Course guide
250571 - CICBIOMGLO - Bio-Geo-Chemical Global Cycles

Unit in charge: Barcelona School of Civil Engineering
Teaching unit: 751 - DECA - Department of Civil and Environmental Engineering.

Degree: BACHELOR’S DEGREE IN MARINE SCIENCE AND TECHNOLOGY (Syllabus 2018). (Compulsory subject).

Academic year: 2022
ECTS Credits: 6.0
Languages: Catalan

LECTURER
Coordinating lecturer: IGNACIO CASANOVA HORMAECHEA
Others: IGNACIO CASANOVA HORMAECHEA, PAULA FELICIDAD RODRIGUEZ ESCALES

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:
13388. To know and apply the lexicon and concepts of the Marine Sciences and Technologies and other related fields.
13392. Evaluate the bio- and geo-diversity of the marine environment, identifying habitats and ecosystems with multidisciplinary criteria.
13394. Address the most relevant processes and their interactions related to their physical / chemical / biological / geological components, applying technical and scientific knowledge and criteria.
13395. To set, evaluate and propose solutions to the different conflicts of use and exploitation in the marine and coastal environment resources based on scientific and technical criteria.
13397. Carry out environmental impact, management and protection studies of the marine environment and adjacent coastal areas, including the corresponding infrastructures and their related impacts.
13403. Develop a conceptual framework to address the sustainability of the marine environment and the related socio-economic activities at different scales, explaining the effects of climate change.
13404. Set, plan and execute basic and applied research in the field of Marine Sciences and Technologies.
13405. Carry out calculations, assessments, surveys and inspections in coastal and marine environments, as well as the corresponding technical documents.
13406. Write technical reports and disseminate knowledge about the different components of the marine system, considering the applicable legal framework.
13407. Apply the necessary tools to analyze the economic and legal aspects of human actions and the related impacts on the marine environment, including technical advice and representation of companies and administrations.

Generical:
13380. Develop a professional activity in the field of Marine Sciences and Technologies.
13382. Apply state-of-the-art methods and techniques in oceanography and marine climate, jointly covering the physical, chemical, geological and biological aspects.
13383. Develop a conceptual framework that links the scientific-technological and management aspects for marine resources, explaining the interactions with marine infrastructures and management plans in coastal areas.
13385. Apply knowledge and academic experience to the biotic and abiotic resources of the marine environment, explaining their interactions with the socio-economic activities that take place in it.
13386. Encompass and teach studies in the different research lines that converge in Marine Sciences and Technologies.
13387. Combining preservation with economic activity within the framework of current legislation promoting the development of a social and environmental awareness.
TEACHING METHODOLOGY

The course consists of 2.3 hours per week of classroom activity (large size group) and 1.2 hours weekly with half the students (medium size group).

The 2.3 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 1.2 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.

The rest of the weekly hours devoted to laboratory practice.

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

This subject will address fundamental aspects of chemical oceanography, with emphasis on issues related to sedimentary hydrocarbons, biomineralization, biomarkers. Biogeochemistry of marine and terrestrial primary production. Geological and contemporary history of the carbon cycle, the global cycle of oxygen, nitrogen, phosphorus, sulfur and silicon. Coupling of biogeochemical cycles. Anthropic effects on the biogeochemical cycles.


3.- Coupling of biogeochemical cycles. Anthropic effects in the biogeochemical cycles.

This subject is oriented to a high-level interdisciplinary training, by addressing in depth all the major areas of the Marine Sciences (Physical, Geological, Chemical and Biological Oceanography), as well as providing a solid foundation in programming and problem solving methods through the use of computer calculation programs that allow a comprehensive understanding of the marine environment, its problems and the possible solutions to them.

This course is intended as an introductory course to biogeochemistry. The goals of the course include (1) learning the basic chemical cycles that occur in the various Earth systems and the environments in which these reactions occur, (2) understanding the basic geochemical concepts including redox chemistry, thermodynamics, kinetics, and acid-base chemistry (3) identifying the typical procedures and methods used to measure these processes on the Earth, and (4) examining the literature concerning biogeochemistry.

LEARNING OBJECTIVES: The student will be able to

- identify the chemical cycles that take place on the Earth
- explain the various geochemical reactions that are important in biogeochemical cycles
- identify the environments in which these cycles occur, and how they differ
- identify key journals, literature, and authors that are presently researching the various core areas within biogeochemistry.

STUDY LOAD

<table>
<thead>
<tr>
<th>Type</th>
<th>Hours</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Self study</td>
<td>84,0</td>
<td>56.00</td>
</tr>
<tr>
<td>Guided activities</td>
<td>6,0</td>
<td>4.00</td>
</tr>
<tr>
<td>Hours large group</td>
<td>30,0</td>
<td>20.00</td>
</tr>
<tr>
<td>Hours small group</td>
<td>15,0</td>
<td>10.00</td>
</tr>
<tr>
<td>Hours medium group</td>
<td>15,0</td>
<td>10.00</td>
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</tbody>
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Total learning time: 150 h
CONTENTS

The origins

Description:

Specific objectives:
Identify the main mechanisms that gave rise to the chemical elements. Qualitative understanding of the relationship between mass, temperature and life cycle of stars. What is accretion and the mechanisms of formation of planetary systems. Identify the characteristics and formation of known types of planets. Contextualize the hypotheses about the origin of the Earth-Moon system in the formation of the solar system. Main hypotheses about the origin and early evolution of the atmosphere and oceans. The first record of biological activity. Comparative evolution of Earth, Mars and Venus.

Full-or-part-time: 9h 36m
Theory classes: 4h
Self study : 5h 36m
Physico-chemical tools of Biogeochemistry

Description:
Air-water equilibrium constant (K_{aw}). Experimental determination of Henry's constants. Environmental effects in K_{aw}.
Aerosols.
Air-water equilibrium (problems)
Distribution of elements and compounds between soils, sediments and waters. Adsorption of metal ions. Adsorption of organic molecules.
Sediment-water equilibrium (problems)

Specific objectives:
Work quantitatively with the concept of partition. Practical applications of the characteristics of the ideal solutions. Know the basic concepts about physical chemistry of aerosols.
Work quantitatively with the concept of partition. Know how to operate (at an introductory level) with the basic concepts of surface chemistry.
Apply the concepts of chemical kinetics to the description of biologically-mediated reactions.

Full-or-part-time: 24h
Theory classes: 6h
Practical classes: 4h
Self study: 14h
The atmosphere

**Description:**

**Atmospheric chemistry exercises**

**Specific objectives:**
Revise and consolidate at a professional level the knowledge about the structure of the atmosphere. Use tools and basic concepts of Thermodynamics to understand the distribution of energy in the atmosphere and its consequences. Understand the main chemical reactions involving the major components of the atmosphere. Identify and model the role of minor components. Achieve notions about the chemistry of some important reactions in the stratosphere and their effects on a global scale.

**Full-or-part-time:** 19h 12m
Theory classes: 6h
Practical classes: 2h
Self study: 11h 12m
The surface of the lithosphere

**Description:**

**Specific objectives:**
Get acquainted with the main types of chemical reactions that transform the primary minerals of the earth's crust and their temporal evolution. Understand the mechanisms that control the mobility of elements and compounds in soil environments.

**Full-or-part-time:** 14h 23m
Theory classes: 4h
Practical classes: 2h
Self study: 8h 23m

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The hydrosphere

**Description:**

**Specific objectives:**
Review of the phase diagram of water and its global implications for the hydrosphere. Study of the physical and chemical exchanges between different bodies of water and sediments and atmosphere. Description of the mechanisms of physical and chemical transport in lakes. Description of the mechanisms of physical and chemical transport in rivers and estuaries. Identify the anthropic processes of change in inland waters. Knowledge of the physical and chemical bases of biogeochemical cycles in the oceans. Identify the main components that influence the chemical evolution of the oceans and their interaction with other terrestrial spheres.

**Full-or-part-time:** 28h 47m
Theory classes: 8h
Practical classes: 4h
Self study: 16h 47m
The hydrosphere

Description:
Inland biogeochemistry exercises
Ocean biogeochemistry exercises

Specific objectives:
Review of the phase diagram of water and its global implications for the hydrosphere. Study of the physical and chemical exchanges between different bodies of water and sediments and atmosphere. Description of the mechanisms of physical and chemical transport in lakes.
Description of the mechanisms of physical and chemical transport in rivers and estuaries. Identify the anthropic processes of change in inland waters.
Knowledge of the physical and chemical bases of biogeochemical cycles in the oceans.
Identify the main components that influence the chemical evolution of the oceans and their interaction with other terrestrial spheres.

Full-or-part-time: 28h 47m
Theory classes: 8h
Practical classes: 4h
Self study: 16h 47m

Synthesis topics

Description:
Synthesis topic.
Synthesis topic
Synthesis topics
Specific objectives:
Know how to identify and give structure to topics of general interest. Development of outreach skills. From a preliminary outline, learn to add more specialized topics covered in class. Development of technical and artistic skills. Final presentation format: TED Talk
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Full-or-part-time: 48h
Laboratory classes: 20h
Self study: 28h
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Specific objectives:
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Full-or-part-time: 48h
Laboratory classes: 20h
Self study: 28h

GRADING SYSTEM

The mark of the course is obtained from the ratings of continuous assessment and their corresponding laboratories and/or classroom computers.

Continuous assessment consist in several activities, both individually and in group, of additive and training characteristics, carried out during the year (both in and out of the classroom).

The teachings of the laboratory grade is the average in such activities.

The evaluation tests consist of a part with questions about concepts associated with the learning objectives of the course with regard to knowledge or understanding, and a part with a set of application exercises.

BIBLIOGRAPHY

Basic: