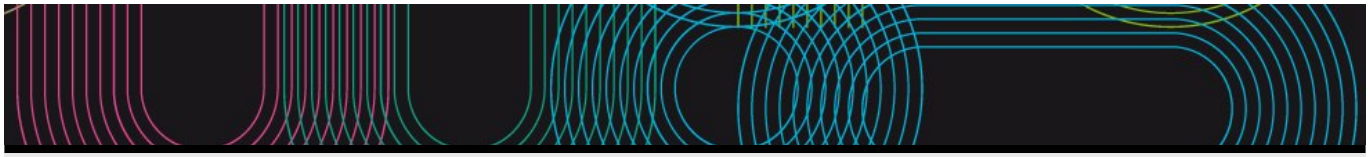

IDENTIFYING DATA				
Biotechnological processes and products				
Subject	Biotechnological processes and products			
Code	V12G350V01922			
Study programme	Degree in Industrial Chemical Engineering			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Optional	4th	1st
Teaching language	#EnglishFriendly Spanish			
Department				
Coordinator	Longo González, María Asunción			
Lecturers	Longo González, María Asunción			
E-mail	mlongo@uvigo.es			
Web	http://faitic.uvigo.es			
General description	The use of microorganisms for the transformation of raw materials has been carried out by humans since antiquity, although it is more recent (2nd half of 20th century) the use of biocatalysts (microorganisms, enzymes or other biological systems) in industrial processes. The biotechnology industry can be considered an emerging sector of high economic profitability, which makes it necessary to have the scientific and technological knowledge that allow developing and adapting bioprocesses in the different sectors of application. The subject aims to provide students with a global view on the use of biocatalysts (microorganisms, cells or biomolecules) for the development of biotechnological industrial processes as an alternative to traditional processes. The main unit operations involved in this type of process will be studied, as well as the specific aspects that differentiate them from conventional industrial chemical processes. Given that it is a field in continuous expansion, reference will be made to the most recent advances and trends. English Friendly subject: International students may request from the teachers: a) materials and bibliographic references in English, b) tutoring sessions in English, c) exams and assessments in English.			

Competencies	
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.
C16	CE16 Basic knowledge and application of environmental technologies and sustainability.
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.
D3	CT3 Oral and written proficiency.
D9	CT9 Apply knowledge.
D10	CT10 Self learning and work.
D16	CT16 Critical thinking.
D17	CT17 Working as a team.

Learning outcomes	
Expected results from this subject	Training and Learning Results

Identification of the basic concepts of biotechnological processes, their products and their sources.	B3 B4	C19	D1 D2 D3 D9 D10
Knowledge and understanding of the biotechnological processes carried out by microorganisms of industrial interest, the stages of transformation and separation of products and the most common equipment used.	B3 B4	C16 C19	D1 D2 D3 D9 D10 D16 D17
Being able to propose biotechnological processes in different areas, through knowledge of methodology, requirements and regulations, considering aspects related to the environment, energy and resources.	B3 B4	C16 C19	D1 D2 D3 D9 D10 D16 D17

Contents

Topic	
Fundamentals of biotechnological processes: microorganisms, enzymes and other metabolites of industrial interest.	- Introduction to biotechnological processes. Microbiological and biochemical fundamentals, and raw materials used.
Technology of biotechnological processes and products. Design of a biotechnological process. Practical cases.	- Preparation of raw materials. - Reaction stage. Kinetics and operation of bioreactors. - Recovery and purification operations. - Study of commercial biotechnological processes and new trends.
Process intensification, energy integration, environmental and biosafety considerations.	- Energy integration methodologies - Introduction to the assessment of environmental impact of processes. - Biosafety. Best available techniques in the biotechnology industry.

Planning

	Class hours	Hours outside the classroom	Total hours
Case studies	9.5	24.5	34
Laboratory practical	18	18	36
Presentation	2	12	14
Lecturing	15	15	30
Mentored work	3	17	20
Seminars	3	11	14
Essay questions exam	2	0	2

*The information in the planning table is for guidance only and does not take into account the heterogeneity of the students.

Methodologies

	Description
Case studies	Processes of interest will be selected, which are representative of the current trends in the biotechnology sector, and a critical analysis will be carried out, in groups or individually. Short presentations will be made in the classroom, encouraging debate, as much as possible.
Laboratory practical	Laboratory experiments and field practices in companies related to the processes treated throughout the course will be carried out. The students will have the support material necessary for a proper understanding of the experiments to be carried out. A brief final report will be prepared in which the main results and conclusions should be collected.
Presentation	The students will make brief presentations of the cases studied in the classroom, as well as the supervised work. A question time will be included, in which the questions posed must be answered.
Lecturing	The lecturer will present the general aspects of the program in a structured way, with special emphasis on the fundamentals and most important or difficult to understand aspects. The lecturer will provide, through the Tem@ platform, the necessary material for a correct follow-up of the subject. The student will be able to work previously the material handed out by the lecturer and consult the recommended bibliography to complete the information.

Mentored work	The students will develop a smal project on a subject assigned by the lecturer. The work will be carried out in groups, that will deliver a written essay and make a presentation.
Seminars	Proposal and resolution of practical cases related to the subject matter. Complementary activity to the case study.

Personalized assistance

Methodologies	Description
Lecturing	Academic activity carried out by the lecturer during tutoring hours where students, individually or in small groups, can ask questions about the subject, and receive guidance and additional support. This activity can also be carried out in a remote way (through email or virtual campus).
Laboratory practical	Academic activity carried out by the lecturer during tutoring hours where students, individually or in small groups, can ask questions about the subject, and receive guidance and additional support. This activity can also be carried out in a remote way (through email or virtual campus).
Seminars	Academic activity carried out by the lecturer during tutoring hours where students, individually or in small groups, can ask questions about the subject, and receive guidance and additional support. This activity can also be carried out in a remote way (through email or virtual campus).
Mentored work	Academic activity carried out by the lecturer during tutoring hours where students, individually or in small groups, can ask questions about the subject, and receive guidance and additional support. This activity can also be carried out in a remote way (through email or virtual campus).
Case studies	Academic activity carried out by the lecturer during tutoring hours where students, individually or in small groups, can ask questions about the subject, and receive guidance and additional support. This activity can also be carried out in a remote way (through email or virtual campus).
Presentation	Academic activity carried out by the lecturer during tutoring hours where students, individually or in small groups, can ask questions about the subject, and receive guidance and additional support. This activity can also be carried out in a remote way (through email or virtual campus).

Assessment

	Description	Qualification	Training and Learning Results
Case studies	The work done during the seminars, case studies and practical classes will be evaluated based on: - assistance - attitude and participation of the students during the sessions - quality of submitted reports	25	B3 C16 D1 B4 C19 D2 D3 D9 D10 D16 D17
Presentation	The students will make a presentation of the supervised work, which will be assessed based on its clarity, rigor and demonstration of the knowledge acquired on the subject.	10	D1 D3 D16 D17
Mentored work	The report presented on the assigned work subject will be evaluated. This report must include some minimum aspects, based on a guide that will be provided to the students.	15	B3 C16 D1 B4 C19 D2 D3 D9 D10 D16 D17
Essay questions exam	Final exam, composed of questions related to all the material made available to the students during the face-to-face sessions.	50	B3 C16 D1 B4 C19 D2 D3 D9

Other comments on the Evaluation

Details about evaluation and qualifications

The participation of the student in any of the acts of evaluation of the subject will imply the condition of presented and, therefore, the assignment of a qualification.

To pass the subject, it is necessary that the student obtain a minimum of 5 points out of 10 in the final exam and a minimum of 5 points out of 10 in the continuous assessment. The score of the continuous assessment will be calculated from the supervised work qualifications (30%), presentation (20%), and follow-up of practical cases seminars and practical sessions (50%).

If the minimum of 5 points out of 10 in the final exam and in the continuous assessment is achieved, the final mark will be

calculated as the sum of 50% of the continuous assessment mark and 50 % of the final exam grade. The same will apply if the student does not reach the established minimum in any of the two sections.

In the case of students who do not pass the minimum of 5 points out of 10 in one of the two parts of the evaluation (final exam or continuous assessment), the score of Fail will be assigned, with a numerical value equal to the mark obtained in the evaluation part in which the minimum level has not been achieved.

The qualification of the continuous evaluation section, if higher than 5 points out of 10, will be kept for the second evaluation opportunity (July), and therefore only the final exam will be necessary.

Students who renounce continuous assessment must take a final exam in which questions from all the activities of the course can be included (also those corresponding to practical classes), and their grade will be the mark obtained in this exam.

Ethical considerations

The student is expected to exhibit an adequate ethical behavior. In case of detecting unethical behavior (copying, plagiarism, use of unauthorized electronic devices, and others), it will be considered that the student does not meet the necessary requirements to pass the subject. In this case, the overall grade in the current academic year will be Fail (0.0).

The use of any electronic device during the evaluation tests will not be allowed unless expressly authorized. The introduction of a non-authorized electronic device in the exam room will be considered a reason for not passing the subject in this academic year and the overall rating will be Fail (0.0)

Sources of information

Basic Bibliography

Henry C. Vogel; Celeste L. Todaro, **Fermentation and biochemical engineering handbook: principles, process design and equipment**, 3ª, Elsevier, 2014

Michael R. Ladisch, **Bioseparations engineering : principles, practice, and economics**, 1ª, Wiley, 2001

Wim Soetaert, Erick J. Vandamme, **Industrial biotechnology : sustainable growth and economic success**, 1ª, Wiley-VCH, 2010

Robin Smith, **Chemical process design and integration**, 2ª, John Wiley & Sons, 2016

José A. Teixeira; Antonio A. Vicente, **Engineering aspects of food biotechnology**, 1ª, CRC Press, 2014

José López Carrascosa y Aurelia Modrego, **La biotecnología y su aplicación industrial en España**, 1ª, Universidad Carlos III, 1994

OECD, **The application of Biotechnology to industrial Sustainability**, 1ª, OECD Publishing, 2001

Complementary Bibliography

Recommendations

Subjects that continue the syllabus

Modelling of biotechnological processes/V12G350V01924

Subjects that are recommended to be taken simultaneously

Product optimisation/V12G350V01701

Subjects that it is recommended to have taken before

Chemical engineering 1/V12G350V01405
Chemical engineering 2/V12G350V01503
Reactors and biotechnology/V12G350V01601

Contingency plan

Description

=== EXCEPTIONAL PLANNING ===
Given the uncertain and unpredictable evolution of the health alert caused by COVID-19, the University of Vigo establishes an extraordinary planning that will be activated when the administrations and the institution itself determine it, considering safety, health and responsibility criteria both in distance and blended learning. These already planned measures guarantee, at the required time, the development of teaching in a more agile and effective way, as it is known in advance (or well in advance) by the students and teachers through the standardized tool.

=== ADAPTATION OF THE METHODOLOGIES ===
* Teaching methodologies maintained / modified
The methodologies indicated in the guide will be maintained; in the event of a health alert, they will be carried out in remote

mode, through the teaching platforms and remote campus of the universities.

* Non-attendance mechanisms for student attention (tutoring)
Tutorials will be attended electronically (email, remote campus)

* Modifications (if applicable) of the contents
The same contents are maintained.

* Additional bibliography to facilitate self-learning
The bibliography provided is sufficient.

* Other modifications
Not applicable.

=== ADAPTATION OF THE TESTS ===
The evaluation will be carried out face-to-face except if there is a Rectoral Resolution that indicates that it must be done remotely, in which case the evaluation will be performed by using the different tools made available to lecturers.

* Additional Information
Vulnerable students: a methodological adaptation will be carried out, providing additional specific information, for those students that can certify that they cannot access the contents by the conventional means.