COURSE DATA

DATA SUBJECT

Code: 36465
Name: Environmental Physical Chemistry
Cycle: Undergraduate Studies
ECTS Credits: 6
Academic year: 2025-26

STUDY (S)

Degree	Center	Acad. year	Period
1110 - Degree in Chemistry	Facultat de Química	4	First quarter

SUBJECT-MATTER

Degree	Subject-matter	Character
1110 - Degree in Chemistry	Physical Chemistry Applied	ELECTIVES

COORDINATION

PEREZ PLA FRANCISCO

SUMMARY

Kinetic study of the chemical interactions between pollutants and between them and the environment, applying concepts of homogeneous and heterogeneous catalysis. Study reactive processes induced by sunlight and products involving natural contaminants and excited states. Applications.

The Environmental Physical Chemistry is a 4.5 credit elective course that is taught during the first semester of the 4th year of the grade. The course describes the main chemical-physical processes related to air pollution, water and soil. Specifically, the chemistry of the atmosphere, photochemical interactions between anthropogenic and natural contaminants, the transfer of pollutants between different environmental compartments, physical chemistry of water, and pollution processes in natural water are studied. As applications, we address some environmental problems even under intense public debate such as: acid rain, the greenhouse effect and it relationship to global warming, and ozone depletion in the stratosphere.

PREVIOUS KNOWLEDGE

RELATIONSHIP TO OTHER SUBJECTS OF THE SAME DEGREE

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

OTHER REQUIREMENTS

It would be advisable to have th basic knowledge outlined below. This knowledge has been acquired during the study of the subjects of Physical Chemistry (I, II and III) and Chemistry I and II.
(a) Photochemistry: primary and secondary photophysical processes. Photochemical processes.
(b) Organic Chemistry: properties of functional groups: alkanes, alkenes, alkynes, aromatics, oxygenated organic compounds and nitrogen.
(c) Physical Chemistry: Partition coefficients, absorption spectra, rate law, reaction

COMPETENCES / LEARNING OUTCOMES

1110 - Degree in Chemistry

Apply metrology in chemical processes, including quality management.

At the end of the course, the student will interpret the data from observations and measurements in the laboratory in terms of their significance and the theories that support them.

At the end of the subject, the student will evaluate, interpret and synthesize the chemical data and information correctly.

Collaborate effectively in work teams, assume responsibilities and leadership roles, and contribute to collective improvement and development.

Communicate effectively both orally and in writing, adapting to the context and audience.

Comprender la empresa como una realidad sistémica e inherentemente compleja, reconociendo e identificando las dimensiones consustanciales a los sistemas de gestión empresarial y los condicionantes, externos e internos, que inciden sobre su gestión.
Ser capaces de categorizar y jerarquizar las decisiones organizativas, e interpretar los procesos de adopción de decisiones en el ámbito de los modelos teóricos. Discriminar y manejar los principales métodos y técnicas disponibles para la elaboración del diagnóstico estratégico. Poder elaborar un diagnóstico estratégico básico.

Comprender las particularidades contables que presenta la regulación jurídico-mercantil de las empresas, relacionando la legislación mercantil aplicable a los distintos tipos operaciones societarias con la contabilidad de los hechos económicos que se regulan. Aprender a relacionar las leyes mercantiles que se ocupan de los concursos de acreedores con la contabilidad, adquiriendo práctica en el manejo de determinados textos legales vigentes.

Contribute to the design, development and implementation of solutions that respond to social demands, using the Sustainable Development Goals as a reference.

Demonstrate both inductive and deductive reasoning skills.

Demonstrate critical and self-critical thinking, considering professional ethics, moral values and social implications of the different activities carried out throughout the degree.

Demonstrate the ability to analyse, synthesise and reason critically.

Describe the characteristics and behaviour of the different states of matter and the theories used to explain them.

Distinguish between the qualitative and quantitative aspects of chemical problems.

Evaluate the risks involved in the use of chemical substances and laboratory procedures.

Express ideas correctly, both orally and in writing, in any of the official languages of the Valencian Community.

Handle the instrumentation used in the different areas of chemistry.

Identify chemical processes in everyday life.

Identify the main types of chemical reactions and their associated key characteristics.

Identify the structure and reactivity of the main classes of biomolecules and the chemistry of key biological processes.

Implement sustainable and environmentally friendly methodologies.

List the principles of quantum mechanics and apply them to the description of the structure and properties of atoms and molecules.

Relate chemistry to other disciplines.

Relate theory to experimentation.

Ser capaces de analizar la influencia que sobre el diseño del sistema de información de costes, ejercen, tanto la actividad concreta desarrollada por la entidad como la tecnología utilizada, la estructura organizativa y el estilo de dirección. Calcular costes preestablecidos y relacionarlos con la planificación y el control de la actividad interna. Seleccionar aquellos indicadores de gestión que faciliten el desempeño personal, estableciendo la frecuencia y el formato en función del usuario de destino.

Ser capaces de configurar y manejar un sistema integrado para la gestión contable de la empresa. Utilizar la hoja de cálculo como herramienta de análisis de la información económica de la empresa. Saber aplicar programas de apoyo a tareas específicas de gestión.

Solve problems effectively.

Understand and analyse, from the perspective of the degree programme, social inequalities based on sex and gender; integrate gender-sensitive approaches into problem-solving and solution design.

Use chemical terminology, nomenclature, conventions and units correctly.

DESCRIPTION OF CONTENTS

1. The terrestrial atmosphere.

Introduction. Our environment: Earth. Hydrosphere. Genesis and evolution of the atmosphere. Atmosphere structure. Composition of the atmosphere. Energy balance. Mass transfer:. Thermodynamics of the atmosphere. Humidity: Dew point. Air Movements: adiabatic. Vertical Stability and instability. Inversions

2. Photochemical characteristics of components of the troposphere.

Photochemistry: fundamentals, primary and secondary photochemical processes. Intensity and distribution of sunlight in the troposphere. Evaluation photolysis rates. Absorption spectrum and photochemistry of tropospheric O2. Absorption and photochemistry other tropospheric components. Photolytic sources of hydroxyl radicals. Formation of other primary radicals. Uni- and ter-molecular processes

3. Introduction to the atmospheric chemistry

Air pollution system. Concentration units. Primary and secondary pollutants. SO2. CO. NOx. COV. Particles. Radiation scattering from aerosols and visibility. Dispersion of pollutants: Meteorology. Air quality criteria. Pollution indoors. Radioactivity and radon.

4. Kinetics and mechanism of the main tropospheric reactions.

Introduction: Reactions of alkanes. Reactions of alkyl, and alkoxide alkyl-peroxide. Reactions of alkenes. Criegee intermediates reactions. Reactions of alkynes. Reactions of aromatic hydrocarbons. Reactions of oxygenated organic compounds. Tropospheric reactions of nitrogen-containing constituents: inorganic, organic. Tropospheric ozone: Potential photochemical ozone creation. Sulfurous and photochemical smog pollution.

5. Acid rain and transport models

Introduction. SO2 oxidation rate in the troposphere. Homogeneous gas phase reactions. Aqueous phase reactions. Heterogeneous reactions on solid surfaces. Oxidation of NO2 to nitric acid. Comparison and contrasts between sulfuric and nitric acids. Influence of Meteorology. Dynamics of Environmental Chemistry: Models of transport and acid rain. Acid mists. Ecological effects.

6. Greenhouse effect and global warming.

Introduction. Mechanism of the greenhouse effect. Gases that contribute to the greenhouse effect. CO2. Water vapor. Methane. Oxides of nitrogen. Chlorofluorocarbons. Ozone. Aerosols. Comparison of greenhouse gases. Global warming potentials. Kyoto Protocol and predictions on Global Climate Change. Reducing greenhouse gas emissions.

7. Chemistry of the stratosphere: The ozone layer.

Stratosphere: the ozone layer. Non-catalytic mechanism of formation and destruction of ozone. Catalytic ozone destruction processes. Role of chlorine and bromine in ozone destruction. Interaction of tropospheric and stratospheric chemistry. Polar stratospheric clouds. General mechanism of formation of "holes". Ozone depletion potentials. Montreal Protocol. Effects of the decrease in the ozone layer.

8. Pollution in aquatic systems

Water pollution. Hydrological cycle. Water resources and consumption. Physical and chemical characteristics of aquatic systems. Degradation of water resources. Classification of pollutants. Nutrients, sediments, and eutrophication. Oxygen-requiring waste. Pathogens. Metals: general overview, mercury. Bioaccumulation: ecological perspective, thermodynamic and kinetic approaches. Petroleum. Persistent organic pollutants. Inorganic pollutants. Thermal pollution. Radioactive materials.

9. Sustainable Development Goals (SDGs)

Introduction. Purpose of the SDGs. Definition of SDGs. Classification. 2030 Agenda. Description of SDGs.

10. Pollution of natural waters.

Classification of pollutants. Nutrients, sediments and eutrophication. Waste requiring oxygen. Pathogens. Metals: general, mercury. Bio-accumulation: Ecological Vision, thermodynamic and kinetic approaches. Oil. Persistent Organic Products. Inorganic products. Thermal pollution. Radioactive materials.

WORKLOAD

PRESENCIAL ACTIVITIES

Activity	Hours
Tutorials	9,00
Theory	51,00
Total hours	**60,00**

NON PRESENCIAL ACTIVITIES

Activity	Hours
Attendance at other activities	0,00
Individual or group project	40,00
Independent study and work	0,00
Preparation of lessons	28,00

Preparation for assessment activities	22,00
Resolution of case studies	0,00
Total hours	**90,00**

TEACHING METHODOLOGY

The development of the subject is carried around the lectures and tutorials.In the lectures, which provides an overview of the subject, the key concepts are emphasized for propercompression and indicates the resources that are necessary for in-depth study of the subject. The tutorials are seminars in which it will study in depth a key concept bysolving a complex numerical problem. In the first part of the seminar, the teacher will pose the problem.Then the students, individually or in groups, will get the solution based on the theory explained. Once thetask is achieved, the teacher will give a reasoned solution, allowing self-assessment by students. If theconcept reviewed presents social debate, there will be a brief discussion according to the results.

EVALUATION

First and second call.

The evaluation of the course will be carried out according to the following criteria:

(a) Attendance and participation in classes and seminars: 5%.

(b) Completion of a final questionnaire: 60%.

(c) Completion of tasks proposed during the course: 35%.

NOTE: The evaluation questionnaire will have the following characteristics:

(a) It will consist of both theory and practical questions.

(b) It will be carried out individually.

(c) It will be handed in to the professor 15 days after the last class of the course.

(d) The course will not be approved if the final questionnaire is not completed.

(f) The minimum grade to be obtained from the questionnaire will be 4 points out of 10 in order to obtain an average of the attendance grade and the proposed tasks. Below 4, the course will be considered failed.

Final warning

Copying or plagiarism of any assignment that is part of the evaluation will make it impossible to pass the course, and the student will be subject to the appropriate disciplinary procedures.

Please note that, according to Article 13 d) of the University Student Statute (RD 1791/2010, December 30), "*it is the duty of a student to refrain from using or cooperating in fraudulent procedures in evaluation tests, in the work performed or in official University documents*".

REFERENCES

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