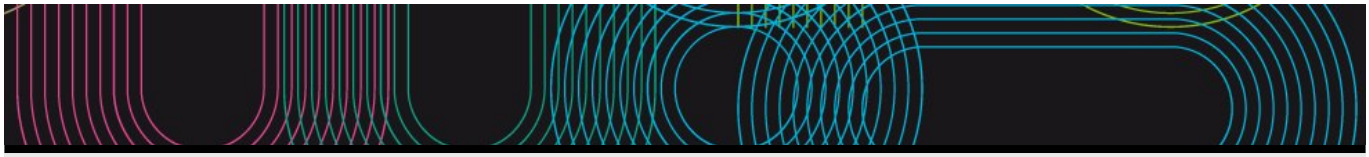

IDENTIFYING DATA				
Industrial chemistry				
Subject	Industrial chemistry			
Code	V12G350V01504			
Study programme	Degree in Industrial Chemical Engineering			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Mandatory	3rd	1st
Teaching language	#EnglishFriendly Spanish			
Department				
Coordinator	Longo González, María Asunción			
Lecturers	Deive Herva, Francisco Javier Longo González, María Asunción Rodríguez Rodríguez, Ana María			
E-mail	mlongo@uvigo.es			
Web				
General description	The chemical industry represents one of the most powerful sectors in the economies of many countries, serving as a base for other industries such as steel, oil, food and electronics. Similarly, recent advances in high-performance materials, electronic devices, medical devices, together with new technologies to remedy environmental damage and increase productivity in agriculture, arise from innovations and continuous improvements developed in each of the stages of chemical processes. Therefore, in this subject it is intended to provide the student with a global vision of the Industrial Chemistry, from the elaboration and understanding of chemical processes flowsheets to the principles of quality that govern this sector. 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.
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.
D6	CT6 Application of computer science in the field of study.

Learning outcomes			
Expected results from this subject	Training and Learning Results		
To know the most common operations for preparation and valorization of raw materials in chemical processes.	B3 B4	C19	D1 D2
To know the different techniques to minimize the amount of by-products and wastes.	B3 B4	C19	D1 D2
To identify energy resources and how to optimize their use.	B3 B4	C19	D1 D2
To acquire skills to perform and interpret industrial process flowsheets.	B3 B4	C19	D1 D2 D6

Contents	
Topic	
Introduction to industrial chemical processes.	General aspects of chemical processes. Characteristics and structure of the chemical industry sector. Situation of the Spanish chemical industry in the European and global context. Best Available Techniques.
Economics of industrial chemical processes.	Budget preparation . Analysis of costs and benefits. Economic viability criteria: Net Present Value, Internal Rate of Return, Return time.
Relevant industrial chemical processes: the industry of aluminum, paper, oil refining and biofuels.	- The aluminium industry: raw materials and properties, alumina manufacture, the Bayer process. - The paper industry: methods for pulp production, different technologies for the manufacture of paper, environmental issues, recycling of paper. - Petrochemistry: introduction to the petrochemical industry, general process flowsheet of a petrochemical refinery, different technologies for the transformation of crude oil to obtain added-value products. - Introduction to biotechnological processes: fundamental stages, conditioning of raw materials, biological reaction and recovery of products. - Biofuels: general characteristics and legal context, advantages, production of biodiesel and stages of the process, production of bioethanol and comparison of production strategies, production and applications of biogas.

Planning			
	Class hours	Hours outside the classroom	Total hours
Introductory activities	0.5	0	0.5
Laboratory practical	12	7.5	19.5
Computer practices	2	2	4
Presentation	2	6.8	8.8
Problem solving	5	12	17
Lecturing	23.5	47	70.5
Mentored work	2	18.7	20.7
Problem and/or exercise solving	1	1	2
Essay questions exam	2	5	7
*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 course syllabus will be presented to the students, as well as the objectives, competencies and evaluation criteria. Recommendations for course organization will be given, and groups for labwork, seminars and supervised work will be assigned.
Laboratory practical	Laboratory experiments and field practices in suitable industrial plants will be carried out. All the necessary support material will be provided, in order to ensure the understanding of the experiments and processes. The students will prepare a final report in which they must summarize the main results and conclusions, according to guidelines that will be available at the virtual campus. Laboratory practices will be evaluated together with field practices.
Computer practices	The students will carry out computer practices in which they will get familiarized with IT tools for the resolution of practical cases presented in theory and laboratory classes.
Presentation	The students will make an oral presentation of the project carried out as a supervised work, and will be evaluated by a jury composed of several lecturers from the Chemical Engineering Department and/or private sector professionals.
Problem solving	At the end of each lesson, the most relevant aspects will be discussed by solving practical cases and problems.
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 virtual campus, 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 carry out a small project on a chemical manufacturing process, based on the technologies discussed during the course. A written memory will be presented.

Personalized assistance	
Methodologies	**Description**
Introductory activities	During tutorials, the students (either individually or in small groups) can ask questions about the topics discussed in the classroom, and receive guidance and additional support from the lecturer. This activity can also be carried out in a remote way (through email or virtual campus). The lecturers will indicate their tutorials schedule at the beginning of the course and through the virtual campus.
Lecturing	During tutorials, the students (either individually or in small groups) can ask questions about the topics discussed in the classroom, and receive guidance and additional support from the lecturer. This activity can also be carried out in a remote way (through email or virtual campus). The lecturers will indicate their tutorials schedule at the beginning of the course and through the virtual campus.
Problem solving	During tutorials, the students (either individually or in small groups) can ask questions about the topics discussed in the classroom, and receive guidance and additional support from the lecturer. This activity can also be carried out in a remote way (through email or virtual campus). The lecturers will indicate their tutorials schedule at the beginning of the course and through the virtual campus.
Mentored work	During tutorials, the students (either individually or in small groups) can ask questions about the topics discussed in the classroom, and receive guidance and additional support from the lecturer. This activity can also be carried out in a remote way (through email or virtual campus). The lecturers will indicate their tutorials schedule at the beginning of the course and through the virtual campus.
Laboratory practical	During tutorials, the students (either individually or in small groups) can ask questions about the topics discussed in the classroom, and receive guidance and additional support from the lecturer. This activity can also be carried out in a remote way (through email or virtual campus). The lecturers will indicate their tutorials schedule at the beginning of the course and through the virtual campus.
Computer practices	During tutorials, the students (either individually or in small groups) can ask questions about the topics discussed in the classroom, and receive guidance and additional support from the lecturer. This activity can also be carried out in a remote way (through email or virtual campus). The lecturers will indicate their tutorials schedule at the beginning of the course and through the virtual campus.
Presentation	During tutorials, the students (either individually or in small groups) can ask questions about the topics discussed in the classroom, and receive guidance and additional support from the lecturer. This activity can also be carried out in a remote way (through email or virtual campus). The lecturers will indicate their tutorials schedule at the beginning of the course and through the virtual campus.

Assessment					
	Description	Qualification	Training and Learning Results		
Laboratory practical	The students will make some laboratory experiments focused on the transformation of raw materials into added value products. A report with the main experimental results and their discussion will be produced.	10	B4	C19	D1
Presentation	The project carried out as a Supervised work will be presented, and evaluated by a jury composed of lecturers from the Chemical Engineering Department and/or professionals from the private sector.	5	B3 B4	C19	D1 D2
Mentored work	During some practical sessions, the students will carry out a small project on a specific chemical process. The project will be presented, and evaluated by a jury, according to quality criteria previously established.	5	B3 B4	C19	D1 D2 D6
Problem and/or exercise solving	After each lesson or group of lessons, the lecturer will propose a short questions test (oral or written). It will be useful to evaluate the understanding of the topics and the ability of the students to synthesize the new concepts learnt in the course.	20	B3 B4	C19	D1 D2
Essay questions exam	A final test will be carried out, for the evaluation of the competencies acquired in the course. In order to pass the course, the student will have to reach a 5 out of 10 mark in the different evaluation sections.	60	B3 B4	C19	D2

Other comments on the Evaluation

Details about evaluation and qualifications

The participation of the student in any of the acts of evaluation of the course will imply the condition of presented and, therefore, the assignment of a qualification.
To pass the course, it is necessary for the student to 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 qualification (12.5 %), presentation (12.5 %), laboratory practices (25 %) and short questions tests (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 40% of the continuous assessment mark and 60 % 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 about 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)

Lecturer acting as course coordinator

María Asunción Longo González

Sources of information

Basic Bibliography

Vian Ortuño, A., **Introducción a la Química Industrial**, Reverté, 1996

Ramos Carpio, M.A., **Refino de petróleo, gas natural y petroquímica**, Fundación Fomento Innovación Industrial, 1997

Casey, J.P., **Pulpa y papel: química y tecnología química**, Noriega, 1991

Díaz, M., **Ingeniería de bioprocesos**, Paraninfo, 2012

Camps M.M., **Los Biocombustibles**, Mundi-Prensa, 2002

Complementary Bibliography

Austin, G.T., **Manual de Procesos Químicos en la Industria**, McGraw Hill, 1993

Happel, J.; Jordan, D.G., **Economía de los procesos químicos**, Reverté, 1981

Atkins, J.W., **Making pulp and paper**, Tappi Press, 2004

De Juana S. J. M., **Energías renovables para el desarrollo**, Thomson Paraninfo, 2003

El-Mansi E.M.T., **Fermentation microbiology and biotechnology**, CRC/Taylor & Francis, 2007

Gary, J.H., **Refino de petróleo: tecnología y economía**, Reverté, 1980

Herranz Agustín, C., **Química para la ingeniería**, UPC, 2010

Rodríguez Jiménez, J., **Los controles en la fabricación de papel**, Blume, 1970

Recommendations

Subjects that continue the syllabus

Experimentation in industrial chemistry 2/V12G350V01602
Technical Office/V12G350V01604
Reactors and biotechnology/V12G350V01601

Subjects that are recommended to be taken simultaneously

Experimentation in industrial chemistry 1/V12G350V01505
Chemical engineering 2/V12G350V01503
Environmental technology/V12G350V01502

Subjects that it is recommended to have taken before

Chemical engineering 1/V12G350V01405

Other comments

To enrol in this matter it is necessary to have passed or be enrolled in all the previous topics with respect to the year in which this course is taught.

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