Course guide
295551 - 295EQ011 - Biotech Processes and Polymer Industry

Last modified: 14/06/2023

Unit in charge: Barcelona East School of Engineering
Teaching unit: 713 - EQ - Department of Chemical Engineering.

Degree: ERASMUS MUNDUS MASTER'S DEGREE IN ADVANCED MATERIALS SCIENCE AND ENGINEERING (Syllabus 2014). (Optional subject).
MASTER'S DEGREE IN CHEMICAL ENGINEERING (Syllabus 2019). (Compulsory subject).
ERASMUS MUNDUS MASTER'S DEGREE IN ADVANCED MATERIALS SCIENCE AND ENGINEERING (Syllabus 2021). (Optional subject).

Academic year: 2023 **ECTS Credits:** 6.0 **Languages:** English

LECTURER

Coordinating lecturer: NURIA SAPERAS PLANA

Others: Primer quadrimestre:
NÚRIA BORRÀS CRISTÒFOL - Grup: T11, Grup: T12
NURIA SAPERAS PLANA - Grup: T11, Grup: T12
DAVID ZANUY GOMARA - Grup: T11, Grup: T12

REQUIREMENTS

A lab coat is required for the laboratory sessions (see activity 1). Attendance to these sessions is mandatory.

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:
CEMUEQ-01. To apply knowledge of mathematics, physics, chemistry, biology and other natural sciences, obtained through study, experience and practice, with critical reasoning, to establish economically viable solutions to technical problems
CEMUEQ-02. To design products, processes, systems and services of the chemical industry, as well as the optimization of others already developed, taking as a technological base the various areas of chemical engineering, including processes and transport phenomena, separation operations and engineering of chemical, nuclear, electrochemical and biochemical reactions

Generical:
CGMUEQ-02. To conceive, project, calculate and design processes, equipment, industrial facilities and services, in the field of chemical engineering and related industrial sectors, in terms of quality, safety, economy, rational and efficient use of natural resources and environment conservation

Transversal:
05 TEQ. TEAMWORK. Being able to work as a team player, either as a member or as a leader. Contributing to projects pragmatically and responsibly, by reaching commitments in accordance to the resources that are available.
03 TLG. THIRD LANGUAGE. Learning a third language, preferably English, to a degree of oral and written fluency that fits in with the future needs of the graduates of each course.

TEACHING METHODOLOGY

- Lectures using both audiovisual media and the blackboard, and encouraging students' participation.
- Problems and cases to solve individually or in small groups.
- Laboratory classes. The experimental techniques will not be presented separately but integrated as part of a project that the student will develop throughout the sessions.

LEARNING OBJECTIVES OF THE SUBJECT

To provide future engineers with the basic knowledge and tools that will allow them to understand, interact and easily integrate in any biotechnological industry and polymer industry.

STUDY LOAD

Type	Hours	Percentage
Hours large group	12,0	8.00
Hours small group	42,0	28.00
Self study	96,0	64.00

Total learning time: 150 h

CONTENTS

1. Introduction to biotechnology and biomolecules

Description:
Definition, development and main areas of application of biotechnology. Organization and chemical composition of the cell. Organisms of biotechnological interest. Introduction to biomolecules (carbohydrates, lipids, proteins and nucleic acids). Examples of biochemical or biotechnological interest. Enzymes. Genetic engineering.

Specific objectives:
- To get an overview of the different fields of application of biotechnology and the role an engineer can play.
- To understand the basic organization of living beings, especially those of biotechnological interest.
- To know the structure and function of the main types of biomolecules and learn that they can be used for technological purposes.

Related activities:
Activity 1.

Full-or-part-time: 35h
Theory classes: 14h
Self study : 21h

2. Upstream and downstream bioprocessing. Examples of different biotechnology industries/applications

Description:
Metabolism: types and regulation. Respiration and fermentation. Industrial culture of microorganisms. Media. Bioreactors. Enzyme technology. Recovery of products. Specific applications of the biotechnology in the food industry, pharmaceutical/medical industry, chemical industry, energy production and environmental biotechnology.

Specific objectives:
- To understand the metabolic diversity of the organisms used in biotechnology and how this knowledge can be used sometimes to increase their productivity.
- To learn the different types of industrial culture of microorganisms and its main goals.
- To know some of the main types of bioreactors and their differences compared to chemical reactors.
- To know the main steps required for the recovery of bioproducts and understand the main differences between bioseparation and chemical separation processes.
- To get acquainted with the main areas of application and industries involved with biotechnology.

Related activities:
Activity 1.

Full-or-part-time: 35h
Theory classes: 14h
Self study : 21h

3. Introduction to the polymer industry and polymer chemistry

Description:
Introduction to polymers. The petrochemical industry. Chemical polymers versus biopolimers.
Composition, constitution and configuration. Molecular weights and distribution. Classification and nomenclature. Characterization of the chemical structure: chromatography, FTIR and RMN spectroscopies. Methods of polymerization. Polycondensation, polyaddition and others.

Specific objectives:
- To know and understand the chemical structure of polymers, how to determine it and how it is related to the polymer behavior.
- To get a basic knowledge of the procedures used for the synthesis of polymers.

Related activities:
Activity 1.

Full-or-part-time: 25h
Theory classes: 10h
Self study : 15h

4. Common use and technological polymers

Description:
Carbon chain thermoplastics: polyethylene, polypropylene, acrylic polymers, polyvinyl chloride, fluorinated polymers. Heterochain thermoplastics: polyamide, polyesters, high performance polymers. Elastomers and resins. Chemical modification and degradation.

Specific objectives:
- To know the properties and applications of the synthetic polymers most frequently used.
- To know the degradation processes that affect polymers in their use and recycling

Related activities:
Activity 1.

Full-or-part-time: 25h
Theory classes: 10h
Self study : 15h

GRADING SYSTEM

Qualification will be based on a continuous evaluation system:
There will be 4 exams during the course (2 corresponding to the biotechnology block, and 2 to the polymers block). Each exam will account for 20% of the final mark.
For the evaluation of the practical sessions, a written report will be required, which will account for the remaining 20% of the final mark.
To benefit from this continuous assessment system, it is mandatory to attend all the evaluation acts. Otherwise, or in case of failing the course, the student will have to attend a final exam.

Final exam: A final exam on the whole subject will be held for those who fail the course or do not follow the continuous assessment system. This exam will account for 80% of the final mark, the remaining 20% coming from the practical sessions mark. Keep in mind that lab sessions are mandatory.

There will be no reassessment exam.

BIBLIOGRAPHY

Basic:
- Ratledge, Colin; Kristiansen, B. Basic biotechnology. 3rd ed. Cambridge: Cambridge University Press, 2006. ISBN 0521549582.
- Madigan, Michael T. [et al.]. Brock biología de los microorganismos. 14a ed. Madrid [etc.]: Pearson Educación, cop. 2015. ISBN 9788490352793.
- Carraher, Charles E., Jr. Seymour/Carraher's polymer chemistry. 7th ed. Boca Raton, FL: CRC Press, cop. 2008. ISBN 9781420051025.
- Fitch, J. Patrick. An engineering introduction to biotechnology. Bellingham (Wash.): SPIE Press, cop. 2002. ISBN 0819444979.
- Smith, John E. Biotechnology. 5th ed. Cambridge [etc.]: University Press, 2009. ISBN 9780521711937.
- Fried, Joel R. Polymer science and technology. 3rd ed. Upper Saddle River: Prentice Hall, cop. 2014. ISBN 9780137039555.
- Painter, Paul C.; Coleman, Michael M. Essentials of polymer science and engineering. Lancaster: DEStech Publications, cop. 2009. ISBN 9781932078756.
- Glazer, Alexander N; Nikaido, Hiroshi. Microbial biotechnology : fundamentals of applied microbiology. 2nd ed. Cambridge: Cambridge University Press, cop. 2007. ISBN 9780521842105.

Complementary:
- Lendlein, Andreas; Sisson, Adam L. Handbook of biodegradable polymers : synthesis, characterization and applications [on line]. 2011. Weinheim, Germany: Wiley-VCH, cop. 2011 [Consultation: 13/05/2020]. Available on: https://onlinelibrary.wiley.com/doi/book/10.1002/9783527635818. ISBN 9783527324415.
- Recasens Baxarías, Francisco J. Processos de separació de biotecnologia industrial [on line]. 2a ed. Barcelona: Universitat Politècnica

de Catalunya. Iniciativa Digital Politècnica, 2017 [Consultation: 13/05/2020]. Available on: ttp://hdl.handle.net/2117/100733.