Universitat Autònoma de Barcelona

2023/2024

Integrated Process Design

Code: 43327
ECTS Credits: 6

Degree	Type	Year	Semester
4314579 Biological and Environmental Engineering	OB	2	1

Contact

Name: Maria Teresa Gea Leiva

Email: teresa.gea@uab.cat

Teaching groups languages

You can check it through this link. To consult the language you will need to enter the CODE of the subject.
Please note that this information is provisional until 30 November 2023.

Prerequisites

None

Objectives and Contextualisation

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 (Competence) Compare the different stages of a process, selecting the sequencing as well the most appropriate alternatives.
- CA14 (Competence) Optimise processes energetically from an integrated analysis thereof.
- KA09 (Knowledge) Contrast different separation sequences in the sustainable treatment of waste and in industrial biotechnology processes.
- SA13 (Skill) Design continuous-contact separation operations using appropriate mass transfer concepts.

- SA14 (Skill) Solve design and operation problems through the analysis of separation operations in biotechnological and environmental processes.
- SA15 (Skill) Apply methods, instruments and strategies to develop biotechnological processes and products while observing energy-saving and sustainability criteria.

Content

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 biotechnolgical 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.

Methodology

Lectures: Master classes with ICT support.
Problem-solving-based and Case study-based teaching: Solving of problems in class and proposal of additional problems. In the case study-based teaching, students work together in small groups on a case study of an integrated bioprocess/biorefinery for the sustainable production of bio-based products (e.g. bioplastics, chemicals, biofuels, etc.), under the supervision of the professors. At the end of the case studies sessions, students will have to explain and discuss key concepts and design solutions with the rest of the class.

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			
Exercise-based and case study-based teaching	12	0.48	CA13, CA14, KA09, SA13, SA14, SA15, CA13
Lectures	27	1.08	CA13, KA09, SA14, SA15, CA13
Type: Autonomous			
Problem solving and work on case study	32	1.28	CA13, CA14, KA09, SA13, SA14, SA15, CA13
Study	62	2.48	CA13, CA14, KA09, SA14, SA15, CA13

Assessment

Please refer to the Catalan or Spanish version of this document

Assessment Activities

Title	Weighting	Hours	ECTS	Learning Outcomes
Final exam (individual)	40%	2	0.08	CA13, SA13, SA14, SA15
Participation in class and activities	20%	5	0.2	CA13, KA09, SA14, SA15
Presentation and discussion case study	20%	2	0.08	CA13, CA14, KA09, SA13, SA14, SA15
Written report case study	20%	8	0.32	CA13, CA14, KA09, SA13, SA14, SA15

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. Biosepartions. 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. Introducción 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 deseparación de biotecnología 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