Universidad de Navarra

Air Pollution (F. Ciencias)

Guía docente 2026-27

PRESENTACIÓN

Breve descripción:

- **Titulación**: Environmental Sciences (Ciencias Ambientales)
- **Módulo/Materia**: Environmental Technology/Air Pollution (Tecnología Ambiental /Contaminación Atmosférica
- **ECTS**: 6
- **Curso, semestre**: 3th-1st four-month period (3º-1er cuatrimestre)
- **Carácter**: Compulsory (Obligatoria)
- **Profesorado**: David Elustondo & Yasser Morera-Gómez
- **Idioma**: English (Inglés)
- **Aula, Horario**: Room 16 - Classes: Monday 8:00 h, Tuesday 11:00 h, Thursday 9: 00 (Aula 16 - Clases: Lunes 8:00 h, Martes 11:00 h y Jueves 9:00 h)

RESULTADOS DE APRENDIZAJE (Competencias)

Competences of the Environmental Sciences Degree:

Specific competences:

- CE1 Know the scientific basis needed to address the specific environmental training.
- CE3 Describe the structure, physicochemical properties and reactivity of elements and compounds involved in biogeochemical processes.
- CE4 Using laboratory techniques and instruments of scientific experimentation.

General and basic competences:

- CB1 That students have demonstrated knowledge and understanding in a field of study that is on the basis of general secondary education, and is typically at a level which, although it is supported by advanced textbooks, includes some aspects that imply knowledge of the forefront of their field of study
- CG2 Think in an integrated way and approach problems from different perspectives.
- CG3 Having critical thinking.

Competences of the Biology Degree:

Specific competences:

- CE6 Autonomously and permanently update the knowledge and integrate new discoveries in its proper context.
- CE7 Understand, critically analyze, discuss, write and present scientific arguments, both in Spanish and English, as the language of reference in the scientific field.

General and basic competences:

- CG1 Plan and organize the time and manage the continuous training itself, updating the knowledge of innovations from science and know how to analyze future trends.
- CG2 Think in an integrated way and approach problems from different perspectives. Have critical thinking. Provide solutions to problems in science.
- CG3 Work in teams, select and choose the work methodology and the distribution of functions. Know how to listen and to speak with positive and constructive interventions.
- CG4 Foster a sense of responsibility towards life, the environment and the ecosystem, with ethical sense. Search information, evaluate and analyze it, synthesize, summarize, communicate, cite and present papers.
- CB1 That students have demonstrated knowledge and understanding in a field of study that is on the basis of general secondary education, and is typically at a level which, although it is supported by advanced textbooks, includes some aspects that imply knowledge of the forefront of their field of study
- CB3 That students have the ability to gather and interpret relevant data (usually within their field of study) to issue judgments that include reflection on relevant social, scientific or ethical topics.
- CB4 That students can transmit information, ideas and solutions to both specialist and non-specialist public.

PROGRAMA

Program

Lesson 1. Features and composition of the atmosphere

Structure and properties of atmosphere. Composition of the present-day atmosphere. Concept of air pollution. Principal air pollutants. Scale and residence time. Pollution episodes.

Lesson 2. Air pollutants

Nature and classification of air pollutants: primary and secondary pollutants, gaseous and particulate pollutants. Pollutant sources: biogenic and anthropogenic. Emission and immission factors. Expression units of concentration.

Lesson 3. Meteorology and air pollution

Atmospheric principles. Role of the atmosphere in the processes of contamination. Thermal inversions. Vertical circulation and atmospheric stability. Dispersion models.

Lesson 4. Effects of atmospheric pollution

Effects on human health, materials, ecosystems and climate. Scales of pollution.

Lesson 5. Methods for the sampling and analysis of pollutants

Sampling techniques. Emission and immission measurements. Detection and quantification techniques: spectroscopic, electroanalytical methods, chemical methods, bioindicators and biomonitors. Separation techniques. Chromatography. Quality control.

Lesson 6. Tropospheric chemistry

Reactions in the troposphere. Urban pollution. Photochemical smog and reducing smog. Chemistry of aerosols. Reduction of ozone in the troposphere. Acid rain.

Universidad de Navarra

Lesson 7. Chemistry of the stratosphere

Ozone chemistry. Ozone-depleting substances. The ozone hole. Effects of the ozone layer depletion.

Lesson 8. Greenhouse effect and climate change

Earth's energy balance. Greenhouse gases. Observed changes in climate. Consequences of Climate Change. Mitigation options. Effects on health.

Lesson 9. Indoor air pollution

Indoor pollution sources. Main indoor air pollutants. Effects of indoor pollution. Sick building syndrome.

Lesson 10. Tropospheric ozone

Effects on health, materials, vegetation, visibility and ecosystems. Local and global effects. Economic valuation of losses.

Lesson 11. Control methods of gaseous emissions

Emission control in combustion processes: formation of pollutants in the combustion exhaust gas recirculation, addition of oxygenates to gasoline, catalytic converters. Emission control: absorption with and without chemical reaction, adsorption, incineration, condensation and biotreatment.

Lesson 12. Emission control methods of primary particles

Concept of collection efficiency. Settling velocity and Stokes' Law. Mechanical separators: settlers, centrifugal collectors, cyclones. Electrofiltration: electrostatic precipitators. Washing and filtration of gases: Venturi scrubbers, bag filters.

ACTIVIDADES FORMATIVAS

Teaching methodology

Attendance

- Teaching through lectures and seminars: 45 hours.
- Introduction to modelling with the PMF receptor model for estimating the source apportionment of atmospheric particulate matter: 5 h.
- Landscapes programme:
  - Students will visit a Incineration Plant located in Zubieta (Gipuzkoa) in order to know its potential impact on air quality and its emission control methods.: 7 hours.
  - Students will visit an Air Quality Station in the city of Pamplona: 3 hours.

Homework

- Lectures and seminars: 75 h.
- Landscape Program activities: 15 h.

EVALUACIÓN

Universidad de Navarra

CONVOCATORIA ORDINARIA

The student's academic performance and overall quality of the course will be calculated on a weighted basis, taking into account the following criteria:

- Answering to questions in class (20%)
- Practical activities (10%)
- Theoretical part (70%): a final exam will be performed. It will include multiple-choice questions, short questions and problems.

CONVOCATORIA EXTRAORDINARIA

The student's academic performance and overall quality of the course will be calculated on a weighted basis, taking into account the following criteria:

- Answering to questions in class (20%)
- Practical activities (10%)
- Theoretical part (70%): a final exam will be performed. It will include multiple-choice questions, short questions and problems.

HORARIOS DE ATENCIÓN

Dr David Elustondo (delusto@unav.es)

- Office 1100 (Despacho 1100); Research building (Edificio de Investigación); 1st floor (Planta 1ª)
- Office hours: write an email to arrange an appointment

Dr Yasser Morera-Gómez (ymorera@unav.es)

- Office 1170 (Despacho 1170); Research building (Edificio de Investigación); 1st floor (Planta 1ª)
- Office hours: write an email to arrange an appointment

BIBLIOGRAFÍA

Recommended literature

- Teacher Notes: ADI.
- Manahan, S.E. “Environmental Chemistry” (10th edition). CRC Press, 2017. Localízalo en la Biblioteca
- Martín, A. y Santamaría, J.M. “Diccionario terminológico de Contaminación Ambiental”. Universidad de Navarra, 2000. Localízalo en la Biblioteca [versión electrónica]
- Seigneur. C. “Air Pollution. Concepts, Theory and Applications”. Cambridge University Press, 2019. Localízalo en la Biblioteca
- Seinfeld, J.H. and Pandis, S.N. “Atmospheric Chemistry and Physics: From air Pollution to Climate Change”. John Wiley & Sons, 2016. Localízalo en la Biblioteca

- IARC Monographs on the Evaluation of Carcinogenic Risks to Humans, No. 109. “Outdoor air pollution”. Localízalo en la Biblioteca ; https://www.ncbi.nlm.nih.gov/books/NBK368020/#a006.sec1.3.2