

Course guide

330455 - BI - Biotechnology

Last modified: 25/04/2024

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

Degree: BACHELOR'S DEGREE IN CHEMICAL ENGINEERING (Syllabus 2016). (Compulsory subject).

Academic year: 2024 **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 INFORMATION 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:

- Ingraham, John L.; Ingraham, Catherine A. Introducció a la microbiologia. Barcelona: Reverté, 1999. ISBN 8429118691.
- 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.
- López Santín-Bellaterra, José; Casas Alvero, Carles; Gòdia i Casablanques, Francesc. Ingeniería bioquímica. Madrid: Síntesis, 1998. ISBN 8477386110.
- 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.
- Díaz Fernández, Mario. Ingeniería de bioprocesos. Madrid: Paraninfo, 2012. ISBN 9788428381239.
- 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.

Complementary:

- Nelson, David L.; Cox, Michael M.. Lehninger principios de bioquímica. 7ª ed. Barcelona: Omega, 2018. ISBN 9788428216678.
- 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.

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).