COURSE DATA

Data Subject	
Code	33185
Name	Bioreactors
Cycle	Grade
ECTS Credits	6.0
Academic year	2019 - 2020

Study (s)

Degree	Center	Acad. year	Period
1102 - Degree in Biotechnology	Faculty of Biological Sciences	3	First term

Subject-matter

Degree	Subject-matter	Character
1102 - Degree in Biotechnology	90 - Biochemical engineering	Obligatory

Coordination

Name	Department
CHAFER ORTEGA, AMPARO	245 - Chemical Engineering
PEÑARROCHA OLTRA, JOSEP MANUEL	245 - Chemical Engineering

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.

OUTCOMES

1102 - Degree in Biotechnology

- Saber aplicar los conocimientos en Biotecnología al mundo profesional.
- Capacidad de interpretar datos relevantes.
- Capacidad para transmitir ideas, problemas y soluciones dentro de la Biotecnología.
- Develop skills to undertake further study.
- Capacidad para trabajar en el laboratorio incluyendo seguridad, manipulación, eliminación de residuos y registro anotado de actividades.
- Conocer los fundamentos de los fenómenos de transporte y saber plantear y utilizar los balances de materia y energía en los procesos bioindustriales.
- Conocer las bases del diseño y funcionamiento de biorreactores.
- Saber utilizar la lengua inglesa en la redacción de informes y para interpretar información a partir de protocolos, manuales y bases de datos.

LEARNING OUTCOMES

At the end of the course, the student must have acquired the following skills:

- Be able to interpret and use mathematical expressions that model the reaction rate in biological systems
- Be acquainted with a wide variety of configurations of bioreactors
- Be able to size and to analyze the most common bioreactors
- Be able to size and to analyze sterilization at industrial scale as well as to know the basic principles of air sterilization
- Be able to size and to analyze agitation and aeration of bioreactors at industrial scale
- know how to interpret and use information to solve practice cases
- to use of equipment and apparatus of industrial application
- Develop skills to handle specialized bibliographic sources for finding, selecting and understanding the information
- Be able to critically analyze the results of practical applications
- Write reports with clarity and order

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

ACTIVITY	Hours	% To be attended
Theory classes	26,00	100
Classroom practices	21,00	100
Laboratory practices	10,00	100
Tutorials	3,00	100
Development of group work	5,00	0
Development of individual work	5,00	0
Study and independent work	20,00	0
Readings supplementary material	5,00	0
Preparing lectures	20,00	0
Preparation of practical classes and problem	24,00	0
Resolution of case studies	10,00	0
Resolution of online questionnaires	1,00	0
TOTAL	**150,00**	

TEACHING METHODOLOGY

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

Lecture sessions: Single group to introduce the theoretical and practical principles of the course.

Practical lessons: Practical questions will be solved in groups of 40 students in a regular classroom.

Laboratory sessions: Students will work with experimental setups and will use software for processing and analysis of experimental data.

Tutorials: Students will be divided into small groups and participate in mandatory sessions.

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 (25% 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 (75% 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, the student may choose to have the theoretical-practical part evaluated the 100% with the objective test.

REFERENCES

Basic

- 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)

Additional

- 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)

ADDENDUM COVID-19

This addendum will only be activated if the health situation requires so and with the prior agreement of the Governing Council

English version is not available