

30102 - Chemistry

Información del Plan Docente

Academic Year	2017/18
Faculty / School	175 - Escuela Universitaria Politécnica de La Almunia 179 - Centro Universitario de la Defensa - Zaragoza
Degree	425 - Bachelor's Degree in Industrial Organisational Engineering 457 - Bachelor's Degree in Industrial Organisational Engineering 563 - Bachelor's Degree in Industrial Organisational Engineering
ECTS	6.0
Year	1
Semester	Half-yearly
Subject Type	Basic Education
Module	---

1.General information

1.1.Introduction

1.2.Recommendations to take this course

1.3.Context and importance of this course in the degree

1.4.Activities and key dates

2.Learning goals

2.1.Learning goals

2.2.Importance of learning goals

3.Aims of the course and competences

3.1.Aims of the course

3.2.Competences

4.Assessment (1st and 2nd call)

4.1.Assessment tasks (description of tasks, marking system and assessment criteria)

5.Methodology, learning tasks, syllabus and resources

5.1.Methodological overview

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The organization of teaching will be carried out using the following steps:

- **Theory Classes** : Theoretical activities carried out mainly through exposition by the teacher, where the theoretical supports of the subject are displayed, highlighting the fundamental, structuring them in topics and or sections, interrelating them.
- **Practical Classes** : The teacher resolves practical problems or cases for demonstrative purposes. This type of teaching complements the theory shown in the lectures with practical aspects.
- **Laboratory Workshop** : The lecture group is divided up into various groups, according to the number of registered students, but never with more than 16 students, in order to make up smaller sized groups.
- **Individual Tutorials** : Those carried out giving individual, personalized attention with a teacher from the department. Said tutorials may be in person or online.

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In order to get the objectives described in the previous sections the following learning activities will be carried out: lectures, practical and problem solving sessions, laboratory sessions.

5.2.Learning tasks

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The subject has 6 ECTS credits, which represents 150 hours of student work in the subject during the trimester, in other words, 10 hours per week for 15 weeks of class.

A summary of a weekly timetable guide can be seen in the following table. These figures are obtained from the subject file in the Accreditation Report of the degree, taking into account the level of experimentation considered for the said subject is moderate.

Activity	Weekly school hours
Lectures	2
Laboratory Workshop	2
Other Activities	6

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1. lectures,
2. practical and problem solving sessions,
3. laboratory sessions.

5.3.Syllabus**SPECIALIZATION IN BUSINESS****THEORETICAL CONTENTS**

Module	Contents
1. THE ATOM AND THE PERIODIC SYSTEM	<p>Topic 1.- The atom.</p> <p>Elemental particles. Atomic models. The Bohr atom. The quantum mechanical model. Atomic orbitals; quantum numbers. Principles for the electronic construction of atoms.</p> <p>Topic 2.- General overview of the periodic table</p> <p>Description of the current periodic table: groups and periods. Study of the electron shell and the periodic system. Periodic properties.</p>

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2. THE CHEMICAL BOND	<p>Topic 3 .- The ionic bond</p> <p>General characteristics of the ionic bond. Network energy. General properties of ionic compounds.</p> <p>Topic 4 .- The covalent bond</p> <p>Simplified model: the Lewis theory. Bond polarity and geometry. Valence bond theory. Orbital hybridization. Molecular orbital theory.</p> <p>Topic 5 .- The metallic bond</p> <p>General characteristics of metals. Theories of the metallic bond: the electron sea theory and valence bond theory. Alloys: classes.</p>
3. BONDS BETWEEN MOLECULES	<p>Topic 6 .- Intermolecular bonds</p> <p>Van der Waal forces. Hydrogen bonds.</p>
4. AGGREGATION STATES	<p>Topic 7 .- The gas state</p> <p>General characteristics of gases. Laws that govern the gas state. Equations of state. Kinetic theory. Gas mixtures: Dalton's Law. Gas diffusion and effusion: Graham's Law. Real gases: The Van der Waal equation.</p> <p>Topic 8 .- The liquid state</p>

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	<p>General characteristics of liquids. Vapour pressure. The effect of temperature on vapour pressure. Critical phenomena. Condensation of vapours and gases. Solidification.</p> <p>Topic 9 .- The solid state</p> <p>Characteristics of solids. Classes of crystal network. Classes of solids based on bonding type. The phase rule and the triple point.</p>
<p>5. INTRODUCTION TO THE STUDY OF SOLUTIONS</p>	<p>Topic 10 .- Introduction to the study of solutions</p> <p>Disperse systems. Types of solutions. Means of expressing concentration. Solid-in-liquid solutions. Liquid-in-liquid solutions. Gas-in-liquid solutions. Colligative properties of solutions. Colloidal solutions.</p>
<p>6. INTRODUCTION TO THE STUDY OF REACTIONS</p>	<p>Topic 11 .- Chemical equilibrium</p> <p>The concept of reaction rate. Reversible and irreversible reactions. Chemical equilibrium: the equilibrium constant. Le Chatelier's principle. Stable, unstable and metastable systems.</p> <p>Topic 12.- Neutralisation reactions</p> <p>The acid-base concept. Aqueous solutions: pH of aqueous solutions. Acid-base strengths. Equilibrium constants. Salt hydrolysis.</p>

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7. ORGANIC CHEMISTRY	<p>Topic 13 .- Organic chemistry</p> <p>The properties of carbon. Types of organic substances Isomers. Organic chemical reactions. Polymers</p>
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PRACTICAL CONTENTS

Practical 1	<p>Standards in Chemical Laboratory</p> <p><i>Techniques, Equipment and Safety</i></p>
Practical 2	<p>Solution Preparation</p> <p><i>Na₂CO₃ 0,1 M from Na₂CO₃ solid; CaCl₂ 0,1 M from CaCl₂ 2 M</i></p>
Practical 3	<p>Filtration</p> <p><i>Gravity Filtration and Vacuum Filtration</i></p>
Practical 4	<p>Volumetric Analysis</p> <p><i>Water hardness; carbonates and bicarbonates in water.</i></p>

Practical 5	Distillation
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Contents

Unit 1. Chemistry and matter

- 1.1. Basic concepts
- 1.2. Fundamental laws of chemical reactions. Atoms
- 1.3. Compounds and chemical formula
- 1.4. Composition of compounds
- 1.5. Mixtures, solutions and solubility

Unit 2. Chemical reactions and stoichiometry

- 2.1. Chemical reaction and chemical equation
- 2.2. Stoichiometry of chemical reactions
- 2.3. Gases

2.3. Aqueous reactions

Unit 3. Chemical equilibrium

- 3.1. Basic concepts
- 3.2. Equilibrium constant and chemical equation
- 3.3. Numerical importance of the equilibrium constant
- 3.4. The reaction quotient, Q
- 3.5. Le Chatelier's principle
- 3.6. Acid-base equilibria and the pH scale

Lab. session 1: Solutions and titration

Unit 4. Energy and Chemistry

- 4.1. Basic concepts
- 4.2. The First Law of Thermodynamics: heat, work and enthalpy
- 4.3. Spontaneous processes
- 4.4. Entropy.
- 4.6. The Second Law of Thermodynamics.

Unit 5. Chemical kinetics

- 5.1. Reaction rates
- 5.2. Concentration and reaction rate
- 5.3. Rate laws
- 5.4. The change of concentration with time.
- 5.5. Temperature and reaction rate
- 5.6. Reaction mechanisms
- 5.7. Catalysis

Lab. session 2: The aluminothermic reaction

Unit 6. Atomic models

- 6.1. From classical physics to quantum mechanics
- 6.2. Line spectra and the Bohr model
- 6.3. The wave behaviour of matter

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- 6.4. Quantum mechanics and atomic orbitals
- 6.5. Many-electron atoms
- 6.6. Electronic configurations and the Periodic Table
- 6.7. Periodic properties
- Unit 7. Chemical bond I
 - 7.1. Chemical bonds, Lewis symbols and the octet rule
 - 7.2. Ionic bonding
 - 7.3. Covalent bonding
 - 7.4. Strength of covalent bonds
- Unit 8. Chemical bond II
 - 8.1. The VSEPR model
 - 8.2. Molecular polarity
 - 8.3. Molecular-orbital model
 - 8.4. Molecular-orbital model for metals
- Unit 9. Intermolecular forces and liquids
 - 9.1. Intermolecular forces
 - 9.2. Solubility and the solution process
 - 9.3. Phases, phase changes and phase diagrams
 - 9.4. Liquids: boiling point, vapor pressure, surface tension, viscosity
- Unit 10. Solids
 - 10.1. Amorphous solids and the short-range order. Glass transition temperature
 - 10.2. Crystalline solids, the long-range order and the unit cell
 - 10.3. Bonding in solids
- Unit 11. Materials
 - 11.1. Materials science and classes of materials
 - 11.2. Ceramics
 - 11.3. Polymers
 - 11.4. Alloys
 - 11.5. Semiconductors

5.4. Course planning and calendar

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SECTION	Topic	Nº hours
0 y 1	Presentation. Atom (<i>Topic 1</i>) and the Periodic System (<i>Topic 2</i>)	10
2 y 3	The Chemical Bond (<i>Topics 3, 4 y 5</i>) and Intermolecular Bonds (<i>Topic 6</i>)	12
4	Aggregation States (<i>Topics 7, 8 y 9</i>)	6
5	Introduction to the study of	8

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	solutions (<i>Topic 10</i>)	
6	Introduction to the study of reactions (<i>Topics 11 y 12</i>)	8
7	Organic Chemistry (<i>Topic 13</i>)	4
	Practical Course	6
	Exams	6
TOTAL		60

The dates of the final exams will be those that are officially published at <http://www.eupla.es/secretaria/academica/examenes.html>.

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Before the start of the semester the course additional information will be published in the Moodle platform, which can be consulted at <http://moodle.unizar.es> after authentication with the student's username and password.

This information will include the course planning, materials, bibliography and other recommendations to follow the course.

Information about general course calendars and timetables can also be found at the website of the Centro Universitario de la Defensa: <http://cud.unizar.es>.

5.5. Bibliography and recommended resources

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References and resources

Basic material prepared by the lecturer:

GONZÁLEZ PAÚLES, J. y BURBANO GARCÍA, G. Apuntes de Química para el Grado en Ingeniería Civil. *Ed. Eupla. 2011. ISBN 978 84 694 0618 2*

GONZÁLEZ PAÚLES, J. Química General. Apuntes del curso práctico. *Ed. Eupla.2010. ISBN 978-84-692-8044-7*

Power Point in moodle platform (<https://moodle.unizar.es/>)

BIBLIOGRAPHY

- Gonzalez Paúles, J . Burbano García, G.. Apuntes de Química para el grado de ingeniería civil/Javier Gonzalez Paúles y Gloria Burbano García.. - 1ª Edición Eupla:La Almunia de doña godina(Zaragoza), 2011
- González Paúles, J.. Química General. Apuntes del curso práctico/ Javier González Paúles. - 1ª edición Eupla:La Almunia de doña godina(Zaragoza), 2010
- Química : un proyecto de la American Chemical Society / [versión española por Roberto Martínez-Alvárez, M^a Josefa Rodríguez Yunta, Luis Sánchez Martín] Barcelona [etc.] : Reverté, D.L. 2005
- Química / Ronald J. Gillespie ... [et al.] ; versión española por Aurelio Beltrán Barcelona [etc.] : Reverté, D.L. 1990
- Negro, José Luis. Iniciación al lenguaje químico inorgánico / José Luis Negro. Madrid: Alhambra, 1979
- Nyman, C.J.. Problemas de química general y análisis cualitativo / C.J. Nyman y G.B. King ; traducción de A. López-Lago . - [1a ed. española] Madrid : AC, D.L.1978
- Peterson, W.R. Formulación y nomenclatura química inorgánica/ W.R. Peterson. - 14 edición Barcelona: Edunsa, 1987
- Sienko, Michell J.. Problemas de química / M.J. Sienko Barcelona [etc.] : Reverté, D.L.1987

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Basic

Química: la ciencia central / Theodore L. Brown ... [et al.]; con la colaboración de Patrick Woodward; traducción, Laura Fernández Enríquez; revisión técnica, María Aurora Lanto Arriola . 12ª ed. México: Pearson Educación, 2014

Brown, L. S. y Holme, T. A. Chemistry for Engineering Students. 2nd ed. México D.F.: Cengage Learning, 2011

Chang, Raymond. Fundamentos de química / Raymond Chang; adaptación Pedro Ibarra Escutia; revisión técnica Isaías de la Rosa Gómez México D. F.: McGraw-Hill/Interamericana, cop. 2011

Problemas y cuestiones de química / María Teresa Aramendía ... [et al.] . - 1ª ed. Zaragoza: Centro Universitario de la Defensa, 2015

Smith, William F. Fundamentos de la ciencia e ingeniería de materiales / William F. Smith, Javad Hashemi; revisión técnica Ramón Esquivel González, Arturo Barba pingarrón , [traductor, Gabriel Nagore Cázares] . - 5ª ed. México D. F.: McGraw-Hill Interamericana, cop. 2014

Complementary

Callister, William D., Jr. Introducción a la ciencia e ingeniería de los materiales / William D. Callister, Jr.; [versión española por Pere Molera Solà y Marc J. Anglada Gomila] . - [1ª] ed. en español, reimp. Barcelona [etc.]: Reverté, 2012

Chang, Raymond. Química / Raymond Chang; revisión técnica, Rodolfo Álvarez Manzo, Silvia Ponce López, Rosa Zugazagoitia Herranz; [traducción, Erika Jasso Hernán D' Bourneville] . - 10ª ed. México [etc.]: McGraw-Hill, cop. 2010

Experimentación en Química General. J. Martínez Urreaga et al. Thomson, 2006

López Cancio, J. A. Problemas de química, cuestiones y ejercicios. J. A. López Cancio. Prentice Hall, 2000

Peterson, W. R. Introducción a la nomenclatura de las sustancias químicas / W. R. Peterson Barcelona [etc.]: Reverté, D. L. 2010

Petrucci, Ralph H. Química general / Ralph H. Petrucci, William S. Harwood, F. Geoffrey Herring; con la colaboración de

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Scott S. Perry; traducción, Concepción Pando G^a-Pumarino, Nerea Iza Cabo; revisión técnica, Juan A. Rodríguez Renuncio . - 8^a ed., reimp. Madrid: Prentice Hall, cop. 2009