

**COURSE DATA****Data Subject**

<b>Code</b>	34226
<b>Name</b>	History of Chemistry
<b>Cycle</b>	Grade
<b>ECTS Credits</b>	4.5
<b>Academic year</b>	2020 - 2021

**Study (s)**

<b>Degree</b>	<b>Center</b>	<b>Acad. Period year</b>
1110 - Degree in Chemistry	Faculty of Chemistry	4 First term

**Subject-matter**

<b>Degree</b>	<b>Subject-matter</b>	<b>Character</b>
1110 - Degree in Chemistry	18 - History of Chemistry	Optional

**Coordination**

<b>Name</b>	<b>Department</b>
BERTOMEU SANCHEZ, JOSE RAMON	225 - History of Science and Documentation

**SUMMARY**

This course provides an overview of the history of science and reviews the general concepts of science, technology and society. It also improves students' skills and techniques and encourages them to develop an appropriate attitude to working in chemistry-related areas in industry, research and education. Students review conclusions from the main studies conducted on the history of chemistry with regard to alchemy, the scientific revolution, the chemical revolution, the science professions, science and gender, atomic theory and the periodic system, environmental history, the social image of chemistry, science and religion, the chemical industry, and the relationship between science, technology and society (STS), with special attention given to chemistry in the 20th century. Students also learn about the connections between science education and the history of science in order to study the pedagogical uses of the history of science and its multiple advantages in science education. The topics are selected and arranged in accordance with a balanced mixture of chronological and thematic sequences based on major problems throughout the history of chemistry. While each chapter follows a chronological sequence, each also presents a particular perspective or selected topic (science and religion, science and gender, technology and society, scientific terminology, scientific revolutions, disciplines and professions, science-teaching practices) that transcends the chronological boundaries of each period.



## PREVIOUS KNOWLEDGE

### Relationship to other subjects of the same degree

There are no specified enrollment restrictions with other subjects of the curriculum.

### Other requirements

None

## COMPETENCES (RD 1393/2007) // LEARNING OUTCOMES (RD 822/2021)

### 1108 - Degree in Chemistry

- Develop capacity for analysis, synthesis and critical thinking.
- Show inductive and deductive reasoning ability.
- Demonstrate leadership and management skills, entrepreneurship, initiative, creativity, organization, planning, control, leadership, decision making and negotiation.
- Demonstrate ability to work in teams both in interdisciplinary teams and in an international context.
- Demonstrate ability to communicate information, ideas, problems and solutions to both specialist and non-specialist audiences and using information technology, as appropriate.
- Demonstrate a commitment to ethics, equality values and social responsibility as a citizen and as a professional.
- Learn autonomously.
- Demonstrate the ability to adapt to new situations.
- Acquire a permanent sensitivity to quality, the environment, sustainable development and the prevention of occupational hazards.
- Demonstrate knowledge of the main aspects of chemical terminology, nomenclature, conventions and units.
- Demonstrate knowledge and understanding of essential facts, concepts, principles and theories related to the areas of chemistry.
- Evaluate, interpret and synthesise chemical data and information.
- Relate theory and experimentation.
- Recognise and evaluate chemical processes in daily life.
- Understand the qualitative and quantitative aspects of chemical problems.
- Develop sustainable and environmentally friendly methods.
- Relate chemistry with other disciplines.
- Students must be able to apply their knowledge to their work or vocation in a professional manner and have acquired the competences required for the preparation and defence of arguments and for problem solving in their field of study.



- Students must have the ability to gather and interpret relevant data (usually in their field of study) to make judgements that take relevant social, scientific or ethical issues into consideration.
- Students must be able to communicate information, ideas, problems and solutions to both expert and lay audiences.
- Students must have developed the learning skills needed to undertake further study with a high degree of autonomy.
- Express oneself correctly, both orally and in writing, in any of the official languages of the Valencian Community.
- Have basic skills in the use of information and communication technology and properly manage the information obtained.

**LEARNING OUTCOMES (RD 1393/2007) // NO CONTENT (RD 822/2021)**

The previous section includes the competences contained in the document VERIFICA. This subject addresses part of the learning results of the matter HISTORY OF CHEMISTRY that allow to acquire specific knowledge of chemistry, cognitive skills and general skills recommended by the EUROPEAN CHEMISTRY THEMATIC NETWORK (ECTN) for the Chemistry Eurobachelor® Label. The following table lists the learning outcomes acquired in the subject HISTORY OF CHEMISTRY related to the competences of the degree in Chemistry.

<b>COMPETENCES AND COGNITIVE SKILLS</b>	
<b>The learning process should allow the degree graduates to demonstrate:</b>	
	<b>Competences of the subject History of Chemistry that contemplate the learning outcomes EUROBACHELOR®</b>
Ability to demonstrate knowledge and understanding of the facts, concepts, principles and fundamental theories related to the topics mentioned above.	Demonstrate knowledge and understanding of essential facts, concepts, principles and theories related to the areas of chemistry..(CE13).
Ability to apply this knowledge and understanding to the solution of common qualitative and quantitative problems.	Understand the qualitative and quantitative aspects of chemical problems..(CE24).
Competences for the evaluation,	Evaluate, interpret and synthesise chemical data and



interpretation and synthesis of information and chemical data.	information..(CE16).
Competences to present and argue scientific issues orally and in writing to a specialized audience.	<p>Relate chemistry with other disciplines.(CE26).</p> <p>Demonstrate ability to communicate information, ideas, problems and solutions to both specialist and non-specialist audiences and using information technology, as appropriate. (CG6).</p> <p>Students must be able to communicate information, ideas, problems and solutions to both expert and lay audiences..(CB4).</p>

GENERAL COMPETENCES	
The learning process should allow the degree graduates to demonstrate:	
	<b>Competences of the subject History of Chemistry that contemplate the learning outcomes EUROBACHELOR®</b>
Ability to apply practical knowledge to solve problems related to qualitative and quantitative information.	<p>Relate theory and experimentation..(CE22).</p> <p>Recognise and evaluate chemical processes in daily life..(CE23).</p> <p>Understand the qualitative and quantitative aspects of chemical problems..(CE24).</p>
Competences in information management, in relation to primary and secondary sources, including information retrieval through on-line searches.	<p>Demonstrate ability to communicate information, ideas, problems and solutions to both specialist and non-specialist audiences and using information technology, as</p>



	appropriate..(CG6).
Ability to adapt to new situations and make decisions.	<p>Demonstrate the ability to adapt to new situations..(CG9).</p> <p>Students must have the ability to gather and interpret relevant data (usually in their field of study) to make judgements that take relevant social, scientific or ethical issues into consideration..(CB3).</p>
Competences in oral and written communication, in one of the main European languages, in addition to the language of the country of origin.	<p>Demonstrate ability to work in teams both in interdisciplinary teams and in an international context..(CG5).</p> <p>Demonstrate a commitment to ethics, equality values and social responsibility as a citizen and as a professional. (CG7).</p> <p>Express oneself correctly, both orally and in writing, in any of the official languages of the Valencian Community. (CT1).</p> <p>Students must be able to communicate information, ideas, problems and solutions to both expert and lay audiences..(CB4).</p> <p>Have basic skills in the use of information and communication technology and properly manage the information obtained.(CT2).</p>
Study skills necessary for professional development. These will include the ability to work autonomously.	Demonstrate leadership and management skills, entrepreneurship, initiative, creativity, organization, planning, control, leadership, decision making and negotiation..(CG3).





	<p>Demonstrate ability to work in teams both in interdisciplinary teams and in an international context..(CG5).</p> <p>Learn autonomously.(CG8).</p> <p>Demonstrate the ability to adapt to new situations..(CG9).</p> <p>Students must have developed the learning skills needed to undertake further study with a high degree of autonomy.(CB5).</p>
<p>Ethical commitment to the European Code of Conduct:</p> <p><a href="http://ec.europa.eu/research/participants/data/ref/h2020/other/hi/h2020-ethics_code-of-conduct_en.pdf">http://ec.europa.eu/research/participants/data/ref/h2020/other/hi/h2020-ethics_code-of-conduct_en.pdf</a></p>	<p>Acquire a permanent sensitivity to quality, the environment, sustainable development and the prevention of occupational hazards.(CG10).</p> <p>Demonstrate a commitment to ethics, equality values and social responsibility as a citizen and as a professional. (CG7).</p> <p>Students must have the ability to gather and interpret relevant data (usually in their field of study) to make judgements that take relevant social, scientific or ethical issues into consideration. (CB3).</p>

These competences are organized through the following teaching-learning routes according to the conceptual topoi related to the area:

1. Ability to correctly handle the basic concepts of chemistry by studying the historical development of chemical ideas and practices.
2. Skills related to teaching and thinking critically on teaching methods, as well as ability to innovate in science teaching by using history of chemistry in the classroom.



3. Ability to information management with gender perspective.
4. Developing reading, oral and written skills.
5. Skills to work in teams adopting serious, professional and gender practices.
6. Ability to think critically the professional identity of chemistry, its social image and its role in society with a gender perspective and with sensitivity to environmental issues and sustainability.
7. Understanding the cultural meaning of chemistry and its bibliographic and material heritage with a gender perspective.
8. Capacity for organization and planning research work with special attention to sources of chemical information.
9. Knowing and using chemical terminology, its origins and current features.
10. Knowing the working methods of chemistry, understanding the relationship between interpretations and experimental data and the relationship between qualitative and quantitative data.
11. Knowing the changing relationships of chemistry with other disciplines, the processes of specialization and creation of subdisciplines, as well as their relationships with industry and the activities of daily life.
12. Promoting autonomous learning, know-how and capacity to adapt to new situations.

## DESCRIPTION OF CONTENTS

### 1. The History of Science

Introduction. The history of science. Methodology. Sources. Problems and approaches. Main periods.

### 2. Chemical technology

Technological systems. Concepts, definitions and classifications. Chemistry-related techniques in prehistory. Fire. Salt. Pottery and ceramics. Glassmaking. Making dyes. Mining and the origins of metallurgy. Metals in antiquity.

### 3. Alchemy

The origins of alchemy. Sources and main traditions. The geographical and chronological framework. Alchemy in China and India. Classical Greek science. The origins of Greek science. Myths and rational explanation. Pre-Socratic philosophers and theories on the constitution of matter. Hellenistic alchemy. Arabic alchemy. Alchemy in the Middle Ages.



#### **4. The Scientific Revolution**

Scientific revolutions. Concept and debates. Spaces, problems, methods and protagonists of the scientific revolution. Science and religion. Alchemy and the origins of modern science.

#### **5. The Chemical Revolution**

Eighteenth-century chemistry. Pneumatic chemistry. Antoine Lavoisier and the crucial year (1772). The "discovery" of oxygen. The table of simple substances and the notion of chemical composition. The new chemical terminology. Chemistry, medicine and industry. The spread of chemical revolution. Chemistry in late 18th-century Spain.

#### **6. Atomic Theory and the Periodic System**

John Dalton's atomic theory. Origin and general characteristics. Atoms and chemical equivalents. Atomic models and quantum mechanics. Periodic classification of the chemical elements. General characteristics of the first classifications of elements. The problems of atomic weights. The Periodic Table: an example of multiple discovery. The explanation of the periodic system.

#### **7. Disciplines and Professions**

Scientific disciplines and school disciplines. The origin of chemistry and its relationship to other disciplines. Chemistry in classrooms throughout history. Chemical sub-fields. Science as a profession. Science and gender. The literature of chemistry. The popularization of chemistry.

#### **8. The Chemical Industry**

The main chemical industries: history and overview. The industrial revolutions and chemistry. Environmental problems and the chemical industry. The pharmaceutical industry. Patents and the chemical industry.

#### **9. History and Science Education**

Using history in science education. Scientific biographies. The history of science in science textbooks. Classic experiments in the classroom. The history of science education.

#### **10. Twentieth-Century Chemistry**

The main features of big science. Science and technology in the 20th century. Technoscience. Science and the military industry: chemical weapons and atomic energy. New sub-fields. The social image of chemistry. Environmental problems. The new molecular sciences at the beginning of the 21st century.



**WORKLOAD**

ACTIVITY	Hours	% To be attended
Theory classes	38,00	100
Tutorials	7,00	100
Attendance at events and external activities	3,00	0
Development of group work	15,00	0
Development of individual work	15,00	0
Study and independent work	7,50	0
Preparation of evaluation activities	15,00	0
Preparing lectures	6,00	0
Resolution of case studies	6,00	0
<b>TOTAL</b>	<b>112,50</b>	

**TEACHING METHODOLOGY**

The course includes lectures, practical sessions, seminars and tutorial activities. The lectures introduce the outlines of the mentioned topics. Practical activities are complements to the lectures introducing new perspectives (biographical, thematic, methodological, etc.) and new views of the main topics included in the syllabus. Students are encouraged to adopt an active and meaningful learning through the frequent use of the recommended bibliography and the development of practical activities in the classroom. The seminars include several activities such as summary and discussion of selected papers, presentations and discussions on topics covered in previous lectures, so students can develop some of the skills which had been previously described.

**EVALUATION**

- Written examinations [30 %] . Minimum score required: 4 (out of 10).
- Evaluation of tutorial sessions and group seminars (participation and work submitted), papers and oral presentations . [40 %].
- Evaluation of student activities based on regular class attendance and classroom activities, participation in debates and the student's degree of involvement in the teaching-learning process [30 %].

**REFERENCES**



### Basic

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- BROCK, W. H. Historia de la química. Madrid: Alianza, 1998.
- FARA, P. Breve historia de la ciencia. Barcelona: Ariel, 2009.

### Additional

- ALIC, M. El legado de Hipatia: historia de las mujeres en la ciencia desde la Antigüedad hasta fines del siglo XIX. México: Siglo XXI, 1991.
- BENSUADE-VINCENT, B.; SIMON, J. Química: la ciencia impura. València: PUV, 2015.
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- PRINCIPE, L. The Secrets of Alchemy, Chicago: University Press, 2012.
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## **ADDENDUM COVID-19**

**This addendum will only be activated if the health situation requires so and with the prior agreement of the Governing Council**

### **Contents**

*1.- The contents initially indicated in the teaching guide are maintained.*

### **Workload and temporary teaching planning**

Regarding the workload:

*1.- The different activities described in the Teaching Guide are maintained with the intended dedication.*

Regarding the temporary teaching planning:

*1.- The material to follow the theory/tutoring/classroom-seminar classes allows to continue the temporary teaching planning both in days and schedule, whether the teaching is face-to-face in the classroom or not.*

### **Teaching Methodology**

Theory subjects:

*Situation of minimal attendance:* In theory classes and tutorials the occupation will be, at most, 30% of their usual occupation. Teaching will be online. Students who have a laboratory session before or after theory classes, and the time to travel is longer than the time established in the schedules, will be able to follow the class in person in the classroom assigned in the schedules. When there are students in this situation, classes will be taught by synchronous videoconference in the group classroom.



*Maximum face-to-face situation:* In theory classes and tutorials, the occupation will respect the sanitary restrictions that limit the capacity of the classrooms. Depending on the capacity of the classroom and the number of students enrolled, it may be necessary that part of the students have to follow the classes synchronously. If this situation arises, the students will attend the group classroom in weekly rotating shifts (preferably in alphabetical order), so as to ensure that the percentage of attendance of all the students enrolled in the subject is the same.

*Confinement situation:* If for health reasons it is not possible to continue with hybrid teaching, totally or partially affecting the classes of the subject, these will be replaced by synchronous non-face-to-face sessions following the established schedules and using the virtual classroom tools.

The methodology used for non-face-to-face classes shall be:

1. Synchronously using virtual classroom tools (preferably Teams or blackboard)
2. Asynchronously using presentations with audio narration, videos or other virtual classroom tools
3. Resolution of exercises and questionnaires
4. Forums (aula virtual) for discussing topics

*In all subjects*

*If there is a closure of the facilities for health reasons that totally or partially affects the classes of the course, they will be replaced by non-face-to-face sessions following the established schedules and using the tools of the virtual classroom.*

*In the case of students confined to home due to COVID, they will be ensured on-line teaching through Teams.*

## **Evaluation**

1. *The possibility of exam-only evaluation is eliminated.*
2. *The evaluation system described in the Teaching Guide of the subject in which the various evaluable activities have been specified as well as their contribution to the final grade of the subject is maintained.*

*If there is a closure of the facilities for health reasons affecting the development of any face-to-face evaluable activity of the subject, it will be replaced by a test of a similar nature that will be carried out in virtual mode using the computer tools licensed by the University of Valencia. The contribution of each evaluable activity to the final grade of the subject will remain unchanged, as set out in this guide.*

## **References**



*The literature recommended in the Teaching Guide is maintained since it is accessible, and it is complemented by notes, slides and problems uploaded to the Virtual Classroom as material of the course.*

