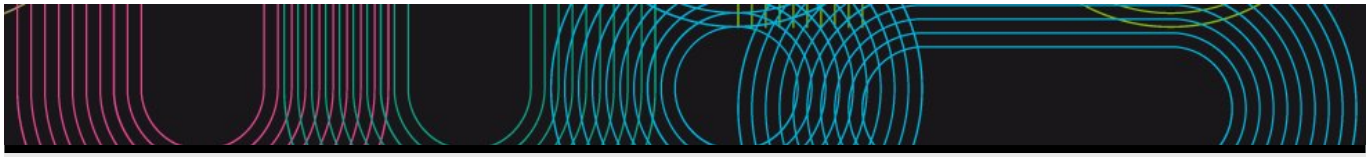

IDENTIFYING DATA				
Chemical engineering				
Subject	Chemical engineering			
Code	V11G200V01502			
Study programme	(*)Grao en Química			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	9	Mandatory	3rd	1st
Teaching language				
Department				
Coordinator	Domínguez Santiago, Angeles			
Lecturers	Canosa Saa, Jose Manuel Domínguez Santiago, Angeles			
E-mail	admguez@uvigo.es			
Web				
General description	(*)Esta asignatura, de 3er curso del grado en Química, es una introducción a Ingeniería Química en la que se relaciona los conocimientos adquiridos en el grado de química con los procesos realizados en la industria química. El objetivo primordial es que el alumno adquiera los conocimientos básicos en balances de materia y energía y aplique sus conocimientos al diseño de operaciones de separación como la destilación o la extracción líquido-líquido. Esta materia sirve de base para comprender los contenidos de otras asignaturas como Química Ambiental, Química Alimentaria y Química Industrial.			

Competencies	
Code	
A1	(*)Demostrar coñecemento e comprensión de feitos esenciais, conceptos, principios e teorías en: aspectos principais da terminoloxía química, nomenclatura, conversións e unidades
A16	(*)Demostrar coñecemento e comprensión de feitos esenciais, conceptos, principios e teorías en: principios e procedementos en Enxeñaría Química
A19	(*)Aplicar os coñecementos e a comprensión á resolución de problemas cuantitativos e cualitativos de natureza básica
A20	(*)Avaliar, interpretar e sintetizar datos e información química
A21	(*)Recoñecer e implementar boas prácticas científicas de medida e experimentación
A22	(*)Procesar datos e realizar cálculo computacional relativo a información e datos químicos
A23	(*)Presentar material e argumentos científicos de xeito oral e escrita a unha audiencia especializada
A25	(*)Manexar con seguridade sustancias químicas, considerando as súas propiedades físicas e químicas, incluíndo a valoración de calquera risco específico asociado co seu uso
A27	(*)Monitorizar, mediante observación e medida de propiedades físicas e químicas, acontecementos ou cambios e documentalos e rexistralos de xeito sistemático e fiable
A28	(*)Interpretar datos derivados das observacións e medicións do laboratorio en termos do seu significado e relacionalos coa teoría adecuada
A29	(*)Demostrar habilidades para os cálculos numéricos e a interpretación dos datos experimentais, con especial énfase na precisión e a exactitude
B1	(*)Comunicarse de forma oral e escrita en polo menos unha das linguas oficiais da Universidade
B3	(*)Aprender de forma autónoma
B4	(*)Procurar e administrar información procedente de distintas fontes
B5	(*)Utilizar as tecnoloxías da información e das comunicacións e manexar ferramentas informáticas básicas
B6	(*)Manexar as matemáticas, incluíndo aspectos tales como análise de erros, estimacións de ordes de magnitude, uso correcto de unidades e modos de presentación de datos
B7	(*)Aplicar os coñecementos teóricos á práctica
B8	(*)Traballar en equipo
B9	(*)Traballar de forma autónoma
B10	(*) Traballar nun contexto tanto nacional como internacional
B12	(*)Planificar e administrar adecuadamente o tempo
B13	(*)Tomar decisións

B14 (*) Analizar e sintetizar información e obter conclusións

B15 (*)Avaliar de modo crítico e construtivo o entorno e a si mesmo

Learning aims

Expected results from this subject	Training and Learning Results	
Interpret the flow charts of chemical processes. Distinguish the types of unit operations Know the different systems of units.	A1 A16	B1 B3 B4
Identify the different types of unit operations and the principles of mass, energy and quantity of movement conservation in which they are based on.	A16	B1 B3
Pose and solve mass balances in stationary and non stationary state, with and without chemical reaction and with recycle, purge or bypass streams.	A16 A19	B1 B3
Pouse and solve energy balances in stationary and non stationary state, with and without chemical reaction.	A16 A19 A20	B1 B3
Apply the mass balance to the design of ideal chemical reactors: batch stirred tank reactor, continuous stirred tank reactor and plug flow reactor.	A16 A19 A20	B3
Pose and solve heat transfer problems through different geometry walls.	A16 A19 A20	B1 B3 B4 B5 B9
Design and interpret phase equilibrium diagrams.	A16	B1 B3
Identify the different distillation processes (simple distillation, flash and multistage distillation) and propouse and solve the mass balances for each case.	A16 A19 A20	B4
Pose and solve problems of liquid-liquid extraction.	A16 A19 A20	B4
Determine experimentally some properties of interest from the point of view of the design of basic operations: viscosity, coefficients of convection, density.	A20 A21 A22 A23 A25 A27 A28 A29	B4 B6 B7 B8 B12 B13 B15
Determine the kinetics of a reaction and operate with continuous and batch chemical reactors at laboratory scale.	A20 A21 A22 A23 A25 A27 A28 A29	B4 B6 B7 B8 B12 B13 B14 B15
Determine experimentally the phase equilibrium diagrams	A20 A21 A23 A25 A28	B5 B6 B7 B8 B10 B12 B15
Analyse the capacity of extraction of some solvents in solid-liquid extraction process.	A20 A21 A23 A25 A28	B6 B8 B12 B14

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. Determination of the kinetics of a reaction and operation with chemical reactors. 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
Master Session	13	30	43
Troubleshooting and / or exercises	25	50	75
Laboratory practises	40	3	43
Autonomous troubleshooting and / or exercises	0	10	10
Presentations / exhibitions	5	5	10
Tutored works	1	10	11
Short answer tests	2	8	10
Long answer tests and development	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
Master Session	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@.
Troubleshooting and / or exercises	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 practises	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 troubleshooting and / or exercises	The students will have to solve some exercises and questions and they will have to present them to the teacher before the deadline.
Presentations / exhibitions	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.
Tutored works	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 attention

Methodologies	Description
Troubleshooting and / or exercises	The students know the tutor hours from the beginning of the course and during those hours they can solve questions about theory, exercises laboratory work or tutored works.
Autonomous troubleshooting and / or exercises	The students know the tutor hours from the beginning of the course and during those hours they can solve questions about theory, exercises laboratory work or tutored works.
Tutored works	The students know the tutor hours from the beginning of the course and during those hours they can solve questions about theory, exercises laboratory work or tutored works.

Assessment

	Description	Qualification

Laboratory practises	The qualification will depend on the laboratory work and the laboratory report made by the students. Laboratory sessions are mandatory.	10
Autonomous troubleshooting and / or exercises	The students will have to deliver, in the terms indicated, the problems proposed of each subject.	10
Presentations / exhibitions	The students will make an oral presentation related to laboratory work.	10
Tutored works	The students will realise, and will deliver in the date indicated, an individual work on a subject proposed to the start of course.	5
Short answer tests	They will realise two short exams, one about the subjects 1 and 2 and another one about the subjects 3 and 4.	20
Long answer tests and development	At the end of the course the students have to do an exam related to all the subjets.	45

Other comments on the Evaluation

Short and long exams. They will realise two short exams along the term. In the final exam the whole of the matter 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 long exam qualification.

Laboratory sessions. The laboratory sessions (lab work and report) and the oral presentation are mandatory and they are the 20% of the final note. It is indispensable to have a minimum grade of 5 out of 10 points in this section. The no assistance to 50% or more than the sessions of laboratory means not to pass the course , independently of the results obtained in the other elements of evaluation. The competencies evaluated are B1, B5, B7, B13 and B14.

The individual work will allow the evaluation of the competencies B1,B3,B4,B5 and B9.

The final qualification could be normalised so that the highest qualification was 10 points.

The participation of the student in any of the exams (short exams and long exam), the attendance to two or more laboratory sessions or the delivery of 20% or more than the works required by the professor, involves the condition of "presented" and the obtention of a qualification.

Extraordinary exam. A long exam of all the matter that will suppose 45% of the note will be done. the students will keep the corresponding notes to the other sections obtained along the course.

Sources of information

Calleja y otros, **Introducción a la Ingeniería Química**, 1999,

R.M. Felder, **Principios elementales de los procesos químicos**, 2003,

C.J. Geankoplis, **Procesos de transporte y principios de procesos de separación**, 2007,

W.L. McCabe, J.C. Smith y P. Harriot, **Operaciones unitarias en Ingeniería Química**, 2007,

Recommendations