



## 1. General information

Course: CHEMISTRY AND ATMOSPHERIC POLLUTION  
Type: ELECTIVE  
Degree: 409 - CHEMISTRY  
Center: 1 - FACULTY OF SCIENCE AND CHEMICAL TECHNOLOGY  
Year: 4

Main language: Spanish  
Use of additional languages:  
Web site:

Code: 57333  
ECTS credits: 6  
Academic year: 2022-23  
Group(s): 20  
Duration: C2  
Second language: English  
English Friendly: Y  
Bilingual: N

| Lecturer: MARIA DEL PILAR MARTIN PORRERO - Group(s): 20 |                |              |                           |                                                                       |
|---------------------------------------------------------|----------------|--------------|---------------------------|-----------------------------------------------------------------------|
| Building/Office                                         | Department     | Phone number | Email                     | Office hours                                                          |
| Marie Curie, 2ª planta                                  | QUÍMICA FÍSICA | 3486         | mariapilar.martin@uclm.es | Monday 11 to 13 wednesday and thursday 16 to 18                       |
| Lecturer: MARIA SAGRARIO SALGADO MUÑOZ - Group(s): 20   |                |              |                           |                                                                       |
| Building/Office                                         | Department     | Phone number | Email                     | Office hours                                                          |
| EDIFICIO MARIE CURIE                                    | QUÍMICA FÍSICA | 3450         | sagrario.salgado@uclm.es  | Monday 9.30 to 12.30 and 17 to 18 horas, Thursday 9.30 to 11.30 horas |

## 2. Pre-Requisites

Have approved the basic training module

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

The aim of this subject is that the students know the physicochemical processes that occur in the atmosphere and its influence on the structure, composition and properties of the same. In addition, it is intended to analyze the issue of air pollution and establish strategies to control and reduce it, as well as alternatives. It is a subject directly related to the subjects of Physical Chemistry, mainly more kinetic aspects of the processes, with subjects of organic Chemistry, while studying processes of degradation of organic compounds, and with Physics when dealing with aspects of radiation transfer, transport and climatology. The subject is therefore justified in the curriculum, especially since it is a current issue. In addition, the theoretical-practical aspects dealt with are especially useful for students who will work in the future on issues related to pollution and the environment.

## 4. Degree competences achieved in this course

## Course competences

| Code | Description                                                                                                                                                                                                 |
|------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| CB02 | Apply their knowledge to their job or vocation in a professional manner and show that they have the competences to construct and justify arguments and solve problems within their subject area.            |
| CB04 | Transmit information, ideas, problems and solutions for both specialist and non-specialist audiences.                                                                                                       |
| E03  | Handle chemicals safely and with respect to the environment                                                                                                                                                 |
| E09  | Know the kinetics of chemical change, including catalysis and reaction mechanisms                                                                                                                           |
| E14  | Know and know how to apply the metrology of chemical processes, including quality management                                                                                                                |
| 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                                        |
| E16  | Plan, design and develop projects and experiments                                                                                                                                                           |
| 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 |
| G03  | Know how to apply the theoretical-practical knowledge acquired in the different professional contexts of Chemistry                                                                                          |
| G04  | Know how to communicate, orally and in writing, the knowledge, procedures and results of chemistry, both specialized and non-specialized                                                                    |
| G05  | Acquire and adapt new knowledge and techniques of any scientific-technical discipline with incidence in the chemical field                                                                                  |
| T03  | Proper oral and written communication                                                                                                                                                                       |
| T05  | Organization and planning capacity                                                                                                                                                                          |
| T06  | Ability to approach decision making                                                                                                                                                                         |
| T07  | Ability to work as a team and, where appropriate, exercise leadership functions, fostering the entrepreneurial character                                                                                    |
| T08  | Skills in interpersonal relationships                                                                                                                                                                       |
| T09  | Motivation for quality, job security and awareness of environmental issues, with knowledge of internationally recognized systems for the correct management of these aspects                                |
| T10  | Ability to use specific software for chemistry at user level                                                                                                                                                |
| T11  | Ability to obtain bibliographic information, including Internet resources                                                                                                                                   |

## 5. Objectives or Learning Outcomes

### Course learning outcomes

#### Description

Have a knowledge of atmospheric chemistry: the reactions that take place in each layer of the atmosphere, the responsible species and the derived effects, relating them to human activity and to atmospheric pollution

Have a knowledge and critical vision of new trends in the use of renewable energy.

Dexterity and management of gas systems in the laboratory

Ability to perform a correct evaluation, interpretation and synthesis of the data and chemical information received

Capacity and skill to search and select information in the field of the topics addressed in the subject

Acquire initiative to raise and solve specific problems of atmospheric chemistry

Know and know how to properly use the spectroscopic and analytical techniques (GC-MS, FTIR, electrochemical, optical, ...) most commonly used in air quality control laboratories

Ability to learn to work autonomously in a laboratory and ability to interpret the experimental results obtained.

Ability to understand the fundamental aspects of Atmospheric Physics and related environmental problems

Ability to process and present information adequately both orally and in writing, thus developing their capacity for synthesis and objective criteria.

## 6. Units / Contents

**Unit 1: Composition and structure of the earth atmosphere**

**Unit 2: Greenhouse effect and climate change**

**Unit 3: Atmospheric photochemistry**

**Unit 4: Tropospheric Chemistry**

**Unit 5: Chemistry of the upper layers**

**Unit 6: Air pollution and its effects**

**Unit 7: Control and reduction of atmospheric pollution.**

**Unit 8: Alternatives to the use of fossil fuels**

**Unit 9: Laboratory practice**

## 7. Activities, Units/Modules and Methodology

| Training Activity                              | Methodology                      | Related Competences                           | ECTS                                        | Hours      | As | Com | Description                                                                               |
|------------------------------------------------|----------------------------------|-----------------------------------------------|---------------------------------------------|------------|----|-----|-------------------------------------------------------------------------------------------|
| Class Attendance (theory) [ON-SITE]            | Lectures                         | CB02 CB04 E09 E16 G02 G05                     | 0.8                                         | 20         | N  |     | Classes dedicated to practical theoretical foundations related to the subject             |
| Class Attendance (practical) [ON-SITE]         | Practical or hands-on activities | CB02 CB04 E03 E15 G02 G03 G05 T10             | 0.8                                         | 20         | Y  | Y   | realization of laboratory practices                                                       |
| Group tutoring sessions [ON-SITE]              | Problem solving and exercises    | CB02 CB04 E09 E16 G03 G05                     | 0.4                                         | 10         | Y  | N   | Activity dedicated to solving exercises and problems                                      |
| Workshops or seminars [ON-SITE]                | Group Work                       | CB02 CB04 E16 G02 G03 G05                     | 0.08                                        | 2          | Y  | N   | Activity dedicated to solving exercises and problems                                      |
| Group tutoring sessions [ON-SITE]              | Guided or supervised work        | CB02 CB04 E15 E16 G02 G03 G04 T10 T11         | 0.16                                        | 4          | Y  | N   | Sessions dedicated to the presentation and exposition of topics developed by the students |
| Other off-site activity [OFF-SITE]             | Combination of methods           | CB02 CB04 E15 E16 G02 G03 G04 T10 T11         | 2.8                                         | 70         | N  |     | Hours of self-work                                                                        |
| Study and Exam Preparation [OFF-SITE]          | Self-study                       | CB02 CB04 E09 E14 E15 E16 G02 G03 G04 T10 T11 | 0.8                                         | 20         | N  |     | Hours of study                                                                            |
| Progress test [ON-SITE]                        | Assessment tests                 | CB02 CB04 E09 E14 E15 E16 G02 G03 G04 T10 T11 | 0.08                                        | 2          | Y  | N   | Carrying out progress tests                                                               |
| Final test [ON-SITE]                           | Assessment tests                 | CB02 CB04 E09 E14 E15 E16 G02 G03 G04 T10 T11 | 0.08                                        | 2          | Y  | N   | Final test run                                                                            |
| <b>Total:</b>                                  |                                  |                                               | <b>6</b>                                    | <b>150</b> |    |     |                                                                                           |
| <b>Total credits of in-class work: 2.4</b>     |                                  |                                               | <b>Total class time hours: 60</b>           |            |    |     |                                                                                           |
| <b>Total credits of out of class work: 3.6</b> |                                  |                                               | <b>Total hours of out of class work: 90</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 |
|---------------------------------------------------|-----------------------|----------------------------|-------------|
| Laboratory sessions                               | 10.00%                | 10.00%                     | ---         |
| Assessment of problem solving and/or case studies | 15.00%                | 0.00%                      | ---         |
| Assessment of active participation                | 15.00%                | 0.00%                      | ---         |
| Progress Tests                                    | 30.00%                | 0.00%                      | ---         |
| Final test                                        | 30.00%                | 90.00%                     | ---         |
| <b>Total:</b>                                     | <b>100.00%</b>        | <b>100.00%</b>             |             |

According to art. 6 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. 13.2) 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:**

In order to pass this subject, it is essential to have carried out and approved the laboratory practices and to have delivered the corresponding laboratory memory.

**Non-continuous evaluation:**

it is essential to have carried out and approved the laboratory practices

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

In the extraordinary call the exam grade will be 90% and the practices 10%

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

In the special call the exam grade will be 90% and the practices 10%

| <b>9. Assignments, course calendar and important dates</b>                  |              |
|-----------------------------------------------------------------------------|--------------|
| <b>Not related to the syllabus/contents</b>                                 |              |
| <b>Hours</b>                                                                | <b>hours</b> |
| Other off-site activity [AUTÓNOMA][Combination of methods]                  | 70           |
| Study and Exam Preparation [AUTÓNOMA][Self-study]                           | 20           |
| <b>Unit 1 (de 9): Composition and structure of the earth atmosphere</b>     |              |
| <b>Activities</b>                                                           | <b>Hours</b> |
| Class Attendance (theory) [PRESENCIAL][Lectures]                            | 2            |
| Group tutoring sessions [PRESENCIAL][Problem solving and exercises]         | 2            |
| <b>Unit 2 (de 9): Greenhouse effect and climate change</b>                  |              |
| <b>Activities</b>                                                           | <b>Hours</b> |
| Class Attendance (theory) [PRESENCIAL][Lectures]                            | 2            |
| Group tutoring sessions [PRESENCIAL][Problem solving and exercises]         | 3            |
| <b>Unit 3 (de 9): Atmospheric photochemistry</b>                            |              |
| <b>Activities</b>                                                           | <b>Hours</b> |
| Class Attendance (theory) [PRESENCIAL][Lectures]                            | 2            |
| Group tutoring sessions [PRESENCIAL][Problem solving and exercises]         | 2            |
| <b>Unit 4 (de 9): Tropospheric Chemistry</b>                                |              |
| <b>Activities</b>                                                           | <b>Hours</b> |
| Class Attendance (theory) [PRESENCIAL][Lectures]                            | 3            |
| Group tutoring sessions [PRESENCIAL][Problem solving and exercises]         | 2            |
| Group tutoring sessions [PRESENCIAL][Guided or supervised work]             | 1            |
| <b>Unit 5 (de 9): Chemistry of the upper layers</b>                         |              |
| <b>Activities</b>                                                           | <b>Hours</b> |
| Class Attendance (theory) [PRESENCIAL][Lectures]                            | 3            |
| Group tutoring sessions [PRESENCIAL][Problem solving and exercises]         | 1            |
| Workshops or seminars [PRESENCIAL][Group Work]                              | 1            |
| <b>Unit 6 (de 9): Air pollution and its effects</b>                         |              |
| <b>Activities</b>                                                           | <b>Hours</b> |
| Class Attendance (theory) [PRESENCIAL][Lectures]                            | 3            |
| Workshops or seminars [PRESENCIAL][Group Work]                              | 1            |
| Group tutoring sessions [PRESENCIAL][Guided or supervised work]             | 1            |
| Progress test [PRESENCIAL][Assessment tests]                                | 2            |
| <b>Unit 7 (de 9): Control and reduction of atmospheric pollution.</b>       |              |
| <b>Activities</b>                                                           | <b>Hours</b> |
| Class Attendance (theory) [PRESENCIAL][Lectures]                            | 2            |
| Group tutoring sessions [PRESENCIAL][Guided or supervised work]             | 2            |
| <b>Unit 8 (de 9): Alternatives to the use of fossil fuels</b>               |              |
| <b>Activities</b>                                                           | <b>Hours</b> |
| Class Attendance (theory) [PRESENCIAL][Lectures]                            | 3            |
| <b>Unit 9 (de 9): Laboratory practice</b>                                   |              |
| <b>Activities</b>                                                           | <b>Hours</b> |
| Class Attendance (practical) [PRESENCIAL][Practical or hands-on activities] | 20           |
| Final test [PRESENCIAL][Assessment tests]                                   | 2            |
| <b>Global activity</b>                                                      |              |
| <b>Activities</b>                                                           | <b>hours</b> |
| Group tutoring sessions [PRESENCIAL][Guided or supervised work]             | 4            |
| Other off-site activity [AUTÓNOMA][Combination of methods]                  | 70           |
| Class Attendance (theory) [PRESENCIAL][Lectures]                            | 20           |
| Study and Exam Preparation [AUTÓNOMA][Self-study]                           | 20           |
| Progress test [PRESENCIAL][Assessment tests]                                | 2            |
| Final test [PRESENCIAL][Assessment tests]                                   | 2            |
| Class Attendance (practical) [PRESENCIAL][Practical or hands-on activities] | 20           |
| Group tutoring sessions [PRESENCIAL][Problem solving and exercises]         | 10           |
| Workshops or seminars [PRESENCIAL][Group Work]                              | 2            |
| <b>Total horas: 150</b>                                                     |              |

**10. Bibliography and Sources**

| Author(s)                          | Title/Link                                                                                                                                                     | Publishing house           | Citv | ISBN              | Year | Description |
|------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------|------|-------------------|------|-------------|
| Baird, C                           | Química Ambiental                                                                                                                                              | Reverté                    |      |                   | 2001 |             |
| Calvert y Col.                     | The Mechanisms of Atmospheric Oxidation of the Oxygenates<br><a href="https://books.google.es/books?isbn=0199767076">books.google.es/books?isbn=0199767076</a> | OUP USA                    |      | 978-0-19-976707-6 | 2011 |             |
| Figueruelo, J. E y Dávila, M.M     | Química física del ambiente y de los procesos medioambientales                                                                                                 | Reverté                    |      |                   | 2004 |             |
| Finlayson-Pitts And J.N.Pitts      | Chemistry of the upper and lower atmosphere : theory, experiments and applications                                                                             | John Wiley and Sons        |      |                   | 1999 |             |
| Jacob, Daniel J                    | Introduction to atmospheric chemistry                                                                                                                          | Princeton University Press |      |                   | 1999 |             |
| John H. Seinfeld, Spyros N. Pandis | Atmospheric chemistry and physics : from air pollution to climate change                                                                                       | Wiley - Interscience       |      |                   | 1997 |             |
| Orozco, C y col                    | Contaminación ambiental, una visión desde la química                                                                                                           | Thomson Paraninfo S.A      |      |                   | 2008 |             |
| S. E. Manahan                      | Introducción a la Química Ambiental                                                                                                                            | Reverté                    |      |                   | 2007 |             |
| Spiro, T.G. y Stigliani, W.M       | Química Medioambiental                                                                                                                                         | Pearson Educación          |      |                   | 2004 |             |
| Wayne, Richard P.                  | Chemistry of atmospheres : an introduction to the Chemistry of the atmospheres of earth, the planets, and their satellites                                     | Oxford                     |      |                   | 2000 |             |