UNIVERSITÀ
DEGLI STUDI DI MILANO-BICOCCA

SYLLABUS DEL CORSO

Chimica Ambientale

2122-1-F7501Q036

Aims

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The student gains chemical knowledge about the nature of chemical reactions that characterize each segment, the nature of the substances present and their reactivity and persistence in the environment. Furthermore, the student acquires knowledge of the chemical and physical parameters useful to evaluate the interaction and the partition between the different environments as well as the transport processes.

Knowledge and understanding
At the end of the course the student knows:
The main chemical reactions for anthropogenic compounds present in the water compartment, the hydrolysis reactions.
The main reactions of atmospheric compounds, the radical reactions.
The chemistry of soil processes for organic contaminants and metals.
The persistence of anthropogenic and natural compounds in environmental compartments.

The chemical and physical quantities useful for evaluating the interactions and the partition between the environmental compartments.
Transport processes in the atmosphere and in the soil

Applying knowledge and understanding
At the end of the course the student is able to:
Calculate the life and half-life time of the compounds in the environmental compartments and predict their reactivity.
Determine which anthropogenic compounds can be persistent, bioaccumulative and toxic.
Determine, on the basis of chemical-physical properties, the distribution / mobility of compounds in the different environmental compartments.

Making judgements
At the end of the course the student is able to:
Identify which chemical compounds can impact on different environmental and human sectors;
Identify the strategies for the control of pollutants in the various environmental sectors;
Identify the processes for water purification.
Examine the chemical and physical pamameters useful for evaluating the interactions and the partition between the different environmental compartments.
Define transport processes in the atmosphere and in the soil.

Communication skills
Exposing, in a clear and concise manner, the main chemical reactions in the different environmental sectors.

Learning skills
Apply the acquired knowledge of environmental chemistry to anthropogenic compounds. Understanding the topics of environmental chemistry in past and present scientific literature.

Contents

Course Part I - ENVIRONMENTAL CHEMISTRY I

The overall aim of the Environmental Chemistry I course is to provide an understanding of the role of chemical compounds and pollutants on soil, water and atmosphere segments and their effects on humans and environment.

Course Part II - ENVIRONMENTAL CHEMISTRY II

Evaluation of the physical and chemical parameters useful to evaluate the interaction and partition between the different environments. Interaction and transport.

Detailed program

Course Part I - ENVIRONMENTAL CHEMISTRY I

- Material cycles. The carbon cycle, the nitrogen cycle, the sulphur cycle, the phosphorus cycle, the metal cycle.
- The atmosphere. Photochemistry, Photochemical smog.
- Water. The earth’s water cycle, chemistry in bodies of water with anthropogenic influences.
- Soil. Biogeochemical processes, metals, organic contaminants.
- Effects of anthropogenic pollutants on atmosphere, water, soil.
- Basic principles of pollutant, general decomposition pathways, hydrocarbon PAHs, PCBs, dibenzodioxins, dibenzofurans, pesticides, heavy metals.
- Air quality control. Processes for the preparation of drinking water. Principles of waste water treatment. Methods for soil remediation.

Course Part II - ENVIRONMENTAL CHEMISTRY II

- Introduction to chemical processes in natural and anthropic environments.
- Reactions typical of the different environments.
- Thermodynamics and kinetics.
- Chemical and physical parameters useful to evaluate the interaction and partition between the different environments.
- Interaction and transport.
- Transport processes.
- Distribution in different environmental compartment.
- Contaminant dispersion in atmosphere. Modeling of chemicals migration in the soil.
- Adsorption.
- Biodegradation kinetics. Models examples.

Prerequisites

Chemistry basic knowledge

Teaching form

Lessons, 12 credits - 96 hours

The course provides 12 credits of lectures through slides. The teaching method develops the topics through a historical time history. The course explains the reasons for the synthesis of the different compounds and the progress of knowledge on chemical reactivity and the determination of the main metabolites and the evaluation of the physical and chemical parameters useful to evaluate the interaction and partition between the different environments.

Textbook and teaching resource

Teaching material can be available on the e-learning platform: http://elearning.unimib.it/course

References:

Suggested reading:

- Pier Luigi Gentili, Untangling Complex System: A Grand Challenge for Science, CRC Press

Course Part I - ENVIRONMENTAL CHEMISTRY I

- Stanley E. Manahan, Environmental Chemistry, Lewis
- C.Baird et al., Environmental Chemistry, Zanichelli
- R.P. Schwarzenbach et al. Environmental Organic Chemistry, Wiley

Course Part II - ENVIRONMENTAL CHEMISTRY II

- R.P. Schwarzenbach et al. Environmental Organic Chemistry, Wiley
- D. Mackay, Multimedia Environmental Models, Lewis Publisher
- G. Tchobanoglous et al., Integrated Solid Waste Management, Mc Graw Hill
- J. Bear and A. Verruijt, Modeling Groundwater Flow and Pollution, Reidel
- H. F. Hemond and E.J. Fechner, Chemical Fate and Transport in the Environment, Academic Press

Semester

annual

Assessment method

The assessment of learning takes place with a final oral examination with questions related to the topics covered in the two modules to verify the aquired skills.

The exam consists in the assessment of the knowledge acquired by the student in the field of environmental chemistry, with particular attention to the reactivity of the volatile organic compounds in the atmosphere, the reactivity of pesticides in water and persistent organic compounds and the dispersion models into the environment.

In the oral examination, as far as possible, the student will be evaluated on the basis of the following criteria: 1) knowledge and ability to understand; 2) ability to connect different concepts; 3) reasoning autonomy; 4) ability to correctly use scientific language.

Exam grade in the range 18-30/30

Office hours

On appointment