Universitat Autònoma de Barcelona

2019/2020

Advanced Biochemical Engineering

Code: 102410
ECTS Credits: 9

Degree	Type	Year	Semester
2500897 Chemical Engineering	OT	4	0

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, they are essential to be able to properly track the subjects of the biochemical engineering itinerary.

Objectives and Contextualisation

Introduce to the student the concepts and practice of the bioprocesses and embedding of a set of unit operations (stages 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 stages 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 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. "Relate and apply known concepts and methods from different subjects (from biology and biochemistry to the principles of chemical engineering) to the analysis and design of bioprocesses; know how, when and where to apply this acquired knowledge."
2. Analyse the economic feasibility of an industrial biotechnology project.
3. Apply analysis techniques to bioprocess and bioproduct engineering.
4. Apply the main concepts of organising and managing a process.
5. Correctly describe the diversity of separation processes on different scales.
6. Critically evaluate the work done.
7. Design and execute properly a protocol for the purification of a biotechnological product.
8. Develop critical thinking and reasoning
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. Use waste and energy consumption minimisation criteria in the design of separation operations.

Content

1.- Introduction

Biochemical, Biotechnology, and Chemical Engineering.

Process Diagrams

Block diagrams, flow diagrams, P & I, Diagrams of implementation

Historical perspective of biotechnological processes

Actors of the biotechnology process:

The products or services, the biocatalyst, the substrates, the bioreactor.

Parts of biotechnological processes

Upstream, process, downstream

Economic analysis as a basic criterion in the development and scaling of bioprocesses

Interrelation ofthe actors of the bioprocess

Environmental and social analysis

Project engineering, modeling and simulation of bioprocesses (Superpro dessigner, Microsoft project).

2.-Biochemical Engineering applied to human and animal health

Diagnosis and Monitoring:

Production of monoclonal antibodies and antigens.

Biosensors and analytical devices.

Therapy:

Therapeutic proteins and enzymes.

Genetic, cellular and tissue therapies.

Prophylaxis:

Conventional, recombinant and DNA vaccines.

3.- Biochemical engineering applied to industrial and energy processes

Products derived from energy and biosynthetic metabolism:

Alcohols, organic acids, fats, amino acids and vitamins.

Structural and functional products:

Polysaccharides, Polyesters: structure and applications, production.

Proteins and enzymes. Enzymatic processes.

Secondary Metabolites:

Antibiotics and pigments.

Insecticides

4.- Biochemical Engineering applied to food biotechnology and agronomy

Biomass for human and animal nutrition.

Fermentation products: Bread, pasta, wine, beer, cava, dairy products, fermented vegetables and meat.

Use of enzymes.

Flavors, smells and fragrances.

Transgenic and functional foods (nutraceuticals).

5.- Application of Biochemical Engineering in environmental biotechnology

Aerobic and anaerobic biological processes related to physicochemical treatments.

Processes with photosynthetic organisms.

Biorefineries

Biological life support: Life in extreme conditions and colonization of space.

Methodology

In addition to the theoretical classes, seminars will be held on specific aspects of biotechnological processes.

The subject is enrolled in the Moodle Classroom and will be deposited with all the materials used in classes and seminars, as well as some articles that will allow students who are interested in deepening their knowledge in a classroom. determined subject

Some of the classes can be done by professionals who work in the biotech industry, including visits to specific research groups in the biotechnology area.

Students, working in groups of 3 or 4, will have to work on a biotechnological process, of their choice, to present in writing and to be discussed in the seminar sessions.

Activities

Title	Hours	ECTS	Learning Outcomes
Type: Directed			
Theoretical classes	42	1.68	1, 2, 13, 5, 8, 14, 10, 16
Type: Supervised			
Seminars	15	0.6	1, 2, 13, 6, 5, 8, 14, 7, 9, 10, 16
work in group	80	3.2	1, 2, 13, 6, 5, 8, 14, 7, 9, 10, 16
Type: Autonomous			
self study	80	3.2	1, 2, 13, 5, 14, 7, 10, 16

Assessment

During the course, two written theoretical exams, previously announced, will be carried out, which will represent 30% of the final mark (total 60% of the mark, 6 points out of 10).

Compulsorygroup work will represent 40% of the final mark (4 points out of 10).

To make the average with the rest of the notes, you must obtain a minimum mark in each part of 40% of the mark (1.2 points the first written theoretical exams, 1.2 points in the second, 1.6 in group work).

For students who do not pass the written theoretical examinations there will be a recovery of the parts not approved only from the suspended part). The mark of each part is 30% of the final mark.A lo largo del curso se llevarán a cabo 2 exámenes teóricos escritos, anunciados previamente, que representarán cada uno de ellos un 30% de la nota final (en total el 60% de la nota, 6 puntos sobre 10).

Assessment Activities

Title	Weighting	Hours	ECTS	Learning Outcomes
Group work	40%	6	0.24	1, 2, 13, 4, 6, 5, 8, 14, 7, 9, 10, 11, 16, 12
partial exams (2)	30%	2	0.08	1, 2, 13, 4, 3, 5, 8, 14, 7, 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/