



## 1. General information

Course: FOUNDATIONS OF CHEMISTRY  
Type: BASIC  
Degree: 409 - CHEMISTRY  
Center: 1 - FACULTY OF SCIENCE AND CHEMICAL TECHNOLOGY  
Year: 1

Code: 57300

ECTS credits: 12

Academic year: 2023-24

Group(s): 20 23

Duration: AN

Second language:

English Friendly: Y

Bilingual: N

Main language: Spanish

Use of additional languages:

Web site:

Lecturer: BEATRIZ CABANAS GALAN - Group(s): 23				
Building/Office	Department	Phone number	Email	Office hours
Edificio Marie Curie (primer piso)	QUÍMICA FÍSICA	926052042	beatriz.cabanas@uclm.es	Monday and Tuesday from 16h to 18 h Wednesday and Thursday from 12h to 13h
Lecturer: MARÍA VICTORIA GÓMEZ ALMAGRO - Group(s): 20				
Building/Office	Department	Phone number	Email	Office hours
IRICA	QUÍMICA INORG., ORG., Y BIOQ.	926052633	MariaVictoria.Gomez@uclm.es	Monday, Tuesday and thursday, 16h-18h.
Lecturer: M <sup>º</sup> ISABEL LOPEZ SOLERA - Group(s): 20				
Building/Office	Department	Phone number	Email	Office hours
Edificio San Alberto Magno (primer piso)	QUÍMICA INORG., ORG., Y BIOQ.	926052501	mabel.lopez@uclm.es	Monday and Wednesday, 17 - 18.30h Tuesday and Thursday, 12 - 13.30 h
Lecturer: JUANA RODRIGUEZ FLORES - Group(s): 23				
Building/Office	Department	Phone number	Email	Office hours
S. Alberto Magno	Q. ANALÍTICA Y TGA. ALIMENTOS	926052428	juana.rflores@uclm.es	Tuesday and thursday from 16 to 19 h

## 2. Pre-Requisites

There are no prerequisites for this subject, although it is recommended that the student have completed Chemistry in High School. Also, it is advisable that the student is familiar with the nomenclature and formulation of inorganic

## 3. Justification in the curriculum, relation to other subjects and to the profession

The subject of Chemistry Foundations intends that the student deepen the understanding of the chemical concepts that he has acquired during the Baccalaureate, complete them and acquire the bases to acquire the necessary

General Chemistry is an annual basic subject, which will be taught in the first year and constitutes an essential starting point for the correct learning of other more specific subjects in the different areas of Chemistry.

## 4. Degree competences achieved in this course

## Course competences

Code	Description
CB01	Prove that they have acquired and understood knowledge in a subject area that derives from general secondary education and is appropriate to a level based on advanced course books, and includes updated and cutting-edge aspects of their field of knowledge.
CB03	Be able to gather and process relevant information (usually within their subject area) to give opinions, including reflections on relevant social, scientific or ethical issues.
E01	Understand and use chemical terminology, nomenclature, conventions and units
E02	Deduce the variation of the properties of the chemical elements according to the Periodic Table
E03	Handle chemicals safely and with respect to the environment
E07	Relate macroscopic properties with those of atoms, molecules and non-molecular chemical compounds
E15	Know how to handle the standard chemical instrumentation and be able to elaborate and manage standardized procedures of work in the laboratory and chemical industry
G01	Know the principles and theories of Chemistry, as well as the methodologies and applications characteristic of analytical chemistry, physical chemistry, inorganic chemistry and organic chemistry, understanding the physical and mathematical bases that require
G02	Be able to gather and interpret data, information and relevant results, obtain conclusions and issue reasoned reports on scientific, technological or other problems that require the use of chemical tools
T03	Proper oral and written communication
T05	Organization and planning capacity

## 5. Objectives or Learning Outcomes

## Course learning outcomes

## Description

Learn to work autonomously in a laboratory and know how to interpret the experimental results obtained.

Homogenize the knowledge of Chemistry already acquired by students in Secondary School courses and complete certain aspects that have not been previously studied with the necessary depth.

Achieve that the student acquires the basic terminology of Chemistry and knows how to use it, as well as being able to establish relationships between the different concepts.

Know and correctly handle the different units.

Encourage and promote in the student all those values and attitudes inherent to scientific activity.

Know the basic concepts and principles of Chemistry, so that the essential foundations are established so that they can successfully face the study of the different branches of the discipline.

## 6. Units / Contents

## Unit 1: Seminary: Inorganic chemical formulation

Unit 1.1 Basic rules of formulation and nomenclature

Unit 1.2 Binary compounds

Unit 1.3 Hydroxides, oxoacids, peroxyacids and thioacids

Unit 1.4 Ions and salts

Unit 1.5 Oxides, hydroxides and double salts

Unit 1.6 Addition compounds

Unit 1.7 Coordination compounds

## Unit 2: Origins of the quantum theory of the atom

Unit 2.1 The electric nature of matter

Unit 2.2 Rutherford's atomic model

Unit 2.3 The dual nature of electromagnetic radiation

Unit 2.4 Emission spectrum of the hydrogen atom

Unit 2.5 Atomic model of Bohr

Unit 2.6 Dual nature of matter: De Broglie's Relation

Unit 2.7 Uncertainty Principle

## Unit 3: Mechanical quantum model of hydrogen atom

Unit 3.1 Schrödinger's equation. Wave function

Unit 3.2 Probability. The wave function conditions

Unit 3.3 Solution of the wave equation for hydrogen atoms

Unit 3.4 Quantum numbers and atomic orbitals

Unit 3.5 Physical meaning and representations of the hydrogen atom orbitals

## Unit 4: Polyelectronic atoms and periodical properties

Unit 4.1 Electronic configurations. Aufbau principle

Unit 4.2 Shielding. Slater's rules

Unit 4.3 Periodic classification of elements. Periodic table

Unit 4.4 Periodical properties of elements

## Unit 5: Covalent Bond I

Unit 5.1 Molecular geometry approximation model. Lewis structures

Unit 5.2 Hybridization. Valence Bonding Theory

Unit 5.3 Valence Shell Electron Repulsion Theory

## Unit 6: Covalent Bond II

Unit 6.1 Molecular Orbitals Theory

Unit 6.2 Application of MO Theory to homo- and heteronuclear diatomic molecules of second period elements.

Unit 6.3 Ionic character of a covalent bond. electronegativity

Unit 6.4 Intermolecular forces

Unit 6.5 Phase transitions and phase diagrams

## Unit 7: Ionic and metallic bond

Unit 7.1 Crystalline structure of ionic solids

Unit 7.2 Ionic radii

Unit 7.3 Lattice energy, Born-Haber's Cycle. Born-Landé equation equation

Unit 7.4 Polarisation. Covalent Character of an Ionic Bond. Fajans Rules

Unit 7.5 Fundamental properties of ionic solids

Unit 7.6 Introduction to metallic bond

- Unit 7.7** Types and properties of crystalline solids
- Unit 8: Gaseous state**
- Unit 8.1** Gas pressure
- Unit 8.2** Elementary gas laws
- Unit 8.3** Ideal gas equations
- Unit 8.4** Mixture of gases. Dalton's law
- Unit 8.5** Introduction to the kinetic theory of gases
- Unit 8.6** Real gases. Real gas equations
- Unit 9: Chemical Thermodynamic**
- Unit 9.1** Energy, heat and work
- Unit 9.2** First principle of thermodynamic
- Unit 9.3** Enthalpy. Hess's law
- Unit 9.4** Second principle of thermodynamics
- Unit 9.5** Gibbs' free energy. Criteria of spontaneity
- Unit 10: Seminary: Organic chemical formulation**
- Unit 10.1** Hydrocarbons: alkanes, alkenes, alkynes
- Unit 10.2** Monocyclic hydrocarbons. aromatic hydrocarbons
- Unit 10.3** Organic compounds with functional groups with oxygen
- Unit 10.4** Organic compounds with functional groups with nitrogen
- Unit 10.5** Organic compounds with functional groups with sulfur
- Unit 11: Solutions**
- Unit 11.1** Solubility and concentration units
- Unit 11.2** Ideal solutions. Raoult's law
- Unit 11.3** Colligative properties of solutions
- Unit 11.4** Non-ideal solutions
- Unit 11.5** Fractional distillation. boiling temperature
- Unit 12: Chemical balance**
- Unit 12.1** Reversible and irreversible reactions
- Unit 12.2** Equilibrium state properties
- Unit 12.3** Free energy of a reaction and equilibrium constant
- Unit 12.4** Factors that affect a system of equilibrium
- Unit 12.5** Strong and weak electrolytes
- Unit 13: Acid base balance**
- Unit 13.1** Acid base balance theories
- Unit 13.2** Concepts of pH and pK
- Unit 13.3** pH calculation in strong and weak acids and bases
- Unit 13.4** Calculation of the pH in the different salts
- Unit 13.5** Buffer solutions. pH and preparation
- Unit 14: Precipitation balance**
- Unit 14.1** Solubility definition. types of ionic solutes
- Unit 14.2** Solubility equilibrium constant K<sub>ps</sub>
- Unit 14.3** Salt and common ion effects on solubility
- Unit 14.4** Fractional precipitation
- Unit 14.5** Dissolution of precipitates
- Unit 15: Complexes balance**
- Unit 15.1** Werner's theory. complex nomenclature
- Unit 15.2** Complex structure
- Unit 15.3** Complex stability constants
- Unit 15.4** Quantitative aspects of precipitation and dissolution of precipitates
- Unit 15.5** Complex chelate types
- Unit 16: Redox balance**
- Unit 16.1** Oxidation index concept
- Unit 16.2** Oxidants and reducers. Adjustment of redox equations
- Unit 16.3** Redox potential and redox equilibrium constant
- Unit 16.4** The Nerst equation. Influence of concentration of redox species
- Unit 16.5** Electrochemical cells. Batteries
- Unit 17: Chemical kinetics**
- Unit 17.1** Reaction rate concept
- Unit 17.2** Factors that affect the chemical rate of a reaction
- Unit 17.3** Reaction rate law
- Unit 17.4** Reactions of zero, one and two order

#### 7. Activities, Units/Modules and Methodology

Training Activity	Methodology	Related Competences (only degrees before RD 822/2021)	ECTS	Hours	As	Com	Description
Class Attendance (theory) [ON-SITE]	Lectures	E01 E02 E03 E07 G01 G02	2.44	61	N		Teaching presence teaching theoretical classes and solving examples
Problem solving and/or case studies [ON-SITE]	Guided or supervised work	CB01 CB03 E01 E02 E03 E07 E15 G01 G02 T03 T05	2	50	Y	N	Problem Seminars and Case Studies
Study and Exam Preparation [OFF-SITE]	Self-study	CB01 CB03 E01 E02 E03 E07 G01 G02	6.76	169	N		Study and exam preparation. Documentation, preparation, learning and resolution of practical cases
Progress test [ON-SITE]	Assessment tests	CB01 CB03 E01 E02 E03 E07 E15 G01 G02 T03 T05	0.16	4	Y	N	In this activity, the student must demonstrate that they are acquiring, progressively, the basic concepts
Group tutoring sessions [ON-SITE]	Group tutoring sessions	CB01 CB03 E01 E02 E07 G01 G02 T03	0.32	8	N		Resolution of doubts
Final test [ON-SITE]	Assessment tests	CB01 CB03 E01 E02 E07 G01 G02 T03	0.32	8	Y	N	This test may be distributed throughout the course in partial tests, according to the schedule that will be published on "Campus virtual".
<b>Total:</b>			<b>12</b>	<b>300</b>			
<b>Total credits of in-class work: 5.24</b>			<b>Total class time hours: 131</b>				
<b>Total credits of out of class work: 6.76</b>			<b>Total hours of out of class work: 169</b>				

As: Assessable training activity

Com: Training activity of compulsory overcoming (It will be essential to overcome both continuous and non-continuous assessment).

#### 8. Evaluation criteria and Grading System

Evaluation System	Continuous assessment	Non-continuous evaluation*	Description
Test	10.00%	0.00%	Test of organic and inorganic formulation must be passed.
Assessment of problem solving and/or case studies	20.00%	0.00%	The resolution of problems by the student will be positively assessed at the proposal of the teacher.
Final test	70.00%	100.00%	This test may be distributed throughout the course in partial tests, according to the schedule that will be published on "Campus virtual"
<b>Total:</b>	<b>100.00%</b>	<b>100.00%</b>	

According to art. 4 of the UCLM Student Evaluation Regulations, it must be provided to students who cannot regularly attend face-to-face training activities the passing of the subject, having the right (art. 12.2) to be globally graded, in 2 annual calls per subject, an ordinary and an extraordinary one (evaluating 100% of the competences).

#### Evaluation criteria for the final exam:

##### Continuous assessment:

Continuous evaluation implies participation in all the formative activities. The course will be considered passed when the overall grade is equal or higher than five and the two formulation exams have been passed. There will be two partial tests in each term that will be averaged between them and with the rest of the formative activities as long as the grade is higher or equal to 4. If any of the partial tests is not passed, it will be recovered in the ordinary call.

##### Non-continuous evaluation:

There will be an exam in which the theoretical and practical concepts of the subject will be fully evaluated and must pass the organic and inorganic formulation test. The final grade will correspond to the final exam grade. The student will pass the course with a minimum grade of 5.

#### Specifications for the resit/retake exam:

The same criteria above will be used. The student will only have to take the exam for the parts not passed.

#### Specifications for the second resit / retake exam:

There will be an exam in which the theoretical and practical knowledge will be fully evaluated and must pass the organic and inorganic formulation test. The final grade will correspond to the final exam grade. The student will pass the course with a minimum grade of 5.

#### 9. Assignments, course calendar and important dates

Not related to the syllabus/contents	
<b>Hours</b>	<b>hours</b>
Progress test [PRESENCIAL][Assessment tests]	4
Final test [PRESENCIAL][Assessment tests]	8
<b>Unit 1 (de 17): Seminary: Inorganic chemical formulation</b>	
<b>Activities</b>	<b>Hours</b>

Class Attendance (theory) [PRESENCIAL][Lectures]	3
Problem solving and/or case studies [PRESENCIAL][Guided or supervised work]	5
Study and Exam Preparation [AUTÓNOMA][Self-study]	12
Group tutoring sessions [PRESENCIAL][Group tutoring sessions]	1
<b>Unit 2 (de 17): Origins of the quantum theory of the atom</b>	
<b>Activities</b>	<b>Hours</b>
Class Attendance (theory) [PRESENCIAL][Lectures]	3
Problem solving and/or case studies [PRESENCIAL][Guided or supervised work]	2
Study and Exam Preparation [AUTÓNOMA][Self-study]	6
<b>Unit 3 (de 17): Mechanical quantum model of hydrogen atom</b>	
<b>Activities</b>	<b>Hours</b>
Class Attendance (theory) [PRESENCIAL][Lectures]	3
Problem solving and/or case studies [PRESENCIAL][Guided or supervised work]	2
Study and Exam Preparation [AUTÓNOMA][Self-study]	9
<b>Unit 4 (de 17): Polyelectronic atoms and periodical properties</b>	
<b>Activities</b>	<b>Hours</b>
Class Attendance (theory) [PRESENCIAL][Lectures]	3
Problem solving and/or case studies [PRESENCIAL][Guided or supervised work]	3
Study and Exam Preparation [AUTÓNOMA][Self-study]	7.5
<b>Unit 5 (de 17): Covalent Bond I</b>	
<b>Activities</b>	<b>Hours</b>
Class Attendance (theory) [PRESENCIAL][Lectures]	4
Problem solving and/or case studies [PRESENCIAL][Guided or supervised work]	3
Study and Exam Preparation [AUTÓNOMA][Self-study]	10
Group tutoring sessions [PRESENCIAL][Group tutoring sessions]	1
<b>Unit 6 (de 17): Covalent Bond II</b>	
<b>Activities</b>	<b>Hours</b>
Class Attendance (theory) [PRESENCIAL][Lectures]	4
Problem solving and/or case studies [PRESENCIAL][Guided or supervised work]	3
Study and Exam Preparation [AUTÓNOMA][Self-study]	11
<b>Unit 7 (de 17): Ionic and metallic bond</b>	
<b>Activities</b>	<b>Hours</b>
Class Attendance (theory) [PRESENCIAL][Lectures]	3
Problem solving and/or case studies [PRESENCIAL][Guided or supervised work]	2
Study and Exam Preparation [AUTÓNOMA][Self-study]	8.5
Group tutoring sessions [PRESENCIAL][Group tutoring sessions]	1
<b>Unit 8 (de 17): Gaseous state</b>	
<b>Activities</b>	<b>Hours</b>
Class Attendance (theory) [PRESENCIAL][Lectures]	4
Problem solving and/or case studies [PRESENCIAL][Guided or supervised work]	3
Study and Exam Preparation [AUTÓNOMA][Self-study]	11
<b>Unit 9 (de 17): Chemical Thermodynamic</b>	
<b>Activities</b>	<b>Hours</b>
Class Attendance (theory) [PRESENCIAL][Lectures]	4
Problem solving and/or case studies [PRESENCIAL][Guided or supervised work]	3
Study and Exam Preparation [AUTÓNOMA][Self-study]	10.5
Group tutoring sessions [PRESENCIAL][Group tutoring sessions]	1
<b>Unit 10 (de 17): Seminary:Organic chemical formulation</b>	
<b>Activities</b>	<b>Hours</b>
Class Attendance (theory) [PRESENCIAL][Lectures]	4
Problem solving and/or case studies [PRESENCIAL][Guided or supervised work]	3
Study and Exam Preparation [AUTÓNOMA][Self-study]	10.5
Group tutoring sessions [PRESENCIAL][Group tutoring sessions]	1
<b>Unit 11 (de 17): Solutions</b>	
<b>Activities</b>	<b>Hours</b>
Class Attendance (theory) [PRESENCIAL][Lectures]	3
Problem solving and/or case studies [PRESENCIAL][Guided or supervised work]	3
Study and Exam Preparation [AUTÓNOMA][Self-study]	13.5
<b>Unit 12 (de 17): Chemical balance</b>	
<b>Activities</b>	<b>Hours</b>
Class Attendance (theory) [PRESENCIAL][Lectures]	5
Problem solving and/or case studies [PRESENCIAL][Guided or supervised work]	4
Study and Exam Preparation [AUTÓNOMA][Self-study]	13.5
Group tutoring sessions [PRESENCIAL][Group tutoring sessions]	1
<b>Unit 13 (de 17): Acid base balance</b>	
<b>Activities</b>	<b>Hours</b>
Class Attendance (theory) [PRESENCIAL][Lectures]	4
Problem solving and/or case studies [PRESENCIAL][Guided or supervised work]	3
Study and Exam Preparation [AUTÓNOMA][Self-study]	10.5
<b>Unit 14 (de 17): Precipitation balance</b>	
<b>Activities</b>	<b>Hours</b>
Class Attendance (theory) [PRESENCIAL][Lectures]	4
Problem solving and/or case studies [PRESENCIAL][Guided or supervised work]	3
Study and Exam Preparation [AUTÓNOMA][Self-study]	10.5
Group tutoring sessions [PRESENCIAL][Group tutoring sessions]	1
<b>Unit 15 (de 17): Complexes balance</b>	
<b>Activities</b>	<b>Hours</b>
Class Attendance (theory) [PRESENCIAL][Lectures]	5
Problem solving and/or case studies [PRESENCIAL][Guided or supervised work]	3
Study and Exam Preparation [AUTÓNOMA][Self-study]	12
Group tutoring sessions [PRESENCIAL][Group tutoring sessions]	1
<b>Unit 16 (de 17): Redox balance</b>	
<b>Activities</b>	<b>Hours</b>
Class Attendance (theory) [PRESENCIAL][Lectures]	3
Problem solving and/or case studies [PRESENCIAL][Guided or supervised work]	3
Study and Exam Preparation [AUTÓNOMA][Self-study]	6
<b>Unit 17 (de 17): Chemical kinetics</b>	
<b>Activities</b>	<b>Hours</b>
Class Attendance (theory) [PRESENCIAL][Lectures]	2
Problem solving and/or case studies [PRESENCIAL][Guided or supervised work]	2
Study and Exam Preparation [AUTÓNOMA][Self-study]	7
<b>Global activity</b>	
<b>Activities</b>	<b>hours</b>
Class Attendance (theory) [PRESENCIAL][Lectures]	61
Problem solving and/or case studies [PRESENCIAL][Guided or supervised work]	50
Study and Exam Preparation [AUTÓNOMA][Self-study]	169
Progress test [PRESENCIAL][Assessment tests]	4
Group tutoring sessions [PRESENCIAL][Group tutoring sessions]	8
Final test [PRESENCIAL][Assessment tests]	8
<b>Total horas: 300</b>	

10. Bibliography and Sources						
Author(s)	Title/Link	Publishing house	Citv	ISBN	Year	Description
J.C. Avila, A. Fernández y col.	Equilibrios químicos en disolución: Aplicaciones analíticas	Universidad de Granada			2005	
Jiménez Tebar	Formulación y nomenclatura de Química Inorgánica	Tebar-Flores			1993	
Jones-Atkins	Principios de Química	Panamericana			2006	
Lopez Cancio	Problemas de Química. Cuestiones y ejercicios.	Prentice Hall,			2001	
M. Rodríguez Morales	Formulación y nomenclatura de Química Orgánica	Oxford Education			2004	
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M.R. Fernández y J. A. Fidalgo	1000 problemas de Química General.	Everest			2006	
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W. R. Peterson	Introducción a la nomenclatura de las sustancias químicas	Reverté	2010
W.H. Freeman	Química. Un proyecto de la ACS	Reverté	2004
Whitten-Davis-Peck	Química General	McGraw-Hill	1998
B. Green	Fundamentals of Chemistry	Chandni Chow	2007
P. Atkins	Chemistry: A very short introduction	OUP Oxford	2014
D.R. Franceschetly	Principles of chemistry	Salem Press, Grey House	2016
D:E Goldberg 4th Ed.	Fundamentals of Chemistry	Maccraw Hill	2003
L. Jones -P. Atkins	Chemistry : molecules, matter and change 4th Ed.	Freeman and Company	2000
F. Vinagre y L. Vázquez de Miguel	Problemas y Fundamentos de Química	Alianza	1996