

Degree programme	Type	Course
Biological and Environmental Engineering	OB	2

Contact lecturer

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Prerequisites

None

Group languages

You can consult this information at the [end](#) of the document.

Objectives

To combine chemical, biological and environmental engineering principles, tools and methodologies for the integrated design and intensification of processes, aiming to the design of economically, energetically and environmentally efficient and sustainable processes.

The learning objectives therefore include identifying and applying criteria (techno economic and environmental) and different approaches to define/select optimal sequences of operations for biotechnological and environmental processes, as well as their integration into biorefineries, with special emphasis in the separation operations and strategies for process intensification.

Learning outcomes

- CA13 (Compare the different stages of a process, selecting the sequencing as well the most appropriate alternatives.) Compare the different stages of a process, selecting the sequencing as well the most appropriate alternatives.
- CA14 (Optimise processes energetically from an integrated analysis thereof.) Optimise processes energetically from an integrated analysis thereof.
- KA09 (Contrast different separation sequences in the sustainable treatment of waste and in industrial biotechnology processes.) Contrast different separation sequences in the sustainable treatment of waste and in industrial biotechnology processes.
- SA13 (Design continuous-contact separation operations using appropriate mass transfer concepts.) Design continuous-contact separation operations using appropriate mass transfer concepts.
- SA14 (Solve design and operation problems through the analysis of separation operations in biotechnological and environmental processes.) Solve design and operation problems through the analysis of separation operations in biotechnological and environmental processes.
- SA15 (Apply methods, instruments and strategies to develop biotechnological processes and products while observing energy-saving and sustainability criteria.) Apply methods, instruments and strategies to develop biotechnological processes and products while observing energy-saving and sustainability criteria.

Contents

Unit 1: Introduction. Integrated process design and process intensification concepts. Biorefinery concept.

Unit 2: Bioreactors and operation. Industry 4.0.

Unit 3: Separation operation in biotechnological and environmental process engineering. Classification, equipment and use. Calculation methods for design of separation operations.

Unit 4: Integrated design of biotechnological and environmental processes. Design of biorefineries. Case studies.

Unit 5: Process intensification. Resources (energy, water, feedstocks) optimisation and waste minimization. Case studies.

Learning activities and methodology

Title	Hours	ECTS	Learning outcomes
Lectures	27	1.08	
Exercise-based and case study-based teaching	12	0.48	
Study	62	2.48	
Problem solving and work on case study	32	1.28	

Theory classes: Lectures and participation of invited speakers of interest to deliver specific seminars related to the subject.

Class discussion based on proposed readings about key case studies. The case studies introduced by the teaching staff will be worked on in student groups, who will be responsible for explaining and debating the key concepts of the case with the rest of the class.

Development of a group project in which students will select a process case study related to integrated bioprocesses or biorefineries and apply the concepts learned during the course to achieve a more efficient and sustainable production of the target products.

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

Continuous assessment activities

Title	Weight	Hours	ECTS	Learning outcomes
Participation in class and activities	10%	5	0.2	CA13, CA14, KA09, SA13, SA14, SA15
Written report case study	10%	8	0.32	CA13, CA14, KA09, SA13, SA14, SA15
Final exam (individual)	50%	2	0.08	CA13, CA14, KA09, SA13, SA14, SA15
Presentation and discussion case study	30%	2	0.08	SA14, SA15

A) Continuous assessment

The final grade for the course will be based on participation in class debates and activities, completion of a group project and oral presentation, and the final exam.

- Class participation: 10%
- Group project monitoring and final report: 10%
- Oral presentation of the group project: 30%
- Final exam: 50% - a minimum grade of 4/10 is required in the exam in order to average with the rest of the assessment elements.

B) Reassessment

Students who obtain a grade lower than 4 in the final exam, provided they have achieved an average score above 3 out of 10 in the remaining course activities, may take the resit exam scheduled in the academic calendar.

The reassessment only allows re-evaluation of the final exam component. The other assessment components are not eligible for reassessment.

C) Review of grades

For each assessment activity, a time, date, and location for grade review will be announced, during which the student may review the activity with the teaching staff. In this context, students may submit claims regarding the grade, which will be reviewed by the course instructors. If a student does not attend the scheduled review, the activity will not be reviewed later.

D) Grading

Honours Distinction (Matrícula d'Honor): The award of an Honours Distinction is at the discretion of the teaching staff. According to UAB regulations, MH can only be awarded to students who have achieved a final grade of 9.00 or higher. Up to 5% of enrolled students may receive this distinction.

Students who take the resit exam (partially or entirely) are not eligible for the Honours Distinction.

A student will be considered *Not Assessable (NA)* if they do not complete a set of activities accounting for at least two-thirds of the total course grade.

E) Irregularities by the student: copying and plagiarism

Without prejudice to other disciplinary measures that may be taken, any irregularities committed by a student that may affect the grade of an assessment activity will result in a grade of zero. This includes cheating, plagiarism, copying, allowing others to copy, etc. Such activities will not be eligible for reassessment. If passing the affected activity is required to pass the course, the course will be failed with no option for recovery during the academic year.

F) Single assessment

This course/module does not allow for a single assessment option.

Bibliography

On-line resources

Integrated Bioprocess Engineering

https://app.knovel.com/web/toc.v/cid:kpIBE0002U/viewerType:toc//root_slug:integrated-bioprocess-engineering?l

Industrial Biotechnology: Products and Processes.

<https://onlinelibrary.wiley.com/doi/book/10.1002/9783527807833>

Continuous Biomanufacturing - Innovative Technologies and Methods.

<https://onlinelibrary.wiley.com/doi/book/10.1002/9783527699902>

Other resources

- Belter PA, Cussler EL, Hu W-S. 1988. Bioseparations. Downstream processing for biotechnology. John Wiley & Sons. ISBN 0-471-84737-2.
- Blanch HW, Clark DS. 1996. Biochemical Engineering. Marcel Dekker. ISBN0-8247-8949-0.
- Heinzle E, Biwer A, Cooney C. 2006. Development of Sustainable Bioprocesses: Modelling and Assessment. John Wiley & Sons, Ltd.
- Harrison RG, Todd PW, Rudge SR, Petrides DP. 2015. Bioseparations Science and Engineering. Oxford University Press. ISBN 978-0-19-539181-7.
- Kamm B, Gruber PR, Kamm M (Eds.) 2006. Biorefineries -Industrial Processes and Products. Wiley-VCH Verlag. ISBN 3-527-31027-4.
- Marcilla Gomis A. 1999. Introducció a las operaciones de separación de contacto continuo. Publicacions de la Universitat d'Alacant.
- Shuler ML, Kargi F (Eds.) 2002. Bioprocess Engineering. Basic concepts. 2nd Edition. Prentice Hall PTR. ISBN 0-13-081908-5.
- Stuart RT, El-Halwagi MM. 2013. Integrated Biorefineries: Design, Analysis, and Optimization. CRC Press. ISBN 9781439803462.
- Ratledge C, Kristiansen B (Eds.) 2006. Basic Biotechnology. 3rd Edition. Cambridge University Press.
- Recasens Baxarias F. 2018. Procesos de separació de biotecnologia industrial. Publicacions Universitat Politècnica de Catalunya. Iniciativa Digital Politècnica ebook.
- Shri Ramaswamy; Bandaru V. Ramarao; Hua-Jiang Huang. 2013. Separation and Purification Technologies in Biorefineries. John Wiley & Sons Incorporated. ebook.

Software

No specific software used

Course groups and languages

The information provided is provisional until November 30. After this date, you will be able to consult the language of each group through this [link](#). To access the information, you will need to enter the course CODE

Type of teaching	Group	Language	Semester	Shift
(TEm) Theory (master)	1	Catalan	first semester	afternoon