250656 - PROCGEOQ - Geochemical Processes

Coordinating unit: 250 - ETSECCPB - Barcelona School of Civil Engineering
Teaching unit: 751 - DECA - Department of Civil and Environmental Engineering
Academic year: 2019
Degree: MASTER'S DEGREE IN ENVIRONMENTAL ENGINEERING (Syllabus 2014). (Teaching unit Compulsory)
ECTS credits: 5
Teaching languages: Spanish, English

Teaching staff
Coordinator: IGNACIO CASANOVA HORMAECHEA
Others: IGNACIO CASANOVA HORMAECHEA

Opening hours
Timetable: Monday from 9:30 to 10:30
Friday 9:30 to 10:30

Degree competences to which the subject contributes
Specific:
13340. Apply scientific concepts to environmental problems and their correlation with technological concepts.
13341. Analyze systems, environmental problems and their resolution using models and evaluate them.
13342. Acquire basic skills of laboratory work and identify the methods and instrumentation for the determination of parameters relevant to the analysis of environmental problems.

Transversal:
8562. EFFECTIVE USE OF INFORMATION RESOURCES: Managing the acquisition, structuring, analysis and display of data and information in the chosen area of specialisation and critically assessing the results obtained.
8563. FOREIGN LANGUAGE: Achieving a level of spoken and written proficiency in a foreign language, preferably English, that meets the needs of the profession and the labour market.

Teaching methodology
The course consists of 2.5 hours per week of classroom activity (large size group) and 1.3 hours weekly with half the students (medium size group).

The 2.5 hours in the large size groups are devoted to theoretical lectures, in which the teacher presents the basic concepts and topics of the subject, shows examples and solves exercises.

The 1.3 hours in the medium size groups is devoted to solving practical problems with greater interaction with the students. The objective of these practical exercises is to consolidate the general and specific learning objectives.

Support material in the form of a detailed teaching plan is provided using the virtual campus ATENEA: content, program of learning and assessment activities conducted and literature.

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.

Concepts of soil science.
Organic pollutants: VOCs, COVSs, pesticides, PCBs, dioxins.
Inorganic contaminants, metals, cyanide, anions, cations.
Properties of compounds: solubility, melting and boiling temperature, vapor pressure, etc..
Henry's Law, partition coefficients.
pH, acidity / alkalinity, oxidation-reduction (redox).
Environmental Geochemistry.
Chemical reactions: dissolution / precipitation, cation exchange.
Photochemical reactions.

### Study load

<table>
<thead>
<tr>
<th></th>
<th>Hours large group:</th>
<th>Hours medium group:</th>
<th>Hours small group:</th>
<th>Guided activities:</th>
<th>Self study:</th>
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<tbody>
<tr>
<td><strong>Total learning time:</strong></td>
<td>15h</td>
<td>10h</td>
<td>10h</td>
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<td>80h</td>
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## Content

<table>
<thead>
<tr>
<th><strong>Background and basic chemical principles</strong></th>
<th><strong>Learning time:</strong> 4h 48m</th>
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<tbody>
<tr>
<td><strong>Description:</strong> Environmental Geochemistry: history and perspectives. Elements and abundances. Measurement of concentrations. The periodic table. Ions, molecules, valence, bonding and chemical reactions. Acid-base equilibria. The equilibrium constant. Fundamentals of oxidation-reduction. Fundamentals of chemical thermodynamics. Fundamentals of chemical kinetics.</td>
<td><strong>Theory classes:</strong> 2h  <strong>Self study:</strong> 2h 48m</td>
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<tr>
<th><strong>Aqueous systems</strong></th>
<th><strong>Learning time:</strong> 7h 11m</th>
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<tbody>
<tr>
<td><strong>Description:</strong> Chemical potential. Variation of chemical potential with temperature, pressure and composition. Relationship between Gibbs free energy and the equilibrium constant. Gases. Ideal solutions of condensed phases. Nonideal solutions of condensed phases. Excess functions. Ideal crystalline solutions. Non-ideal crystalline solutions.</td>
<td><strong>Theory classes:</strong> 2h  <strong>Practical classes:</strong> 1h  <strong>Self study:</strong> 4h 11m</td>
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<tr>
<th><strong>Carbonate geochemistry the carbon cycle</strong></th>
<th><strong>Learning time:</strong> 7h 11m</th>
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<tbody>
<tr>
<td><strong>Description:</strong> The inorganic carbon in the atmosphere and hydrosphere. Atmospheric CO2 carbonate species and the pH of rainwater. Alkalinity. Solubility. The effect of partial pressure of CO2 on the stability of carbonates. Oxidation states of carbon. Global fluxes and reservoirs. Fixation of carbon into the crust. The oceanic reservoir. Carbon fixation in the oceans. The atmospheric reservoir. Carbon capture and storage.</td>
<td><strong>Theory classes:</strong> 2h  <strong>Practical classes:</strong> 1h  <strong>Self study:</strong> 4h 11m</td>
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<tr>
<td>Biogeochemical cycles</td>
<td>Learning time: 7h 11m</td>
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<tr>
<td>Description:</td>
<td>Theory classes: 2h</td>
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<td>Practical classes: 1h</td>
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<td>Self study: 4h 11m</td>
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<td><strong>Description:</strong></td>
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<thead>
<tr>
<th>EVALUATION</th>
<th>Learning time: 14h 23m</th>
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<tbody>
<tr>
<td>Laboratoy classes: 6h</td>
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<tr>
<td>Self study: 8h 23m</td>
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<thead>
<tr>
<th>Chemical weathering and soils</th>
<th>Learning time: 7h 11m</th>
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<tr>
<td>Description:</td>
<td>Theory classes: 2h</td>
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<tr>
<td></td>
<td>Practical classes: 1h</td>
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<tr>
<td></td>
<td>Self study: 4h 11m</td>
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<td><strong>Description:</strong></td>
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<tr>
<th>Stable isotope geochemistry and environmental applications</th>
<th>Learning time: 7h 11m</th>
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<tr>
<td>Description:</td>
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<tr>
<td></td>
<td>Practical classes: 1h</td>
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<td>Self study: 4h 11m</td>
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<td><strong>Description:</strong></td>
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Case Study

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<tr>
<th>Learning time: 28h 47m</th>
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<tbody>
<tr>
<td>Theory classes: 6h</td>
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<td>Practical classes: 6h</td>
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<tr>
<td>Self study: 16h 47m</td>
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Description:

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 (quiasi-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) to 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): 30%
Written test #1: 20%
Written test #2: 20%
Case study: 20%
Participation in class and proactivity: 10%

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.
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Bibliography

Basic:


Complementary:

Sahai, N.; Schoonen, M.A.A. (eds.). "Reviews in mineralogy and geochemistry". Reviews in mineralogy and geochemistry. vol. 64.