UNIVERSIDAD DE CASTILLA - LA MANCHA

GUÍA DOCENTE

1. General information

Course: BIOREACTOR DESIGN
Code: 13339
Type: ELECTIVE
ECTS credits: 4.5
Degree: 341 - UNDERGRADUATE DEGREE PROGRAMME IN BIOCHEMISTRY
Academic year: 2021-22
Center: 501 - FACULTY OF ENVIRONMENTAL SCIENCES AND BIOCHEMISTRY
Group(s): 40
Year: 4
Duration: C2
Main language: Spanish
Second language: English
Use of additional languages:
English Friendly: Y
Web site:
Bilingual: N

Lecturer: **RAFAEL CAMARILLO BLAS** - Group(s): **40**

Building/Office	Department	Phone number	Email	Office hours
Sabatini/0.10	INGENIERÍA QUÍMICA	5414	rafael.camarillo@uclm.es	Prior appointment by mail

Lecturer: **FABIOLA MARTINEZ NAVARRO** - Group(s): **40**

Building/Office	Department	Phone number	Email	Office hours
Sabatini/0.8	INGENIERÍA QUÍMICA	926051507	fabiola.martinez@uclm.es	Prior appointment by mail

2. Pre-Requisites

Not established

3. Justification in the curriculum, relation to other subjects and to the profession

"Biotechnology" is the "application of scientific and engineering principles to the treatment of organic and inorganic materials by biological systems to produce goods and services". Biotechnology has important applications in industrial sector such as health-care, agriculture, biodegradable plastics, biofuels and bioremediation.

"Biochemical Engineering" creates the scientific and technical basis of engineering needed to understand the design and operation of different industrial set-ups involving biological agents. The most important ones are the bioreactors.

The subject "Design of bioreactors" focuses on the study of principles and equipments where biochemical and enzimatic reactions take place. The different types of reactors according to their application, the keys of design and scaling-up from lab to industry are described.

The study of "Design of bioreactors" requires specific knowledge from subject "Biochemical Engineering" together with basic knowledge in maths, physcis, chemistry and biochemistry. Moreover, the subject "Design of bioreactors" complements the contents of other subjects in 4th course, such as "Bioeconomy and business management".

4. Degree competences achieved in this course

Course competences

Code	Description
E01	Express themselves correctly in basic biological, physical, chemical, mathematical and computer terms.
E13	Correct handling of different computer tools
E15	Experimentally determine the concentrations of metabolites, the kinetic and thermodynamic parameters and the control coefficients of the reactions of the intermediate metabolism.
E21	Understand the chemical and thermodynamic principles of biocatalysis and the role of enzymes and other biocatalysts in the functioning of cells and organisms.
G02	To know how to apply the knowledge of Biochemistry and Molecular Biology to professional practice and to possess the necessary intellectual skills and abilities for this practice, including the capacity for: information management, analysis and synthesis, problem solving, organization and planning and generation of new ideas.
G04	To know how to transmit information, ideas, problems and solutions in the field of Biochemistry and Molecular Biology to a specialized and non-specialized public.
G05	Develop those strategies and learning skills necessary to undertake further studies in the area of Biochemistry and Molecular Biology and other related areas with a high degree of autonomy.
T02	User-level knowledge of Information and Communication Technologies (ICT).
T03	A correct oral and written communication
T06	Capacity for design, analysis and synthesis
T10	Ability to self-learn and to obtain and manage bibliographic information, including Internet resources

5. Objectives or Learning Outcomes

Course learning outcomes

Description

In the professional profile "biotechnology", the student is oriented towards professional activity in the business and pharmaceutical fields; he or she also acquires skills to carry out a professional activity in the field of teaching and research.

Additional outcomes

Other competences: E2 (Working in a good way and motivated by quality in chemical, biological and biochemical lab, including safety, waste handling and disposal and activity log) and E3 (To understand and explain the scientific and chemical basis of biochemical processes and the techniques employed to explore them). This is related to practical activities and technical visit.

SPECIFIC LEARNING OUTCOMES: The student must be able to make difference between the types of bioreactors and the uniqueness of each one. He/She must be able to make difference between the types of biochemical and enzimatic reactors and make basic design calculations. He/She must be able to propose intrumentation and control systems necessary to develop industrial bioreactions in a automatic and controlled way. He/She must be able to tackle the scaling-up of bioreactions from lab to industry.

6. Units / Contents

Unit 1: Introduction to design of bioreactors
Unit 2: Biochemical reactors
Unit 3: Enzimatic reactors
Unit 4: Instrumentation in bioreactors
Unit 5: Control of bioreactors
Unit 6: Scale-up of bioreactors
Unit 7: Labwork and technical visit

7. Activities, Units/Modules and Methodology

Training Activity	Methodology	Related Competences (only degrees before RD 822/2021)	ECTS	Hours	As	Com	Description
Class Attendance (theory) [ON-SITE]	Lectures	E21	0.7	17.5	Y	N	Participatory lectures (in which questions will be proposed through Turning point). Non-reschedulable in the second resit
Problem solving and/or case studies [ON-SITE]	Problem solving and exercises	E01 T06	0.38	9.5	N	-	Problem solving and exercises in class
Laboratory practice or sessions [ON-SITE]	Practical or hands-on activities	E13 E15 E21 T02	0.6	15	Y	Y	Realization of laboratory practices and treatment of the results. Visit to an industrial facility (if sanitary conditions allow it). It is a NON-RESCHEDULABLE activity
Practicum and practical activities report writing or preparation [OFF-SITE]	Group Work	E13 G04 T02 T03 T06 T10	0.6	15	Y	Y	It will be MANDATORY to submit a practice report per group
Final test [ON-SITE]	Assessment tests	G04 T06	0.06	1.5	Y	Y	End of course test that will consist of problems
Final test [ON-SITE]	Assessment tests	E01 G04 T03	0.06	1.5	Y	Y	Final test of the subject that will consist of theory
Other off-site activity [OFF-SITE]	Case Studies	E13 G02 G04 T02 T10	0.2	5	Y	N	Delivery of problems proposed by teachers. Completion of tasks (viewing of videos or materials) proposed by teachers through CAMPUS VIRTUAL. Non-reschedulable in the second resit
Study and Exam Preparation [OFF-SITE]	Self-study	G02 G05 T10	1.9	47.5	N	-	Preparation of theory tests and problems
		Total:	**4.5**	**112.5**			
		Total credits of in-class work: 1.8					**Total class time hours: 45**
		Total credits of out of class work: 2.7					**Total hours of out of class work: 67.5**

As: Assessable training activity
Com: Training activity of compulsory overcoming (It will be essential to overcome both continuous and non-continuous assessment).

8. Evaluation criteria and Grading System

Evaluation System	Continuous assessment	Non-continuous evaluation*	Description
Final test	35.00%	42.00%	A minimum mark of 4.0 in theory test is required
Laboratory sessions	5.00%	5.00%	Attitude in both laboratory and technical visit will be evaluated, being 5.0 the minimum mark. The attendance to labwork and technical visit are compulsory and non-reschedulable
Other methods of assessment	7.00%	0.00%	Performing tasks; problems delivery; Answering to questions raised in class. There is not a minimum mark. Non-reschedulable in the second resit
Other methods of assessment	3.00%	0.00%	Answering to questions raised in class with TURNING POINT. There is not a minimum mark. Non-reschedulable in the second resit

Practicum and practical activities reports assessment	20.00%	20.00%	Minimum mark in laboratory memory is 4.0. If not, this part can be passed with specific questions in a test
Final test	30.00%	33.00%	A minimum mark of 4.0 in problems test is required
Total:	**100.00%**	**100.00%**	

According to art. 4 of the UCLM Student Evaluation Regulations, it must be provided to students who cannot regularly attend face-to-face training activities the passing of the subject, having the right (art. 12.2) to be globally graded, in 2 annual calls per subject , an ordinary and an extraordinary one (evaluating 100% of the competences).

Evaluation criteria for the final exam:

Continuous assessment:

The mark of each activity will be numerical (0-10).
In all cases, the attendance to labwork and technical visit and the delivery of a lab memory are compulsory. Both attitude in labwork and technical visit (5 %) and memory (20 %) are evaluated. The final mark is calculated taking into account the mark of final tests (35 % + 30 %), practices (25 %), case studies (7 %) and answering questions in class (3%).
Minimum mark in some compulsory activities:
-Final test (4.0 in both theory test and problems test)
-Practices (compulsory attendance and 4.0 in both attitude and memory).
To pass the course it will be necessary to obtain a 5.0 in the overall mark when taking into account the marks of all the activities.

Non-continuous evaluation:

The mark of each activity will be numerical (0-10).
In all cases, the attendance to labwork and technical visit and the delivery of a lab memory are compulsory. Both attitude in labwork and technical visit (5 %) and memory (20 %) are evaluated. The final mark is calculated taking into account the mark of final tests (theory test 42 + problems test 33 %) and practices (25 %).
Minimum mark:
-Final test (4.0 in both theory test and problems test)
-Practices (compulsory attendance and 4.0 in both attitude and memory).
To pass the course it will be necessary to obtain a 5.0 in the overall mark when taking into account the marks of all the activities.

Specifications for the resit/retake exam:

The mark of each activity will be numerical (0-10).
In the retake evaluation, the final tests will have a weight of 65 % (theory test 35 % + theory test 30 %) in final mark. To pass the test, a minimum mark of 4.0 in theory test and problems test is required. If the mark in laboratory memory is smaller than 4.0, the student will be evaluated of practices through a test.
The final mark is calculated taking into account the marks of practices (25 %), case studies (7 %) and answering questions in class (3%), provided that practices and retake exam are passed.
To pass the course it will be necessary to obtain a 5.0 in the overall mark when taking into account the marks of all the activities.

In NON-CONTINUOUS EVALUATION the weight of the final tests is 75 % (theory test 42 % + theory test 33 %). If the mark in laboratory memory is smaller than 4.0, the student will be evaluated of practices through a test.
The final mark is calculated taking into account the marks of practices (25 %) and the final exams (75 %), provided that practices and retake exam are passed.
To pass the course it will be necessary to obtain a 5.0 in the overall mark when taking into account the marks of all the activities.

Specifications for the second resit / retake exam:

The mark of each activity will be numerical (0-10).
In the second retake evaluation, the final tests will have a weight of 75 % (theory test 42 + problems test 33 %) in final mark. To pass the test, a minimum mark of 4.0 in theory test and problems test is compulsory.
The final mark is calculated taking into account the mark of practices in previous course (25 %), provided that practices and second retake exam are passed.
To pass the course it will be necessary to obtain a 5.0 in the overall mark when taking into account the marks of all the activities.

9. Assignments, course calendar and important dates

Not related to the syllabus/contents	
Hours	**hours**
Final test [PRESENCIAL][Assessment tests]	3
Study and Exam Preparation [AUTÓNOMA][Self-study]	52.5
Unit 1 (de 7): Introduction to design of bioreactors	
Activities	**Hours**
Class Attendance (theory) [PRESENCIAL][Lectures]	3
Unit 2 (de 7): Biochemical reactors	
Activities	**Hours**
Class Attendance (theory) [PRESENCIAL][Lectures]	5
Unit 3 (de 7): Enzimatic reactors	
Activities	**Hours**
Class Attendance (theory) [PRESENCIAL][Lectures]	3
Unit 4 (de 7): Instrumentation in bioreactors	
Activities	**Hours**
Class Attendance (theory) [PRESENCIAL][Lectures]	4.5
Other off-site activity [AUTÓNOMA][Case Studies]	1
Unit 5 (de 7): Control of bioreactors	
Activities	**Hours**
Class Attendance (theory) [PRESENCIAL][Lectures]	2.5
Unit 6 (de 7): Scale-up of bioreactors	
Activities	**Hours**
Class Attendance (theory) [PRESENCIAL][Lectures]	2
Other off-site activity [AUTÓNOMA][Case Studies]	1
Unit 7 (de 7): Labwork and technical visit	
Activities	**Hours**
Laboratory practice or sessions [PRESENCIAL][Practical or hands-on activities]	15
Practicum and practical activities report writing or preparation [AUTÓNOMA][Group Work]	15
Global activity	
Activities	**hours**
Class Attendance (theory) [PRESENCIAL][Lectures]	20
Other off-site activity [AUTÓNOMA][Case Studies]	2
Laboratory practice or sessions [PRESENCIAL][Practical or hands-on activities]	15
Final test [PRESENCIAL][Assessment tests]	3
Practicum and practical activities report writing or preparation [AUTÓNOMA][Group Work]	15
Study and Exam Preparation [AUTÓNOMA][Self-study]	52.5
Total horas:	107.5

10. Bibliography and Sources

Author(s)	Title/Link	Publishing house	City	ISBN	Year	Description
Atkinson, B.	Reactores bioquímicos	Reverté		84-291-7009-X	1986	
Carl-Fredrik Mandenius	Bioreactors: Design, Operation and Novel Applications	Wiley-VCH	Weinheim, Germany	978-3-527-33768-2	2016	
	https://books.google.es/books?id=ERyACgAAQBAJ&printsec=frontcover&dq=Bioreactors:+Design,+Operation+and+Novel+Applications&hl=es&sa=X&redir_esc=y#v=onepage&q=Bioreactors%3A%20Design%2C%20Operation%20and%20Novel%20Applications&f=false					
Casablancas, G.	Ingeniería bioquímica	Síntesis		84-7738-611-0	1998	
J. Bayo, S. Moreno	Diseño de biorreactores y enzimología		Murcia	84-7684-559-2	2010	