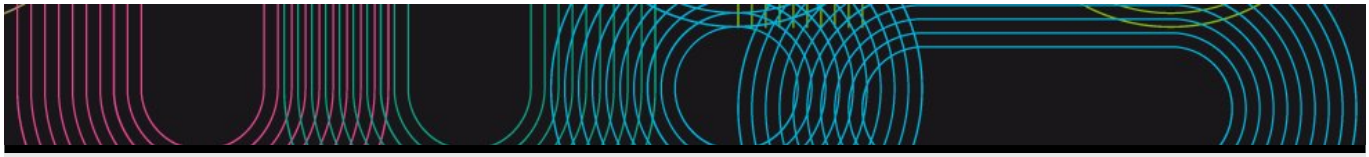

IDENTIFYING DATA				
Modelling of biotechnological processes				
Subject	Modelling of biotechnological processes			
Code	V12G350V01924			
Study programme	Grado en Ingeniería en Química Industrial			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Optional	4th	2nd
Teaching language	#EnglishFriendly Spanish Galician English			
Department				
Coordinator	Deive Herva, Francisco Javier			
Lecturers	Álvarez Álvarez, María Salomé Deive Herva, Francisco Javier			
E-mail	deive@uvigo.es			
Web	http://https://moovi.uvigo.gal/			
General description	Since ancient times, man has used biotechnological processes to obtain products of interest. Currently, the biotechnology sector is one of the areas that is experiencing the greatest growth, which entails the need to select, within a space of possibilities, those alternatives that, based on a predetermined criterion, allow meeting the desired objectives . The search for a formal approach to the design problem promotes the need to find mathematical models that fit the empirical data and that allow greater ease in the optimization and simulation of these processes. All this will result in greater efficiency and ease of control of the diversity of biotechnology-based processes. 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.			

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.
B6	CG6 Capacity for handling specifications, regulations and mandatory standards.
B10	CG10 Ability to work in a multidisciplinary and multilingual environment.
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.
C21	CE21 Ability to design and management procedures applied experimentation, especially for the determination of thermodynamic and transport properties, and modeling of phenomena and systems in the field of chemical engineering, systems with fluid flow, heat transfer, mass transfer operations, kinetics of chemical reactions and reactors.
C22	CE22 Ability to design, manage and operate simulation procedures, control and instrumentation of chemical processes.
D2	CT2 Problems resolution.
D6	CT6 Application of computer science in the field of study.
D8	CT8 Decision making.
D9	CT9 Apply knowledge.
D10	CT10 Self learning and work.
D14	CT14 Creativity.
D15	CT15 Objectification, identification and organization.
D17	CT17 Working as a team.

Learning outcomes

Expected results from this subject	Training and Learning Results		
Knowledge of complex dynamic phenomena by simulation or by reconstruction in simple laboratory models	B3 B6 B10	C19 C21	D2 D6 D8 D9 D10 D14 D15
Understand the integration of equipment for the correct design of a biotechnological process	B3	C19 C22	D8 D9 D15
Know how to apply control techniques to biotechnological processes	B4 B6 B10	C21 C22	D2 D6 D8 D9 D10 D14 D15 D17

Contents	
Topic	
Subject 1. Introduction to the modelling of biotecnological processes.	Models and types of models in biotechnology. Hierarchical analysis in modelling.
Subject 2. Sequential modelling of bioprocesses.	Integral analysis of biotechnological processes. Use of simulation tools. SuperProDesigner.
Subject 3. Mathematical modelling.	Obtaining empirical data. Characterisation and control of biotechnological processes. Microbial kinetics
Subject 4. Numerical methods in bioprocesses.	Linear and non linear equations. Ordinary differential equations.
Subject 5. Introduction to the design of experiments in bioprocesses	Factorial designs. Utilisation of specific software for the design of experiments
Subject 6. Design of basic units in a biotechnological process.	Design of equipment like tanks and pipes. Scaling-up

Planning			
	Class hours	Hours outside the classroom	Total hours
Introductory activities	1	0	1
Lecturing	15	30	45
Mentored work	10	40	50
Laboratory practical	18	18	36
Presentation	3	6	9
Essay questions exam	3	6	9
*The information in the planning table is for guidance only and does not take into account the heterogeneity of the students.			

Methodologies	
	Description
Introductory activities	In this activity the different parts and topics developed during the course will be presented to the students, as well as the aims, competences and evaluation criteria. Likewise, the project case will be given to different groups and the way to tackle it will be it will explained
Lecturing	Lecturing will be structured by following the contents distribution in a sequential manner, and highlighting the foundations and more difficult parts to be understood by the students. The lecturer will facilitate, through moovi platform, the material required for a correct follow-up of the matter. The student will have to work on the material prior to the lecture and consult the recommended bibliograpy to complete the information.
Mentored work	Along the course, the students will develop a work consisting in modelling and simulating a biotechnological plant, based on scientific literature and laboratory data. A report must be carried out where all the details, simulation, modelling, data discussion, control strategy, plans, etc. are included.

Laboratory practical	The students will perform laboratory experiments , and all the required material will be available for them in the laboratory to ease their ability to sucessfully carry out biotechnological tasks like media preparation, enzyme determination, plate culturing or bioreactor set up. They will also perform visits to imporant biotechnological companies from our surroundings like Lonza Biologics. The student will prepare a final report in which the main results and conclusions must be collected, in accordance with a guide that will be facilitated them through the platform tem@.
Presentation	The students will make a public defence on the simulation projects, and will be evaluated by a jury composed by lecturers from the department of chemical engineering and/or professionals from the private sector in the field of the chemical engineering

Personalized assistance

Methodologies	Description
Lecturing	During the tutorships, individually or in groups, the student may ask the lecturer about any doubt posed on the matter. Likewise, the students also will be able to do queries to the professor through the moovi platform or by email. The lecturer will inform on the available schedule in the presentation of the matter and in moovi platform
Mentored work	During the tutorships, individually or in groups, the student may ask the lecturer about any doubt posed on the matter. Likewise, the students also will be able to do queries to the professor through the moovi platform or by email. The lecturer will inform on the available schedule in the presentation of the matter and in moovi platform
Laboratory practical	During the tutorships, individually or in groups, the student may ask the lecturer about any doubt posed on the matter. Likewise, the students also will be able to do queries to the professor through the moovi platform or by email. The lecturer will inform on the available schedule in the presentation of the matter and in moovi platform
Presentation	During the tutorships, individually or in groups, the student may ask the lecturer about any doubt posed on the matter. Likewise, the students also will be able to do queries to the professor through the moovi platform or by email. The lecturer will inform on the available schedule in the presentation of the matter and in moovi platform

Assessment

	Description	Qualification	Training and Learning Results		
Mentored work	During some sessions, the students will develop a work on a biotechnological process that will be exposed in front of a jury, that will evaluate it in accordance with some quality criteria	10	B4 B6 B10	C19 C21 C22	D2 D6 D8 D9 D10 D14 D15 D17
Laboratory practical	The students will develop laboratory practices on biotechnological processes, going from data obtaining to process modelling and simulation. After the practical session, a report must be delivered where the main results are critically discussed	10	B3 B6	C19	D2 D6 D8 D9 D14 D17
Presentation	The project will be exposed to a jury composed by lecturers and/or professionals from private companies of chemical engineering.	20	B4 B6 B10		D2 D6 D8 D14 D15 D17
Essay questions exam	A global evaluation of the competencies described in the matter will be carried out at the end of the teaching period. To pass the exam, the students will have to get a minimum of 50% of the maximum mark.	60	B3 B4 B10	C19 C21 C22	D2 D6 D8 D9 D10 D14 D15 D17

Other comments on the Evaluation

The participation of the student in any of the evaluation activities involve that she/he will be subjected to assessment and

involves a "presented" mark. A total of 5 points out of 10 should be reached to pass the matter. It is expected that the student shows an ethical behaviour in what it concerns to copy, plagiarism, utilisation of unauthorised electronic devices or commitment with the team work. Otherwise, it will be considered that the student does not meet the indispensable requirements to pass the matter. In this case, the global qualification in the present academic course will be "fail" (0). Finally, the utilisation of any electronic device during the evaluation will not be allowed except for a explicit permission. In case of detecting his presence in the classroom during the examination the student will be assesed with a global mark "fail".

Sources of information

Basic Bibliography

Bjorn K. Lydersen, **Bioprocess Engineering: Systems, Equipment and Facilities**, Jouhn Wiley, 1994

Jonh Smith, **Biotechnology**, 5º, Cambridge University Press, 2009

G.D. Najafpour, **Biochemical Engineering and Biotechnology,**, Elsevier, 2007

Pauline M. Doran, **Bioprocess Engineering Principles,**, Elsevier Science and Technology, 1995

Complementary Bibliography

H.G. Vogel and C.L. Todaro, **Fermentation and Biochemical Engineering Handbook, Principles, Process Design and Equipment**, 2º, Noyes publications, 1997

M. Rodríguez Fernández, **Modelado e identificación de bioprocesos,**, 2006

Recommendations

Subjects that are recommended to be taken simultaneously

Biotechnological processes and products/V12G350V01922

Subjects that it is recommended to have taken before

Chemical engineering 1/V12G350V01405
Chemical engineering 2/V12G350V01503
Industrial chemistry/V12G350V01504
Reactors and biotechnology/V12G350V01601

Other comments

To enrol in this matter it is necessary to have passed or be enrolled in all the matters of previous courses of the degree

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