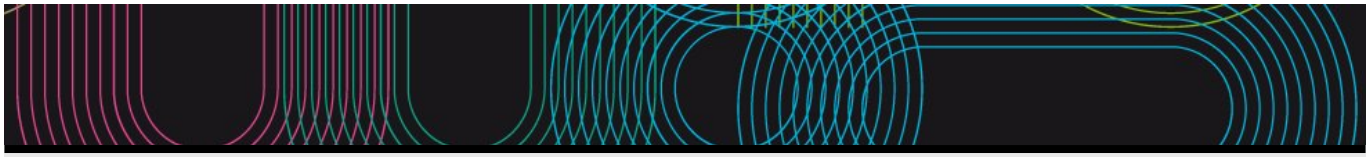

IDENTIFYING DATA				
Reactors and biotechnology				
Subject	Reactors and biotechnology			
Code	V12G350V01601			
Study programme	Grado en Ingeniería en Química Industrial			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	9	Mandatory	3rd	2nd
Teaching language	#EnglishFriendly Spanish Galician			
Department				
Coordinator	Pazos Currás, Marta María			
Lecturers	Escudero Curiel, Silvia Pazos Currás, Marta María Rosales Villanueva, Emilio			
E-mail	mcurras@uvigo.es			
Web				
General description	This subject provides the basis for chemical reaction engineering and biotechnology. Chemical reaction engineering is concerned with the design and operation of chemical reactors. It can be said to be the discipline that quantifies the influence of transport phenomena and kinetics, in order to relate reactor performance to inlet conditions and variables. For this task, it is required basic skills in chemistry, thermodynamics and kinetics, fluid mechanics and transport phenomena, physics, biochemistry, etc. Performance, selectivity or production can be considered as measurements of operation, whereas feeding and operating conditions constitute the inlet variables. Single or multiphase fluid mechanics determine the contact, while the kinetic description relates the reaction rate to intensive variables such as concentrations, temperature, pressure, catalyst activity, etc. Thus, chemical reaction engineering is the methodology for reactive chemical systems, where the cause-effects observed in laboratories need to be scaled up and operated industrially, which allows to deal in a unified way with any reaction problem regardless of its chemical nature or specific industry. On the other hand, students will also be introduced to the field of biotechnology. Although the concept of biotechnology has had many definitions, in general terms, biotechnology is the technology based on the use of biological systems and living organisms or their derivatives for the creation or modification of products or processes for specific uses. This part of the subject aims to provide the student with an overview of some of the processes of the biotechnology industry, highlighting the importance of changing scales and the existing problems regarding the environment, energy and natural resources. English Friendly subject: International students may request the following from the teaching staff: a) materials and bibliographic references to follow the subject in English, b) tutoring sessions in English, c) exams and assessments in English.			

Skills	
Code	
B3	CG3 Knowledge in basic and technological subjects that will enable students to learn new methods and theories, and provide them the versatility to adapt to new situations.
B4	CG4 Ability to solve problems with initiative, decision making, creativity, critical thinking and the ability to communicate and transmit knowledge and skills in the field of industrial engineering specializing in Industrial Chemistry.
C19	E19 Knowledge of mass and energy balances, biotechnology, mass transfer, separation operations, chemical reaction engineering, reactor design, and recovery and processing of raw materials and energy resources.
D1	CT1 Analysis and synthesis.
D2	CT2 Problems resolution.
D5	CT5 Information Management.

Learning outcomes

Expected results from this subject	Training and Learning Results		
Comprise the basic appearances of the Engineering of the chemical reactions.	B3 B4		D1 D2 D5
Know the fundamental appearances in the design of reactors for his application to productive processes	B4	C19	D1 D2 D5
Purchase skills on the process of analysis and interpretation of kinetical data and his application to the design of reactors		C19	D1 D2
Know the basic principles, physical factors, chemists and biological, on which supports the Biotechnology	B3	C19	D1

Contents	
Topic	
Basic principles of biotechnology	Biotechnological Processes General diagram of a biotechnological process Bioreactors Immobilization Recovery and purification of products
Chemical kinetics. Analysis and interpretation of rate data. Multiple reactions	Chemical reaction kinetics Microbial kinetics Enzyme kinetics
Design of isothermal and no isothermal reactors	Ideal reactors Flow models Reactors in state stationary
Residence time distribution in chemical reactors Non-ideal reactor models	Real reactor model
Catalysis and catalytic reactors Diffusion and reaction. Effects of external diffusion in heterogeneous reactions	Basic concepts of catalysis Characteristic of the catalytic systems Catalytic reactors

Planning			
	Class hours	Hours outside the classroom	Total hours
Lecturing	20	18	38
Problem solving	29	58	87
Laboratory practical	20	20	40
Presentation	1	12	13
Introductory activities	4	4	8
Case studies	4	30	34
Essay questions exam	2	0	2
Objective questions exam	2	0	2
Oral exam	1	0	1
*The information in the planning table is for guidance only and does not take into account the heterogeneity of the students.			

Methodologies	
	Description
Lecturing	Presentation by the teacher of the general aspects of the programme in a structured way, with special emphasis on the fundamentals and the most important or difficult aspects for the student to understand. The professor will facilitate, through the platform MOOVI, the necessary material for a correct follow-up of the matter. The student will have to work previously the material delivered by the professor and consult the bibliography recommended to complete the information.
Problem solving	During the development of the subject, the resolution of questions and problems will be used in order to reinforce the aspects presented in the lectures.
Laboratory practical	Laboratory experiments and field trips to companies related to chemical reaction engineering and biotechnology will be carried out. The student will be provided with practice scripts as well as the necessary support material for a proper understanding of the experiments to be carried out. The student will prepare a final report in which the main results and conclusions will be presented.
Presentation	The students will make a presentation of the CASE STUDY carried out, and will be assessed by an examining board made up of the lecturers of the subject.

Introductory activities	In this activity, students will be introduced to the syllabus and practices to be developed during the course, as well as the objectives, competences and evaluation criteria. Likewise, the way the course will be developed will be explained to them, and the groups that will carry out the work and practicals will be created.
Case studies	Along the course, students will develop a group work, a CASE STUDY , related to the subject of the course, which will be proposed by the teachers using various scientific articles as starting material.

Personalized assistance

Methodologies	Description
Lecturing	During the hours of tutorships the students, individually or in group, can consult with the professors any doubt posed on the matter. The teacher will inform on the available schedule in the presentation of the matter.
Problem solving	During the hours of tutorships the students, individually or in group, can consult with the professors any doubt posed on the matter. The teacher will inform on the available schedule in the presentation of the matter.
Laboratory practical	During the hours of tutorships the students, individually or in group, can consult with the professors any doubt posed on the matter. The teacher will inform on the available schedule in the presentation of the matter.
Case studies	During the hours of tutorships the students, individually or in group, can consult with the professors any doubt posed on the CASE STUDY . The teacher will inform on the available schedule in the presentation of the matter.

Assessment

	Description	Qualification	Training and Learning Results		
Problem solving	This matter is mainly practical, so the best way to evaluate the student's knowledge is by means of problem solving. Thus, throughout the four-month period, students will be assessed on the basis of exercise resolution deliverables	10	B3 B4	C19	D2
Laboratory practical	Students will carry out different laboratory practicals and field trips. At the end of the various practicals and on the dates indicated by the teachers, they will have to hand in the practical reports and complete a questionnaire on the field trips.	10	B3 B4		
Presentation	Students must present a CASE STUDY which will be assessed by an examining board made up of the lecturers of the subject.	10	B3 B4		D1
Case studies	Students will carry out a CASE STUDY as a group. Report will be worth 10% of the final grade.	10	B4		D1 D5
Essay questions exam	This subject is mainly practical, so in the final exam the student's knowledge will be assessed by solving problems.	30	B3 B4	C19	D2
Objective questions exam	In the final exam the student will have to answer a series of short questions or multiple-choice questions in which they will have to demonstrate their knowledge as well as their capacity for synthesis. In addition, during the four-month period, multiple-choice exams may be held, which may account for up to 1/4 of the grade assigned to this section.	20	B3		D1
Oral exam	There will be an individual oral examination of the laboratory practicals carried out in the course.	10	B3 B4		D1

Other comments on the Evaluation

CONTINUOUS ASSESSMENT

All students will be assessed on a continuous basis through the development of the CASE STUDY, practicals, multiplechoice questionnaires and problem solving.

Problem solving (10%): during the course, students will carry out different problem solving tasks, as well as multiple-choicetests.

CASE STUDY (20%): throughout the four-month period, students will have to carry out a group work in which they will use the different knowledge they are acquiring in the subject. The lecturer will plan seminars to monitor the work in which the progress of the work will be assessed. The partial evaluations of deliverables on the work carried out during the course as well as the evaluation of the final presentation of the work (report and presentation) constitute 20% of the mark for the subject, with 10% corresponding to the report and follow-up and 10% to the presentation.

Laboratory practicals and field trips (20%): During the four-month period, students will carry out laboratory practicals and field trips, which will account for 20% of the final mark for the course. The total mark for the practicals and field trips will be divided in the following way: 10% individual oral examination of the practicals and 10% the practical report and the test on field trips. A minimum attendance of 90% of the practices and field trips of the subject is required to be entitled to the evaluation of the same. Otherwise, the mark for this section will be 0.0 and the student will have to take a test in the final exam. Similarly, a minimum of 40% of the mark for the practicals must be achieved. If a minimum mark is not achieved in the practicals, an exam on the practicals must be taken during the final exam.

Multiple-choice questionnaires: throughout the term, multiple-choice questionnaires may be taken, which may be worth up to 1/4 of the mark assigned to the exam of objective questions.

FINAL MARK

The final mark will be the sum of the marks obtained in each section as long as a minimum mark is achieved in the exam (50% of the maximum mark). If the minimum mark is not reached in the exam, this will be the mark that will appear in the final mark.

SECOND CALL

In the second call, the mark obtained in the practicals in the first call will be maintained (if 40% of the maximum mark is reached) and the mark obtained in the CASE STUDY will be maintained. Students who do not obtain 40% of the maximum mark in the practicals will have to take an exam in this second call.

RESIGNATION OF CONTINUOUS ASSESSMENT

If the student is granted permission to resign from continuous assessment, he/she will only be assessed by a final exam of the contents of the subject (theoretical and practical), which will be 100% of the mark.

ETHICAL COMMITMENT

Students are expected to behave ethically. If unethical behaviour is detected (copying, plagiarism, use of unauthorised electronic devices, for example) it will be considered that the student does not meet the requirements to pass the subject. In which case the overall mark for the academic year will be a fail (0.0). The use of any electronic device will not be permitted during the assessment tests unless expressly authorised. Bringing an unauthorised electronic device into the exam room will be considered grounds for failing the subject in the academic year and the overall mark will be a fail (0.0).

Sources of information

Basic Bibliography

Fogler, H.S., **Elementos de Ingeniería de las Reacciones Químicas**, 4ª, Prentice Hall, 2008

Levenspiel, O., **Ingeniería de las Reacciones Químicas**, Reverté, 2004

González, J.R., González, J.A, González, M.P., Gutiérrez J.I. y Gutiérrez M.A., **Cinética Química Aplicada**, Síntesis, 1999

Santamaría, J., Herguido, J., Menéndez, M.A. y Monzón, A., **Ingeneniería de Reactores**, Síntesis, 1999

Gòdia Casablancas F. y López Santín J, **Ingeniería Bioquímica**, Síntesis, 1998

Complementary Bibliography

Coker, A.K., **Modeling of chemical kinetics and reactor design**, 2ª, Butterworth-Heinemann, 2001

Levenspiel, O., **El Omnilibro de los Reactores Químicos**, Reverté, 1986

Delannay, F., **Characterization of heterogeneous catalysts**, Marcel Dekker, 1984

Izquierdo, J. F., **Problemas resueltos de cinética de las reacciones químicas**, Ediciones Libreria Universitaria, 2019

Izquierdo, J. F., **Cinética de las reacciones químicas**, Ediciones Libreria Universitaria, 2019

Recommendations

Subjects that continue the syllabus

Modelling of biotechnological processes/V12G350V01924

Biotechnological processes and products/V12G350V01922

Subjects that are recommended to be taken simultaneously

Technical Office/V12G350V01604

Subjects that it is recommended to have taken before

Chemical engineering 1/V12G350V01405

Chemical engineering 2/V12G350V01503

Industrial chemistry/V12G350V01504

Other comments

To enrol in this subject it is necessary to have passed or enrolled in all the subjects of the courses lower than the course in which this subject is located.

In case of discrepancies, will prevail the version in Spanish of this guide.

Contingency plan

Description

=== EXCEPTIONAL MEASURES SCHEDULED ===
In front of the uncertain and unpredictable evolution of the sanitary alert caused by the COVID-19, the University of Vigo establishes an extraordinary planning that will activate in the moment in that the administrations and the own institution determine it attending to criteria of security, health and responsibility, and guaranteeing the teaching in a no face-to-face stage or partially face-to-face. These already planned measures guarantee, when required, the development of teaching in a more agile and efficient way by being known in advance (or well in advance) by students and teaching staff through the standardised and institutionalised tool of the teaching guides.

=== ADAPTATION OF THE METHODOLOGIES ===
* Educational methodologies to be maintained
-Introductory activities: to be carried out synchronously via remote campus.
-Lecture: to be carried out synchronously via remote campus.
-Problem solving: to be carried out synchronously via remote campus.
-CASE STUDY : the follow-up will be carried out via remote campus and virtual sessions will be provided to the groups to facilitate the work.

* Educational methodologies to be modified
-Laboratory practicals will be carried out virtually and field trips will be cancelled. The oral exam will be replaced by a multiple-choice exam.
- Presentation of the CASE STUDY : the students will make the recording of the presentation that will be sent for his evaluation by examining board made up of the lecturers of the subject.

*Non-face-to-face student support mechanism (tutoring sessions)
* Tutoring sessions individualizized previously concerted between the student and professor that will make in virtual dispatches/on-line platform
* Modifications (if they proceed) of the contents to be taught
No modification
* Additional bibliography to facilitate the self-study
No modification
* Other modifications

=== ADAPTATION OF THE EVALUATION ===

* Test already made
Proof XX: [previous Weight 00%] [Weight Proposed 00%]
...

* Pending proofs that keep
Proof XX: [previous Weight 00%] [Weight Proposed 00%]
...

* Proofs that modify
[previous Proof] =&*gt; [new Proof]
oral Examination practices will change by an on-line examination type New

* New test

* Additional Information
Vulnerable students: methodological adaptation will be carried out, providing them with additional specific information, if it is accredited that they cannot have access to the contents taught in a conventional way.
Assessment: The tests will be carried out face-to-face except in the case of a rector's resolution that indicates that they should be done in a non-face-to-face manner, being carried out in this way through the different tools made available to the teaching staff. The assessment criteria are maintained, adapting the tests to be carried out, if necessary, as indicated in the Rector's Resolution, using the telematic means made available to the teaching staff.