Universitat Autònoma de Barcelona

2021/2022

Advanced Biochemical Engineering

Code: 102410
ECTS Credits: 9

Degree	Type	Year	Semester
2500897 Chemical Engineering	OT	4	0

The proposed teaching and assessment methodology that appear in the guide may be subject to changes as a result of the restrictions to face-to-face class attendance imposed by the health authorities.

Contact

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Use of Languages

Principal working language: catalan (cat)
Some groups entirely in English: No
Some groups entirely in Catalan: Yes
Some groups entirely in Spanish: No

Prerequisites

The syllabus does not determine any specific prerequisite for this subject. However, due to its integrating nature of the different knowledge acquired throughout previous courses, the recommendation is to have passed the maximum number of subjects possible before taking it. In any case, it is essential to have complete the optative course Enginyeria Bioquímica

Objectives and Contextualisation

Introduce to the student the concepts and practice of the bioprocesses and embedding of a set of unit operations (steps of the process) for the production of a product, service or desired at a cost and acceptable quality.

Acquire understanding and practice in the analysis and design of biotechnological processes in terms of engineering, economics, compliance with regulations, quality, intellectual property, etc.

Introduce to the student the most important steps and tools used in the analysis and be able to use these tools in the evaluation and comparison of different solutions (proposals) of design of a specific process.

Overall, it is a subject that intends to integrate / synthesize knowledge of the different scientific disciplines and engineering acquired in other subjects of the degree for the design of bioprocesses.

Competences

- Analyse the economic feasibility of an industrial chemical engineering project.
- Analyse, evaluate, design and operate the systems or processes, equipment and installations used in chemical engineering in accordance with certain requirements, standards and specifications following the principles of sustainable development.
- Apply relevant knowledge of the basic sciences, such as mathematics, chemistry, physics and biology, and the principles of economics, biochemistry, statistics and material science, to comprehend, describe and resolve typical chemical engineering problems.
- Apply the techniques for analysing and synthesising systems to process and product the engineering.
- Communication

- Demonstrate knowledge of the different reaction, separation and processing operations for materials, and transport and circulation of fluids involved in the industrial processes of chemical engineering.
- Develop personal attitude.
- Develop personal work habits.
- Develop thinking habits.
- Evaluate, in a structured and systematic manner, the health and safety risks in an existing process or one in design phase, and apply the suitable measures to each situation.
- Objectively compare and select different technical options for chemical processes.
- Show an understanding of the role of chemical engineering in the prevention and resolution of environmental and energy problems, in accordance with the principles of sustainable development.
- Understand and apply the basic principles on which chemical engineering is founded, and more precisely: balances of matter, energy and thermodynamic momentum, phase equilibrium and kinetic chemical equilibrium of the physical processes of matter, energy and momentum transfer, and kinetics of chemical reactions

Learning Outcomes

1. Analyse the economic feasibility of an industrial biotechnology project.
2. Apply analysis techniques to bioprocess and bioproduct engineering.
3. Apply the main concepts of organising and managing a process.
4. Critically evaluate the work done.
5. Describe the bases of the integrated design of bioprocesses and particularly how different unitary operations of a bioprocess interact and the different stages of the development of the same (from the discovery of basic knowledge to the development of applications and marketing them).
6. Design and execute properly a protocol for the purification of a biotechnological product.
7. Develop critical thinking and reasoning
8. Develop curiosity and creativity.
9. Efficiently use ICT for the communication and transmission of ideas and results.
10. Identify and apply immobilisation systems and their operation modes.
11. Identify and apply the optimisation strategies of biotechnological processes and products.
12. Make structured evaluations of irrigation for the health and safety of a biotechnological process.
13. Properly apply biosafety requirements to the design of bioprocess operations.
14. Properly design and analyse a bioprocess for a certain product, in accordance with the requirements and application being made.
15. Propose the suitable design for a bioreactor and its application.
16. Resolve different problems of relevance to bioindustrial processes.

Content

1.- Introduction

Biochemical Engineering, Biotechnology, and Chemical Engineering. Biotechnology sectors

Historical perspective of biotechnological processes
Data of the Biotechnology sector

Actors of the biotechnology process: the products or services, the biocatalyst, the substrates, the bioreactor.

Parts of biotechnological processes: upstream, process, downstream

The pillars of the development of a bioprocess: economical, environmental, social

2.- Industrial biotechnology and energy

Products derived from energy and biosynthetic metabolism

Structural and functional products

Secondary Metabolites

3.- Human and animal health
Insulin
Therapeutic proteins. Monoclonal antibodies
Biosensors
Vaccines
Gene and cell therapies. Tissue engineering

4.- Food

Fermentation products: wine, beer, cava, bread dairy products

Use of enzymes.

Functional foods
Genetic improvements in food production

5.- Environmental biotecchnology

Biological processes of waste water treatment.

Processes with photosynthetic organisms.

Treatment of gaseous efluents
Bioremediation

Methodology

Theoretical classes may be taught in person or, if required, virtually, as a practice during the 2020-2021 academic year. In this case, the teacher will determine the modality that can be done (class with virtual platform like teams, preparation of video or powerpoint classes that are posted on the virtual campus). In addition to the theoretical classes, it will be seminars on specific aspects of biotechnological processes. The subject is given in the Moodle Classroom and all the materials used in the classes and seminars will be deposited, plus author articles that allow students who are not interested in deepening their knowledge in a specific topic.

Students, working in groups, will have to do a work on a biotechnological process, of their choice, which will be presented and discussed in the seminar sessions.

Annotation: Within the schedule set by the centre or degree programme, 15 minutes of one class will be reserved for students to evaluate their lecturers and their courses or modules through questionnaires.

Activities

Title	Hours	ECTS	Learning Outcomes
Type: Directed			
Theoretical classes	40	1.6	1, 13, 3, 2, 5, 8, 7, 14, 6, 10, 11, 15, 16, 12
Type: Supervised			
Seminars	15	0.6	1, 13, 3, 2, 5, 8, 7, 14, 6, 10, 11, 15, 16, 12
work in group	80	3.2	1, 13, 3, 2, 4, 5, 8, 7, 14, 6, 9, 10, 11, 15, 16, 12
Type: Autonomous			
self study	80	3.2	1, 13, 3, 2, 4, 5, 8, 7, 14, 6, 10, 11, 15, 16, 12

Assessment

During the course, 2 partial examsn will be performed. The first one corresponding to topics 1 and 2 (30% of the final mark). The second one corresponding to topics 3,4 and 5 (40% of the final mark).

Compulsory group work will represent 30% of the final mark.

To make the average with the rest of the notes, you must obtain a minimum mark in each part of 4 (out if 10)

For students not passing the partial examinations, and additional final examination will be performed, for the total of the topics.

Assessment Activities

Title	Weighting	Hours	ECTS	Learning Outcomes
Group work	30%	6	0.24	1, 3, 2, 4, 8, 7, 14, 6, 9, 11, 15, 16, 12
partial exams (2)	70%	4	0.16	1, 13, 3, 2, 5, 8, 7, 14, 6, 10, 11, 15, 16, 12

Bibliography

Couse textbook:

Development of Sustainable Bioprocesses. (2006). E. HEINZLE, A.P. BIWER, C.L. COONEY. John Wiley & Sons Ltd, UK. ISBN-10 0-470-01559-4

Related texbooks:

Microbial Biotechnology.Fundamentals of Applied Microbiology (2007). Second Edition Alexander N. Glazer and Hiroshi Nikaido. CambridgeUniversity Press. ISBN-13 978-0-511-34136-6

Modern Industrial Microbiology and Biotechnology. (2007). Nduka Okafor. Science Publishers. USA. ISBN 978-1-57808-434-0 (HC)

Industrial Pharmaceutical Biotechnology. Heinrich Klefenz (2002). Wiley-VCH Verlag GmbH. ISBNs: 3-527-29995-5 (HC)

Biopharmaceuticals. Biochemistry and Biotechnology. Second Edition (2003). Gary Walsh. John Wiley & Sons, Inc. UK. ISBN 0 470 84326 8 (ppc)

Pharmaceutical Biotechnology, Drug Discovery and Clinical Applications. O.Kayser and R.H.Muller. (2004). Wiley-VCH Verlag GmbH & Co. KGaA, Weinheim. ISBN: 3-527-30554-8

Enzymes in Food Technology. (2002).R.J. Whitehurst and B.A. Law. Sheffield Academic Press Ltd, UK. ISBN 1-84127-223-X

Food Biotechnology. Second Edition (2006). Kalidas Shetty, Gopinadhan Paliyath, Anthony Pometto, Robert E. Levin. CRC Press.Taylor & Francis Group. Boca Raton, FL33487-2742

Wastewater Microbiology. (2005). Gabriel Bitton. Third Edition. John Wiley & Sons, Inc. UK.

WEBs: Fundación Genoma España: http://www.gen-es.org/

Software

No specificc software