Learning objectives of the subject

CE01 - Apply scientific concepts to environmental problems and their correlation with technological concepts.
CE02 - Analyze systems, environmental problems and their resolution using models and evaluate them.
CE03 - Acquire basic skills of laboratory work and identify the methods and instrumentation for the determination of parameters relevant to the analysis of environmental problems.

Very aware of the structure of land, water and artificial ecosystems and their interactions.
Meet the ecology and the cycling of elements.
Meet the major environmental problems globally.
Analyzes energy bases, stoichiometric and kinetic of different processes.
Modeling process and quantifies the performance and efficiency of systems.
Determines the basis of environmental hazards to human health and ecosystems.
Apply material balances and energy to environmental problems.
Interprets water-rock and water - air interactions using thermodynamic and kinetic methods.
Meet the pollutants and identify their impact.
Learn the basics of how the atmosphere and applies them in maintaining air quality.
Learn the basics of climate and discusses the implications of current climate change.
Conceptualized an environmental problem described by equations and poses analytical or numerical solution. Identifies the codes you need to solve a problem as conceptualized. Recognizes the spatial and temporal scales required to resolve the problem. Is familiar with solutions to problems relating to dynamical systems. Learn about simple solutions to problems advection- dispersion - reaction. Recognizes the existence of uncertainty in the parameters of the equations and is capable of performing an uncertainty analysis and sensitivity. Learn methods for information and action on various parameters or variables. Understand that any measure inherently carries an associated error and is able to work with them. It is critical to the values reported by others when the measurement method is not specified. He has worked in the laboratory measurement of some parameters of environmental interest.


### Study load

<table>
<thead>
<tr>
<th>Total learning time: 125h</th>
<th>Theory classes: 15h</th>
<th>12.00%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Practical classes: 10h</td>
<td>8.00%</td>
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</tr>
<tr>
<td>Laboratory classes: 10h</td>
<td>8.00%</td>
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<tr>
<td>Guided activities: 10h</td>
<td>8.00%</td>
<td></td>
</tr>
<tr>
<td>Self study: 80h</td>
<td>64.00%</td>
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</tbody>
</table>
## Content

### Background and basic chemical principles

<table>
<thead>
<tr>
<th><strong>Learning time:</strong></th>
<th>7h 11m</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Theory classes:</strong></td>
<td>3h</td>
</tr>
<tr>
<td><strong>Self study:</strong></td>
<td>4h 11m</td>
</tr>
</tbody>
</table>

**Description:**

### Aqueous systems

<table>
<thead>
<tr>
<th><strong>Learning time:</strong></th>
<th>7h 11m</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Theory classes:</strong></td>
<td>2h</td>
</tr>
<tr>
<td><strong>Practical classes:</strong></td>
<td>1h</td>
</tr>
<tr>
<td><strong>Self study:</strong></td>
<td>4h 11m</td>
</tr>
</tbody>
</table>

**Description:**

**Specific objectives:**
Understanding and use of the main variables for the characterization and computation of equilibrium conditions in aqueous solutions. Behavior of gases, liquids and solids depending on the concentrations of their components. Problem solving and use of results in the assessment of real cases.

### Carbonate geochemistry the carbon cycle

<table>
<thead>
<tr>
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<th>7h 11m</th>
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<tbody>
<tr>
<td><strong>Theory classes:</strong></td>
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<tr>
<td><strong>Practical classes:</strong></td>
<td>1h</td>
</tr>
<tr>
<td><strong>Self study:</strong></td>
<td>4h 11m</td>
</tr>
</tbody>
</table>

**Description:**

**Exercises**
# Biogeochemical cycles

**Description:**

**Learning time:** 7h 11m
- Theory classes: 2h
- Practical classes: 1h
- Self study: 4h 11m

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# EVALUATION

**Learning time:** 21h 36m
- Laboratory classes: 9h
- Self study: 12h 36m

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# Chemical weathering and soils

**Description:**

**Learning time:** 7h 11m
- Theory classes: 2h
- Practical classes: 1h
- Self study: 4h 11m

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# Stable isotope geochemistry and environmental applications

**Description:**

**Learning time:** 7h 11m
- Theory classes: 2h
- Practical classes: 1h
- Self study: 4h 11m
Description:
Case 1 -. Aznalcóllar Accident Analysis (1998)
Nature and environmental dangers of radioactive contamination. Field studies of the behavior of radionuclides. Applications: geochemical risk assessment models
Case 1 -. Norman (USA). Case 2 -. Grinsted (DK).
Geomaterials and human health. Routes of exposure, absorption, biodistribution, metabolism, and detoxification. Geochemistry biodurable medical materials: asbestos, erionite, other fibrous materials, crystalline silica. Medical Geochemistry of materials readily soluble, bioaccessible components, and / or bioreactive
Case 1 -. Chlorofluorocarbons (CFC) in large urban areas. Case 2 -. Flows polychlorinated biphenyls (PCBs) in Lake Michigan
Case 1 -. Emissions of heavy metals in the U.S. Case 2 -. European Inventory of heavy metal pollution in lake basins
Specific objectives:
Analysis and prevention of geochemical environmental effects of mining operations (mainly metal ores as sulfides)
Application of the concepts of theme Geochemistry of acid mine drainage to the critical study of specific cases
Establishment of criteria for the assessment and prevention of environmental risks of storage facilities for nuclear waste
Establishment of criteria for the assessment and prevention of environmental risks in groundwater caused by leachate from landfill facilities
Application of the concepts of unit 9 (Geochemistry of groundwater in waste disposal facilities) to the critical study of specific cases
Study of the response of ecosystems in water bodies (quasi-closed or closed) to the addition of artificial or natural substances that alter the initial equilibrium
Application of the concepts of Item 10 (Eutrophication of water bodies: causes and control) the critical study of specific cases
Concentration, transport and distribution of geomaterials harmful to human health
Application of the concepts of Item 12 (Medical Geochemistry of dust, soil and other earth materials) to the critical study of specific cases
Analysis and prevention of environmental effects of halogenated organic compounds (mainly atmospheric flows)
Application of the concepts of Item 11 (Biogeochemistry halogenated hydrocarbon) to the critical study of specific cases
Application of the concepts of theme Kinetics global geochemical cycles to the critical study of specific cases

Qualification system

Problems (weekly assignments): 25%
Written test #1: 20%
Written test #2: 20%
Case study: 20%
Assistance and participation: 15%

Regulations for carrying out activities

Failure to perform a laboratory or continuous assessment activity in the scheduled period will result in a mark of zero in that activity.

Bibliography

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