluate the transport phenomena involved in their design.
- Choose the appropriate techniques for separating products obtained by biotechnological processes.

## STUDY LOAD

| Type | Hours | Percentage |
|---|---|---|
| Self study | 90,0 | 60.00 |
| Hours large group | 45,0 | 30.00 |
| Hours medium group | 15,0 | 10.00 |

**Total learning time:** 150 h

## CONTENTS

### Content 1: Fundamentals of Biochemistry and Microbiology

**Description:**
- BIOCHEMICAL ENGINEERING AND BIOTECHNOLOGY
Introduction to biotechnology.
Biomolecules: characteristics and functions of carbohydrates, lipids, proteins and nucleic acids.
Examples of biotechnological processes of industrial interest.
- ENZYMES
Fundamental characteristics.
Kinetic enzyme.
Inhibition.
- MICROORGANISMS WITH INDUSTRIAL APPLICATION
Levels of cellular organization.
Characteristics of microorganisms with industrial application.

**Related activities:**
- Lectures with active participation of students.
- Problem solving and exercises in class (large and small group).
- Problems and / or exercises (forms part of assessable activity 1).
- Individual test (these contents will be part of activity 2)
- Visits to industries (activity 4).

**Full-or-part-time:** 36h
Theory classes: 12h
Practical classes: 4h
Self study : 20h

**Content 2: Metabolism and Growth of microorganisms**

**Description:**
- NUTRITION AND METABOLISM OF MICROORGANISMS
Concepts of nutrition and metabolism. Catabolism and anabolism.
Nutritional types of microorganisms.
Aerobic and anaerobic respiration. Fermentations.
- GROWTH OF MICROORGANISMS
Culture media.
Growth measure.
Environmental effects on growth.
Growth kinetics.
Cell performance and maintenance.
Growth and product formation stoichiometry.

**Related activities:**
- Lectures with active participation of students.
- Problem solving and exercises in class.
- Problems and / or exercises (forms part of assessable activity 1).
- Individual test (this content is part of assessable activity 2).
- Visits to industries (activity 4).

**Full-or-part-time:** 64h
Theory classes: 18h
Practical classes: 6h
Self study : 40h

**Content 3: Bioreactors**

**Description:**
- BASIC ASPECTS OF THE BIOREACTOR
Types of bioreactors.
Balances of matter and energy.
Instrumentation and control.
Aeration.
Agitation.
Sterilization.
- PRODUCT RECOVERY
Cell disruption.
Filtration, sedimentation and centrifugation.
Concentration: extraction and absorption.
Product purification.

**Related activities:**
- Lectures with active participation of students.
- Problem solving and exercises in class.
- Problems and / or exercises (forms part of assessable activity 1).
- Individual test (this content will be part of assessable activity 3).
- Visits to industries (activity 4).

**Full-or-part-time:** 50h
Theory classes: 15h
Practical classes: 5h
Self study : 30h

## ACTIVITIES

### ACTIVITY 1: PROBLEM RESOLUTION AND / OR EXERCISES

**Description:**
For each content, problem solving and / or exercises by the student body, proposed by the teacher. Correction by the teacher who will return it evaluating the results and conclusions with the students.

**Specific objectives:**
Upon completion of this activity, the student should be able to:
Understand, apply, analyze and discuss the theoretical concepts of the related content.

**Material:**
Statements of the problems and / or exercises available on the ATENEA digital campus.
Power-Point Presentations.
Recommended bibliography.
Exercises solved in class.

**Delivery:**
Delivery of the solution of the problems and / or exercises proposed in writing.

**Full-or-part-time:** 42h
Practical classes: 6h
Self study: 36h

### ACTIVITY 2: INDIVIDUAL ASSESSMENT TEST 1

**Description:**
Individual test in class with a part of theoretical concepts and problem solving and / or questions related to contents 1 and 2 of the subject.

**Specific objectives:**
Evaluate the general assimilation of the objectives of contents 1 and 2.

**Material:**
Statements and calculator to carry out the tests.

**Delivery:**
Resolution of the evidence and presentation in writing.

**Full-or-part-time:** 33h
Practical classes: 3h
Self study: 30h

### ACTIVITY 3: INDIVIDUAL EVALUATION TEST 2

**Description:**
Individual test in class with a part of theoretical concepts and problem solving and / or questions related to content 3 of the subject.

**Specific objectives:**
Evaluate the general assimilation of the content objectives 3.

**Material:**
Statements and calculator to carry out the tests.

**Delivery:**
Resolution of the test and presentation in writing.

**Full-or-part-time:** 23h
Practical classes: 3h
Self study: 20h

### ACTIVITY 4: INDUSTRY VISIT

**Description:**
Visit to an industry that uses biotechnological processes in its production lines.

**Specific objectives:**
Evaluate the degree of benefit of the visit to the industry.

**Material:**
Statements and notes collected by the student during the visit.
Specific bibliography of the industrial sector.

**Delivery:**
Resolution of a questionnaire on the visit to the biotechnology industry and written presentation.

**Full-or-part-time:** 7h
Practical classes: 3h
Self study: 4h

## GRADING SYSTEM

The final grade is obtained by applying the following percentages:
Exercises and / or problems (evaluable activity 1) 15%
Individual test (evaluable activity 2) 40%
Individual test (evaluable activity 3) 40%
Visits questionnaire (evaluable activity 4) 5%

## EXAMINATION RULES.

- Deliver, according to the conditions required by the teacher, the problems and / or continuous assessment exercises.
- Compulsory attendance at visits to industries and completion of questionnaires.
- Solve and deliver the two individual continuous assessment tests.

## BIBLIOGRAPHY

**Basic:**
- López Santín-Bellaterra, José; Casas Alvero, Carles; Gòdia i Casablancas, Francesc. Ingeniería bioquímica. Madrid: Síntesis, 1998. ISBN 8477386110.
- Schaechter, M., i altres. Microorganismes [on line]. Barcelona: Reverté, 2008 [Consultation: 07/06/2022]. Available on: https://www-ingebook-com.recursos.biblioteca.upc.edu/ib/NPcd/IB_BooksVis?cod_primaria=1000187&codigo_libro=6598. ISBN 9788429118605.
- Bailey, James Edwin; Ollis, David F. Biochemical engineering fundamentals. 2nd ed. New York: McGraw-Hill, cop. 1986. ISBN 0070032122.
- Doran, Pauline M. Bioprocess engineering principles [on line]. London: Academic Press, 1995 [Consultation: 10/06/2022]. Available on: https://www-sciencedirect-com.recursos.biblioteca.upc.edu/book/9780122208515/bioprocess-engineering-principles. ISBN 0122208560.
- Díaz Fernández, Mario. Ingeniería de bioprocesos. Madrid: Paraninfo, 2012. ISBN 9788428381239.
- Ingraham, John L.; Ingraham, Catherine A. Introducció a la microbiologia. Barcelona: Reverté, 1999. ISBN 8429118691.
- Najafpour, Ghasem D. Biochemical engineering and biotechnology [on line]. Amsterdam: Elsevier, 2007 [Consultation: 10/06/2022]. Available on: https://www-sciencedirect-com.recursos.biblioteca.upc.edu/book/9780444633576/biochemical-engineering-and-biotechnology. ISBN 9780444528452.

**Complementary:**
- Rittmann, Bruce E.; McCarty, Perry L. Environmental biotechnology: principles and applications. Boston: McGraw-Hill, 2001. ISBN 0071181849.
- Scragg, A. H. Biotecnología para ingenieros: sistemas biológicos en procesos tecnológicos. México: Limusa, 1996. ISBN 9681847083.
- Nelson, David L.; Cox, Michael M.. Lehninger principios de bioquímica. 7ª ed. Barcelona: Omega, 2018. ISBN 9788428216678.

## RESOURCES

**Other resources:**
Teaching digital material (Power Point Presentations).
Collection of Exercises.
Virtual digital support (Athena).
The physical space (the classroom with a blackboard and audiovisual support to teach the classes).