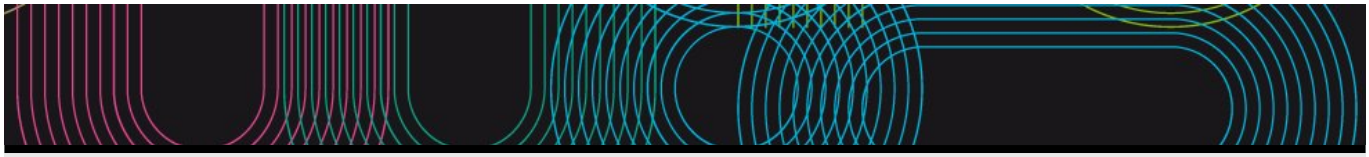

IDENTIFYING DATA				
Chemical engineering				
Subject	Chemical engineering			
Code	V11G200V01502			
Study programme	(*)Grao en Química			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	9	Mandatory	3rd	1st
Teaching language	#EnglishFriendly Spanish			
Department				
Coordinator	González de Prado, Begoña			
Lecturers	Canosa Saa, Jose Manuel Deive Herva, Francisco Javier González de Prado, Begoña			
E-mail	bgp@uvigo.es			
Web				
General description	This subject is an introduction to Chemical Engineering, where the knowledge gained in the previous Chemistry degree courses is related to Chemical industry processes. The mail goal is to enable the students to learn the basic knowledge about material and energy balances so that they can applied it to the design of separation processes such as distillation or liquid-liquid extraction. 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. This subject gives the basis to understand other subjects such as Environmental Quemistry, Food Chemistry and Industrial Chemistry.			

Competencies	
Code	
C1	Demonstrate knowledge and understanding of essential facts, concepts, principles and theories: Major aspects of chemical terminology, nomenclature, units and unit conversions.
C16	Demonstrate knowledge and understanding of essential facts, concepts, principles and theories: principles and procedures in chemical engineering
C19	Apply knowledge and understanding to solve basic problems of quantitative and qualitative nature
C20	Evaluate, interpret and synthesize data and chemical information
C21	Recognize and implement good scientific practices for measurement and experimentation
C22	Process and perform computational calculations with chemical information and chemical data
C23	Present oral and written scientific material and scientific arguments to a specialized audience
C25	Handle chemicals safely, considering their physical and chemical properties, including the evaluation of any specific risks associated with its use
C27	Monitor, by observation and measurement of physical and chemical properties, events or changes, and document and record them in a consistent and reliable way
C28	Interpret data derived from laboratory observations and measurements in terms of their significance and relate them to the appropriate theory
C29	Demonstrate skills for numerical calculations and interpretation of experimental data, with special emphasis on precision and accuracy
D1	Communicate orally and in writing in at least one of the official languages of the University
D3	Learn independently
D4	Search and manage information from different sources
D5	Use information and communication technologies and manage basic computer tools
D6	Use mathematics, including error analysis, estimates of orders of magnitude, correct use of units and data representations
D7	Apply theoretical knowledge in practice
D8	Teamwork
D9	Work independently
D10	Work at a national and international context

D12	Plan and manage time properly
D13	Make decisions
D14	Analyze and synthesize information and draw conclusions
D15	Evaluate critically and constructively the environment and oneself

Learning outcomes

Expected results from this subject	Training and Learning Results	
Know the different unit systems.	C1 C19	D7
Interpret the flow charts of chemical processes.	C16 C19 C20	
Differentiate the steady, non-steady, continuos and batch operations	C16 C19 C20	D3 D7 D9
Know and know how to apply the mass and energy balances in steady or not steady processes, with or without chemical reaction and with recycle, purge and bypass streams	C16 C19 C20	D3 D9
Know and know how to apply the mass, energy and momentum conservation laws	C16 C19 C20	D3 D7 D9
Pose and solve the design equations to the ideal chemical reactors.	C16 C20 C23	D3 D4 D5
Differentiate the heat transfer mechanisms	C16 C19 C20	D3 D4 D6 D7 D9
Calculate the heat transferred by conduction and convection in simple systems and the heat transferred in shell and tube type heat interchanger.	C16	D4
Identify the different operation units and their application.	C16 C19 C20	D7
Elaborate and interpretate vapour-liquid, liquid-liquid and gas-liquid flow diagrams.	C21 C22 C23 C25 C27 C28 C29	D1 D6 D8 D10 D12 D13 D14 D15
Solve mass balances for flash and batch distillation, liquid-liquid and solid-liquid extraction and absorption.	C21 C22 C23 C25 C27 C28 C29	D6 D8 D10 D12 D13 D14 D15
Determine the number of theoretical stages in separation units for simple mixtures.	C16 C19 C20	D7
Carry out and monitor separation processes in operation units at laboratory level.	C21 C22 C23 C25 C27 C28 C29	D1 D6 D8 D12 D13 D14 D15

Determine experimentally some properties of interest from the point of view of transport phenomena: viscosity, coefficients of convection, density.	C16 C20 C21 C22 C23 C25 C27 C28 C29	D1 D4 D5 D7 D8 D10 D12 D13 D14 D15
Work with continuous and batch chemical reactors at laboratory level.	C16 C21 C22 C25 C27 C28 C29	D1 D4 D5 D6 D7 D8 D12 D13 D14 D15

Contents	
Topic	
Subject 1. Introduction to Chemical Engineering	Origin, concept and evolution of the Chemical Engineering. Discontinuous and continuous operation. Stationary and non stationary state. Cocurrent and countercurrent operations. Classification of the unit operations. Systems of units.
Subject 2. Mass and energy balances	General equation of balance. Mass balances in systems without chemical reaction in stationary and non stationary state. Recycle, purge and bypass. Mass balances in systems with chemical reaction in stationary and non stationary state. Energy balances. Energy balances in systems with chemical reaction in stationary state.
Subject 3. Design of ideal reactors	Speed of reaction. Ideal reactors: batch stirred tank reactor, continuos stirred tank reactor and plug flow reactor
Subject 4. Heat transfer	Mechanisms of heat transfer. heat transfer through flat walls, cylindrical and spherical. Heat exchangers.
Subject 5. Distillation	Vapour-liquid equilibria. Phase diagrams for binary mixes. Simple and flash distillation. Multistage distillation
Subject 6. Liquid-liquid extraction	Liquid-liquid equilibrium for binary and ternary systems: binodal curve and distribution coefficients. Liquid-liquid extraction in cocurrent and countercurren contact.
Laboratory sessions	Experimental determination of some properties of interest from the point of view of the design of basic operations: viscosity, coefficients of convection, density. Operation with chemical reactors at lab scale. Experimental determination of phase equilibrium curves. Analysis of the capacity of extraction of several solvents in a process of solid-liquid extraction.

Planning			
	Class hours	Hours outside the classroom	Total hours
Lecturing	13	30	43
Problem solving	25	50	75
Laboratory practical	40	3	43
Autonomous problem solving	0	10	10
Presentation	5	5	10
Mentored work	1	10	11
Problem and/or exercise solving	2	8	10
Essay questions exam	3	20	23
*The information in the planning table is for guidance only and does not take into account the heterogeneity of the students.			

Methodologies	
	Description
Lecturing	During these classes (one hour per week) the teacher will explain the most relevant aspects of the subject. The students will have the available documentation on Tem@.

Problem solving	There will be a set of exercises of each subject available for the students. Some of these exercises will be solve in class and other ones will be solved by each student and presented to the teacher in order to be corrected.
Laboratory practical	Laboratory sessions will last 3.5 hours. The experimental procedure will be available for the students and they will have to write a report for each session.
Autonomous problem solving	The students will have to solve some exercises and questions and they will have to present them to the teacher before the deadline.
Presentation	The students will have to make an oral presentation related to the theoretical bases, experimental procedure, obtained results and conclusions for some of their laboratory sessions.
Mentored work	The students will have to write an individual report about one subject related to Chemical Engineering. The teacher will indicate them the main points of the subject that they will have to develop and the recommended literature.

Personalized assistance

Methodologies	Description
Problem solving	In the assigned hours of tutoring the professor will solve any doubts regarding the subject
Autonomous problem solving	In the assigned hours of tutoring the professor will solve any doubts regarding the subject
Mentored work	In the assigned hours of tutoring the professor will solve any doubts regarding the subject

Assessment

	Description	Qualification	Training and Learning Results	
Laboratory practical	The qualification will depend on the laboratory work and the laboratory report made by the students. Laboratory sessions are mandatory.	10	C21 C22 C23 C25 C27 C28 C29	D1 D6 D8 D10 D12 D13 D14 D15
Autonomous problem solving	The students will have to deliver, in the terms indicated, the problems proposed of each subject.	5	C1 C16 C19 C22	D3 D7 D9
Presentation	The students will make an oral presentation related to laboratory work.	5	C16 C20 C23	D4 D5 D7 D8 D14
Mentored work	The students will realise, and will deliver in the date indicated, an individual work on a subject proposed to the start of course.	5	C1 C16 C20 C23	D1 D3 D14
Problem and/or exercise solving	They will realise two short exams, one about the subjects 1 and 2 and another one about the subjects 3 and 4.	20	C1 C16 C19	D1 D6 D7 D9
Essay questions exam	At the end of the course the students have to do an exam related to all the subjets.	55	C1 C16 C19	D1 D6 D7 D9

Other comments on the Evaluation

Short and long exams. They will realise two short exams along the term. In the final exam, all topics will be evaluated and it is necessary to reach a minimum of 3 out of 10 points to take into account the other elements of evaluation. In case of not reaching the minimum note, the final qualification will be the one obtained in the long exam. Laboratory sessions. The laboratory sessions (lab work and report) and the oral presentation are mandatory and they are 15% of the final qualification. It is indispensable to have a minimum grade of 5 out of 10 points in this section. 50% or more laboratory sessions non-attendance means not to pass the course, independently of the results obtained in the other elements of evaluation. The participation of the student in any of the exams (short exams and long exam), two or more laboratory sessions or the delivery of 20% or more of the works required by the professor, involves the condition of "presented" and the obtention of a qualification. June final exam. A long exam of all the matter that will suppose 75% of the qualification will be

done. The students will keep the grades of obtained in laboratory sessions, oral presentation, autonomus exercices and tutored work obtained along the course.

Sources of information
Basic Bibliography
Calleja y otros, **Introducción a la Ingeniería Química**, Síntesis, 1999
W.L. McCabe, J.C. Smith y P. Harriot, **Operaciones unitarias en Ingeniería Química**, McGraw-Hill, 2007
Complementary Bibliography
R.M. Felder, **Principios elementales de los procesos químicos**, Limusa Wiley, 2003
C.J. Geankoplis, **Procesos de transporte y principios de procesos de separación**, Grupo editorial patria. México, 2007
José Felipe Izquierdo y otros, **Introducción a la Ingeniería Química. Problemas resueltos de balances de materia y energía**, Reverté, 2015

Recommendations