COURSE DATA

DATA SUBJECT

Code: 33185
Name: Bioreactors
Cycle: Undergraduate Studies
ECTS Credits: 6
Academic year: 2026-27

STUDY (S)

Degree	Center	Acad. year	Period
1111 - Grado en Biotecnología	Facultat de Ciències Biològiques	3	First quarter

SUBJECT-MATTER

Degree	Subject-matter	Character
1111 - Grado en Biotecnología	Biochemical engineering	COMPULSORY

COORDINATION

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SUMMARY

\"Bioreactors\" is a 6 credits mandatory course that is taught in the fall semester of the third year of the biotechnology degree.

Bioreaction is the main issue for applications of biotechnology at industrial scale and it has different and specific characteristics from other process industries. Implementation of a bioreaction at industrial scale presents fundamentally different issues than laboratory-scale development. In this sense, the contents of this course introduce, from a practical approach, the skills and tools in order to develop bioreactions at industrial scale.

The overall objective of the course is to introduce the basic concepts necessary to carry out the design and analysis of industrial-scale bioreactors. In order to achieve this goal, the following contents are developed throughout the course:

- Microbial and enzyme kinetics

- Design and analysis of bioreactors
- Sterilization at industrial scale
- Agitation
- Aeration
- Scale-up

PREVIOUS KNOWLEDGE

RELATIONSHIP TO OTHER SUBJECTS OF THE SAME DEGREE

There are no specified enrollment restrictions with other subjects of the curriculum.

OTHER REQUIREMENTS

It is suggested to pass previously the next subjects in order to affront with guaranties the matter:
- Mathematics I and II on the first year.
- Introduction to Biochemical Engineering on the second year.

COMPETENCES / LEARNING OUTCOMES

1102 -

Capacidad de interpretar datos relevantes.

Capacidad para trabajar en el laboratorio incluyendo seguridad, manipulación, eliminación de residuos y registro anotado de actividades.

Capacidad para transmitir ideas, problemas y soluciones dentro de la Biotecnología.

Conocer las bases del diseño y funcionamiento de biorreactores.

Conocer los fundamentos de los fenómenos de transporte y saber plantear y utilizar los balances de materia y energía en los procesos bioindustriales.

Develop skills to undertake further study.

Saber aplicar los conocimientos en Biotecnología al mundo profesional.

Saber utilizar la lengua inglesa en la redacción de informes y para interpretar información a partir de protocolos, manuales y bases de datos.

1111 - Grado en Biotecnología

Actuar con autonomía en el aprendizaje, tomando decisiones fundamentadas en diferentes contextos, emitiendo juicios en base a la experimentación y el análisis y transfiriendo el conocimiento a nuevas situaciones

Apply analytical, synthetic and critical thinking skills in the application of the scientific method.

Colaborar eficazmente en equipos de trabajo, asumiendo responsabilidades y funciones de liderazgo y contribuyendo a la mejora y desarrollo colectivo

Conocer las etapas de procesado de materiales anterior y posterior a una etapa de biorreacción a escala industrial

Conocer los fundamentos de transporte y saber plantear y utilizar balances de materia y energía en los procesos bioindustriales

Conocer los principios básicos de las principales operaciones utilizadas en la industria biotecnológica.

Contribuir en el diseño, desarrollo y ejecución de soluciones que den respuesta a demandas sociales, teniendo en cuenta como referente los Objetivos de Desarrollo Sostenible

Demostrar razonamiento crítico y autocrítico en el ámbito de la titulación, considerando aspectos tales como la ética profesional, los valores morales y las implicaciones sociales de las diferentes actividades realizadas

Participate in multidisciplinary teams, engaging in teamwork and collaboration.

Propose creative and innovative solutions to complex situations or problems, typical of the area of ¿¿¿¿connection, to donate responses to the various professional and social needs

Saber comunicarse de manera efectiva, tanto de forma oral como escrita, adaptándose a las características de la situación y de la audiencia

Saber interpretar un diagrama de flujo de materiales

Ser capaz de llevar a cabo el dimensionado y análisis de los biorreactores más comunes, de la esterilización térmica del medio de reacción a escala industrial y del aire, así como de los procesos de agitación y aireación en un biorreactor a nivel industrial

Ser capaz de plantear alternativas plausibles en el proceso de recuperación de producto a escala industrial

Understand the principles of the design and functioning of bioreactors.

Use English to write reports and to interpret information from protocols, manuals and databases.

Work in laboratories, including safety procedures, waste management and accurate activity logging.

DESCRIPTION OF CONTENTS

1. Introduction

Historical development of fermentation processes. Conventional industrial fermentation processes. Future developments in biotechnology.

2. Mathematical modeling of reaction rate in biological systems

Microbial kinetics. Enzyme kinetics.

3. Design and analysis of bioreactors

Basic concepts. Batch bioreactor. Continuous stirred tank bioreactor. Plug flow bioreactor. Comparison between batch and continuous bioreactors. Bioreactors design alternatives. Advanced designs.

4. Sterilization

Introduction. Media sterilization. Air sterilization.

5. Mass transfer in bioreactors

Mass transfer. Aeration: gas-liquid mass transfer. Agitation: Forced convection mass-transfer.

6. Scale-up of bioreactors

Bases of scale-up. Media sterilization. Aeration-agitation. Regime analysis and scale-down.

WORKLOAD

PRESENCIAL ACTIVITIES

Activity	Hours
Tutorials	3,00
Theory	26,00
Laboratory	10,00
Classroom practices	21,00
Total hours	**60,00**

NON PRESENCIAL ACTIVITIES

Activity	Hours
Attendance at other activities	0,00

Individual or group project	10,00
Independent study and work	25,00
Preparation of lessons	44,00
Preparation for assessment activities	1,00
Resolution of case studies	10,00
Total hours	**90,00**

TEACHING METHODOLOGY

The methodology to be used in the course will consider the following aspects:

Theory sessions: Students will be offered an overview of the subject to be covered and will focus on the key concepts to be developed, as well as the resources to be used for the subsequent preparation of the subject in depth. Being an eminently applied subject, in these sessions will be able to present, as an example, some practical applications in order to enhance the assimilation of the concepts introduced.

Practical class sessions: In these sessions, on the one hand, the professor will carry out a series of type-problems of each one of the contents that are developed. On the other hand, the students will work analogous problems supervised by the teacher. Likewise, practical applications will be proposed for the autonomous work of the students.

Laboratory practices: Students will work with different experimental setups and will become familiar with the use of computer tools for data processing and analysis. Concepts developed in the theoretical sessions will be worked on at in order to enhance their assimilation. The
practices that can be performed are:

- Oxygen transfer in a bioreactor.
- Enzymatic catalysis
- Cell immobilization
- Simulation/Analysis of bioreactors using computer tools

Tutorials: students will be divided into small groups and will participate in 3 sessions distributed throughout the course. In them, the professor will try to clarify concepts and solve
the doubts that may have arisen during the realization of the problems proposed throughout the course.

EVALUATION

The evaluation of the course is based in:

a) Lab work: 15% of grade

b) Theory and practice: 85% of grade.

The course will be over passed when the weighted average grade is equal to or greater than 5 (out of 10), being mandatory to obtain in each part (lab + theory and practice) a grade equal or greater than 5 (out of 10) in each part.

The theory and practice part will be graded base in:

1. Continuous assessment and practical activities (30% of grade of part b): Based on written work given to the professors (reports, problems solved, etc) and/or individual specific tests and on regular course attendance and classroom activities.

2. Objective test (70% of grade of part b): Based on a written test with theoretical and practical questions.

The part b (Theory and practice) of the course will be over passed when the weighted average grade is equal to or greater than 5 (out of 10), being mandatory to obtain in the objective test a grade equal or greater than 4.5 (out of 10)

In any case, each student can choose that the objective test counts 100% of the theoretical-practical part of the subject.

REFERENCES

- Basic Bioreactor Design. Vant Riet, K., Tramper, J. (Marcel Dekker)
- Biochemical Engineering. S. Aiba, A.E. Humprey y N.F. Millis (Academic Press)
- Biochemical Engineering Fundamentals. J.E. Bayley y D.F.G. Ollis (McGraw-Hill)
- Principios de ingeniería de los bioprocesos. P.M. Doran (Ed. Acribia)
- Biochemical engineering. H.W. Blanch y D.S. Clark (Marcel Dekker)
- Introducció a l'Enginyeria dels Reactors Químics. Escardino, A., Berna, A. (PUV)
- Elementos de ingeniería de las reacciones químicas. Fogler, H. S. (Pearson Educación)
- El omnilibro de los reactores químicos. Levenspiel, O. (Reverté)

- Ingeniería de las reacciones químicas. Levenspiel, O. (Reverté)
- Bioprocess Engineering: Kinetics, Sustainability, and Reactor Design. L. Shijie (Elsevier)
- Biochemical engineering : a textbook for engineers, chemists and biologists. S. Katoh and F. Yoshida (Weinheim) URL
- Biochemical engineering and biotechnology. G.D. Najafpour (Elsevier)