Industrial Production of Bioproducts. Design and Operation of Bioprocesses in Pilot Plant

Code: 42907
ECTS Credits: 9

2024/2025

Degree	Type	Year
4313772 Advanced Biotechnology	OT	0

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Teachers

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Teaching groups languages

You can view this information at the end of this document.

Prerequisites

To attend the module it is necessary to have a basic formation in Biochemical Engineering, in fundamental aspects of Bioprocess Engineering, in Bioreactors and some very basic concepts of recombinant DNA and Genetic Engineering.

Objectives and Contextualisation

The objective of this module is to familiarize the student with the most important tools used in a bioprocess, and its application in the design and operation of bioprocesses in their future professional careers. In order to achieve this objective, different cellular factories will be explored, designed, integrated and optimized for producing industrial biotechnological products, integrating the production and purification of the bioproduct in a reproducible way (BIOPAT concept) and economically viable Bioprocess Engineering. The quality and safety regulations of bioproducts from different fields will also be explained and the principles on which the scale up of a bioprocess is based will be presented.

Competences

- Continue the learning process, to a large extent autonomously.
- Integrate knowledge and use it to make judgements in complex situations, with incomplete information, while keeping in mind social and ethical responsibilities.
- Solve problems in new or little-known situations within broader (or multidisciplinary) contexts related to the field of study.
- Synthesise, weigh up alternatives and engage in critical discussion.
- Use acquired knowledge as a basis for originality in the application of ideas, often in a research context.
- Use advanced biotechnology tools in combination to solve problems in emerging areas of biotechnology.
- Use and manage bibliography and IT resources related to biotechnology responsibly.
- Work in a multidisciplinary team.

Learning Outcomes

1. Continue the learning process, to a large extent autonomously.
2. Define and protocolise experimenting and production in accordance with BPL, ISO and GMP norms. Write standard working protocols.
3. Describe PAT methodology.
4. Describe and apply the norms on correct production to safeguard human and animal health
5. Describe and apply the quality norms of a bioprocess.
6. Design and select the optimal operation strategy in bioreactors.
7. Design and select the optimal operation strategy in conventional bioreactors.
8. Design the main separation and purification operations in bioprocesses.
9. Identify the advantages, disadvantages and engineering of the bioprocess of mammal cells as a cell factory.
10. Identify the advantages, disadvantages and engineering of the bioprocess of the eukaryotic cell factory P.pastoris.
11. Identify the advantages, disadvantages and engineering of the bioprocess of the prokaryotic cell factory E. coli.
12. Identify, evaluate and calculate the different design parameters for non-conventional fixed bed, fluidised bed and air-lift bioreactors.
13. Integrate knowledge and use it to make judgements in complex situations, with incomplete information, while keeping in mind social and ethical responsibilities.
14. Recognise the problem of change of scale in biotechnology.
15. Recognise the work of a pilot fermentation plant and apply its working rules.
16. Solve problems in new or little-known situations within broader (or multidisciplinary) contexts related to the field of study.
17. Synthesise, weigh up alternatives and engage in critical discussion.
18. Use acquired knowledge as a basis for originality in the application of ideas, often in a research context.
19. Use and manage bibliography and IT resources related to biotechnology responsibly.
20. Work in a multidisciplinary team.

Content

1.- Introduction to the industrial production of bioproducts. Scale up in bioreactors

2.- Bioprocess design based on quality.

2.1.- Quality by Design (QbD) / Process Analytical Technology (PAT)

2.2.-Good Manufacturing Practice (GMPs). Good Laboratory Practices (BPLs),

3.-Cell factories: Animal cell culture

4.-Cell factories: *Pichia pastoris.*

5.-Cell factories: *Escherichia coli.*

6.- Case of study workshop

Activities and Methodology

Title	Hours	ECTS	Learning Outcomes
Type: Directed			
Case study workshop	20	0.8	1, 6, 7, 13, 14, 15, 16, 17, 18, 19
Lectures	33.5	1.34	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 13, 14, 15, 16, 17, 18, 19
seminars	4	0.16	1, 13, 16, 17, 18
Type: Supervised			
Workshop report	15	0.6	1, 2, 3, 4, 5, 9, 15, 17, 18, 20
group work	35	1.4	3, 9, 10, 11, 14, 15, 17, 18, 19, 20
Type: Autonomous			
Case study preparation	10	0.4	1, 2, 4, 5, 6, 13, 14, 15, 16, 18, 19
Search of documentation and bibliography	28	1.12	13, 16, 17, 18, 19, 20
Study	50	2	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 13, 14, 15, 16, 17, 18, 19
writing work and oral exposure	24.5	0.98	1, 13, 15, 16, 17, 18, 19, 20

Lectures on the topics of the syllabus.

Seminars on aspects of the industrial world of Biotechnology by experts invited from the sector.

Elaboration of gruop works. Group activity. Students will prepare a report on a topic related to the contents, at the teacher's proposal. These works will be exposed and defended in public.

Case study workshop. Students will carry out workshops on the different cell factories, consisting offamiliarization with a recombinant protein production process, cell cultures and bioprocess monitoring. In addition, a visit will be made to a biotechnology company related to the course theme.

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.

Assessment

Continous Assessment Activities

Title	Weighting	Hours	ECTS	Learning Outcomes

4 Writing exams	13,1% each	3	0.12	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19
Assesment of worshop	25	1	0.04	1, 2, 3, 4, 5, 11, 13, 14, 15, 16, 17, 18, 20
Assessment of oral presentation	22,5%	1	0.04	1, 13, 16, 17, 18, 19, 20

Evaluation of the theoretical part of the module:

Continuous assessment
Individual written evaluation: It is 70% of the final grade. Four partial tests corresponding to different subjects of the course are carried out with a weight of 25% each of them. If in the individual written evaluation the student obtained a grade lower than 3/10, he will not pass the module.

Evaluation of the defense and oral presentation of a research paper (30%)

Final evaluation:
Students who do not pass the continuous assessment will have a global test of written individual final recovery. Whenever this test is exceeded with a grade higher than 3/10, it will be done with the grade of the oral presentation.

Global evaluation of the module

Evaluation of workshop (25%).

Evaluation of the theoretical part of the module (75%). Minimum note of this part to approve trhe module 3.5/10

The calendar of exams and the different activities to be carried out in the module will be announced at the beginning of the course. Once scheduled, in no case will exams be held with different dates and times.

For the review of the results of the evaluations, the time and manner will be fixed within 10 working days after the communication of the results through the virtual platform. If the student does not show up for this review, this activity will not be subsequently reviewed.

Matriculation of Honor (MH). Awarding the grade of MH is the decision of the faculty responsible for the subject. UAB regulations state that MHs can only be awarded to students who obtain a final grade equal to or higher than 9.00. Up to 5% of the total number of students may be awarded MHs.

A student is considered as not evaluable (NA) if he/she has not shown up for any of the evaluation activities.

Regardless of other disciplinary measures that may be considered appropriate, irregularities committed by students that may result in a modification of the grade of an evaluation activity will be graded with a zero. Therefore, copying, plagiarism, cheating, allowing copying, etc... in any of the evaluation activities will imply a zero grade.

Bibliography

López Santín, Josep et al. Ingeniería bioquímica / Eds: Francesc Gòdia Casablancas, Josep López Santín. Madrid: Síntesis, 2010.

Bailey, James E. (James Edwin), and David F Ollis. Biochemical Engineering Fundamentals / James E. Bailey, David F. Ollis. 2nd ed. New York [etc: McGraw-Hill, 1986.

Doran, Pauline M. Bioprocess Engineering Principles. 2nd ed. San Diego: Elsevier Science & Technology, 2012.

Villadsen, John, ed. Fundamental Bioengineering / Ed. John Villadsen. 1st ed. Weinheim, Germany: Wiley-VCH, 2016.

Additional bibliography, mainly scientific articles, necessary for following the module can be consulted through the virtual platform. In parallel, the student will have to carry out specific bibliographic searches and consultations for the preparation of their group work.

Software

It is not planned to use any specific software for the subject.

Language list

Name	Group	Language	Semester	Turn
(PLABm) Practical laboratories (master)	1	Catalan	first semester	morning-mixed
(SEMm) Seminars (master)	1	Catalan	first semester	afternoon
(SEMm) Seminars (master)	2	Catalan	first semester	afternoon
(TEm) Theory (master)	1	Catalan	first semester	afternoon