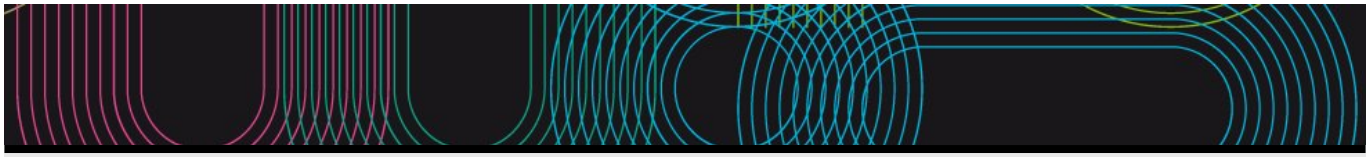

IDENTIFYING DATA				
Modelling of biotechnological processes				
Subject	Modelling of biotechnological processes			
Code	V12G350V01924			
Study programme	Degree in Industrial Chemical Engineering			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Optional	4th	2nd
Teaching language	Spanish Galician English			
Department				
Coordinator	Deive Herva, Francisco Javier			
Lecturers				
E-mail				
Web				
General description	(*)Desde la antigüedad el hombre ha utilizado los procesos biotecnológicos para la obtención de productos de interés. En la actualidad, el sector biotecnológico es una de las áreas que está experimentando un mayor crecimiento, lo que conlleva la necesidad de seleccionar, dentro de un espacio de posibilidades, aquellas alternativas que en base a un criterio predeterminado, permitan cumplir con los objetivos deseados. La búsqueda de un planteamiento formal del problema de diseño promueve la necesidad de encontrar modelos matemáticos que se ajusten a los datos empíricos y que permitan una mayor facilidad en la optimización y simulación de dichos procesos. Todo ello redundará en una mayor eficiencia y facilidad de control de diversidad de procesos con base biotecnológica			

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.
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

(*)Conocer ecuaciones cinéticas microbianas típicas para caracterizar correctamente distintos procesos biotecnológicos	B3 B6 B10	C19 C21	D2 D6 D8 D9 D10 D14 D15
(*)Conocer la integración de equipos para lograr un correcto diseño de un proceso biotecnológico	B3	C19 C22	D8 D9 D15
(*)Adquirir habilidades de utilización de software específico para la simulación y optimización de procesos biotecnológicos	B4 B6 B10	C21 C22	D2 D6 D8 D9 D10 D14 D15 D17

Contents	
Topic	
Lesson 1. Modelling biological systems	Models and types of models in biotechnology. Hierarchical analysis in modelling. Linear and non-linear equations. Ordinary differential equations application in biotechnological processes. Use of specific software for graphic representation
Lesson 2. Comprehensive analysis of biotechnological processes	Factorial designs. Use of specific software for the design of experiments in bioprocesses.
Lesson 3. Application of control strategies in biotechnological processes	Obtaining empirical data. Characterization and control of biotechnological processes. Microbial kinetics
Lesson 4. Application of dynamic optimization	Comprehensive analysis of biotechnological processes. Use of simulators. SuperProDesigner. Design of equipment for the transport of fluids. Design of process vessels. Design of pipes.
Lesson 5. Case studies	Development of real biotechnological processes related with the main aspects takcled during the course.

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	(*)Nesta actividade presentaráselles ós alumnos o temario que se desenvolverá ó longo do curso, así como os obxectivos, competencias e criterios de avaliación. Do mesmo xeito, explicaraselles a forma de desenvolver a asignatura, e crearanse os grupos que realizarán os traballos e prácticas
Lecturing	(*)Exposición por parte do profesor dos aspectos xerais do programa de forma estructurada, salientando os fundamentos e aspectos máis importantes ou de difícil comprensión para ó alumno. O profesor facilitará, a través da plataforma tem@, o material necesario para o correcto seguimento da materia. O alumno deberá traballar previamente o material entregado polo profesor e consultar a bibliografía recomendada para completar a información.
Mentored work	(*)Ó longo do curso, os alumnos desenvolverán un traballo consistente na modelaxe e simulación dunha planta biotecnolóxica, con base en datos da literatura científica e nas prácticas de laboratorio realizadas. O traballo será presentado por escrito

Laboratory practical	(*)Realizaranse experimentos de laboratorio e prácticas de campo en empresas do sector biotecnolóxico. O alumno disporá dos guions de prácticas así como do material de apoio preciso para unha adecuada comprensión dos experimentos a levar a cabo. O alumno elaborará un informe final no que deberá recoller os principais resultados e conclusións, de acordo cunha guía que se lles facilitará a través da plataforma tem@. Estas prácticas serán avaliadas conxuntamente coas prácticas de campo
Presentation	(*)Os alumnos realizarán unha defensa pública sobre o proxecto realizado nos traballos tutelados, e serán avaliados por un tribunal composto por profesores do departamento de enxeñería química e/oo profesionais do sector privado do ámbito da enxeñería química

Personalized assistance

Methodologies	Description
Lecturing	The lecturer will explain the general aspects of the program in a structured way, with special emphasis on the fundamentals and thow aspects entailing greating difficulties for being understood by the students. The teacher will provide, through the tem@ platform, the material required for a correct follow-up of the subject. The student must previously work on the material delivered by the teacher and consult the recommended bibliography to complete the information
Mentored work	Throughout the course, students will develop a consistent work in modeling and simulation of a biotechnological plant, based on data from scientific literature and laboratory practices. A written project memory should be carried out by the students
Laboratory practical	Laboratory experiments and field practices will be carried out in companies belonging to the biotechnological sector. The students will have the practice scripts as well as the support material necessary for a proper understanding of the experiments to be carried out. The students will prepare a final report in which the main results and conclusions should be collected, according to a guide that will be provided through the tem@ platform. These practices will be evaluated together with field practices
Presentation	The students will deliver a public defense about the project carried out as supervised works, and will be evaluated by a jury composed by academicians and / or professionals of the private sector in the field of chemical engineering.

Assessment

	Description	Qualification	Training and Learning Results		
Mentored work	During some sessions, the students will develop a work on a specifical biotechnological process that will be publicly exposed in front of a jury, who will evaluate it according to established quality criteria.	10	B4 B6 B10	C19 C21 C22	D2 D6 D8 D9 D10 D14 D15 D17
Laboratory practical	The students will perform laboratory practices on biotechnological processes covering both the obtaining of data allowing the characterization of the system and the modeling and simulation of the process. At the end of the internship session, they must submit a report with the main results obtained and their discussion.	10	B3 B6	C19	D2 D6 D8 D9 D14 D17
Presentation	The public defence of the project carried out during the supervised works will be evaluated by a jury composed by both academicians and / or professionals from the private sector in the field of chemical engineering.	20	B4 B6 B10		D2 D6 D8 D14 D15 D17
Essay questions exam	A global test for the evaluation of the competences acquired during the subject will be carried out at the end of the course. To overcome the subject the student must pass a minimum of 50% in all written tests, presentations, work and laboratory practices.	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 evaluated items of the subject will involve the condition "presented" and,

therefore, the assignment of a qualification. To pass the subject it will be necessary to overcome, with a total of 5 points out of 10, the sum of all the tests evaluated. It is expected that the students present an adequate ethical behavior regarding copy, plagiarism, use of unauthorized electronic devices or commitment to collaborative work. Otherwise, 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). Finally, the use of any electronic device during the evaluation tests will not be allowed unless expressly authorized. In the case of detecting their presence in the exam room, it will be considered a reason for not passing the subject in the current academic year and the overall grade will be suspended (0.0).

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