COURSE DATA

Data Subject	
Code	36465
Name	Química Física del Medio Ambiente
Cycle	Grade
ECTS Credits	6.0
Academic year	2018 - 2019

Study (s)

Degree	Center	Acad. year	Period
1110 - Degree in Chemistry	Faculty of Chemistry	4	First term

Subject-matter

Degree	Subject-matter	Character
1110 - Degree in Chemistry	15 - Physical Chemistry Applied	Optional

Coordination

Name	Department
PEREZ PLA, FRANCISCO	315 - Physical Chemistry

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 mechanism. Homogeneous and heterogeneous catalysis. Difussion. Transport phenomena. Heterogeneous equilibria.
(d) General Chemistry: Acid-base reactions, pH, precipitation reactions, oxidation-reduction reactions.

OUTCOMES

1110 - 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.
- Solve problems effectively.
- 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.
- 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 of the characteristics and behaviour of the different states of matter and the theories used to describe them.
- Demonstrate knowledge of the main types of chemical reaction and their main characteristics.

- Demonstrate knowledge of the principles of quantum mechanics and their application to the description of the structure and properties of atoms and molecules.
- Show knowledge of the metrology of chemical processes including quality management.
- Relate the macroscopic properties and the properties of individual atoms and molecules, including macromolecules (natural and synthetic), polymers, colloids and other materials.
- Show knowledge of the structure and reactivity of the main classes of biomolecules and the chemistry of the main biological processes.
- Demonstrate knowledge and understanding of essential facts, concepts, principles and theories related to the areas of chemistry.
- Solve qualitative and quantitative problems following previously developed models.
- Evaluate, interpret and synthesise chemical data and information.
- Handle chemicals safely.
- Handle the instrumentation used in the different areas of chemistry.
- Interpret data from observations and measurements in the laboratory in terms of their significance and the theories that underpin them.
- Evaluate the risks in the use of chemicals and laboratory procedures.
- 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

Demostrar capacitat per seleccionar el mètode adequat al tipus de problema químic i conèixer els errors esperables.

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. Transfers between environmental compartments.

Phase equilibria: air-water distribution, air sprays, water, biota, other two-phase systems. Coefficients octanol-water. Residence times in compartments, environmental implications. Dry deposition processes: gas, particle. Particle coagulation. Nucleation. Wet deposition of particles, gases.

6. 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.

7. 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.

8. 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.

9. Introduction to the Chemistry of the Hydrosphere

Introduction. Hydrosphere: Water Cycle. Physical-chemical properties of water. Physical-chemical properties of aquatic systems. Salinity. Temperature in aquatic systems: Thermal stratification. Gases in aquatic systems.

10. Processes in aquatic systems.

Equilibria of CO2 in aquatic systems. Equilibria in pure and saline water. Equilibria in natural systems. Alkalinity and hardness of natural waters. Redox processes: pE-pH diagrams. Photosynthesis. Electronic transmission and phosphorylation. Photo-independent reactions. Illumination and nutrients. Redox processes in natural systems: bacteria as catalysts. Other photochemical processes in aquatic systems: direct, indirect and heterogeneous.

11. 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

ACTIVITY	Hours	% To be attended
Theory classes	51,00	100
Tutorials	9,00	100
Development of individual work	25,00	0
Study and independent work	25,00	0
Readings supplementary material	5,00	0
Preparation of evaluation activities	15,00	0
Preparing lectures	10,00	0
Preparation of practical classes and problem	10,00	0
TOTAL	**150,00**	

TEACHING METHODOLOGY

The development of the subject is carried around the lectures and classes of problems.

In the lectures, which provides an overview of the subject, the key concepts are emphasized for proper compression and indicates the resources that are necessary for in-depth study of the subject.

The classes of problems are actually mini-seminars in which it will study in depth a key concept by solving 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 the task is achieved, the teacher will give a reasoned solution, allowing self-assessment by students. If the concept 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 conducted according to the following criteria:

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

(b) Conduct a final questionnaire: 50%

(c) Performing tasks proposed during the course: 45%

NOTE. The guest reviews have the following characteristics:

(a) consist of both theory and practical issues.

(b) be conducted individually.

(c) the teacher will be given 15 days after the last class of the course.

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

(e) The minimum that must be obtained from the questionnaire will be 4 points out of 10 for to average out the attendance note and the proposed tasks. Below 4, the course will be suspended.

REFERENCES

Basic

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- BAIRD, C. Environmental Chemistry. 2a. Ed. W.H.Freeman and Co. , Nueva York, 1998.

Additional

- ALLOWAY, B.J. y AYRES, D.C.B. "Chemical Principles of Environmental Pollution". Blackie, Londres. 1997
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- VAN LOON, G.W y DUFFY, S.J. "Environmental chemistry: a global perspective" Oxford University Press. Oxford. 2000