Course guides
250561 - PROFIQUIMA - Marine Physical-Chemical Processes

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: 2020 ECTS Credits: 6.0 Languages: Catalan, English, Spanish

LECTURER
Coordinating lecturer: PAULA - FELICIDAD RODRIGUEZ ESCALES
Others: ARNAU CANELLES GARCIA, IGNACIO CASANOVA HORMAECHEA, OCTAVIO CESAR MÓSSE ARANDA, 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.
13390. Establish a good practice in the integration of common numerical, laboratory and field techniques in the analysis of any problem related to the marine environment.
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.

Generical:
13380. Develop a professional activity in the field of Marine Sciences and Technologies.
13381. Address in a comprehensive manner the analysis and preservation of the marine environment with sustainability criteria.

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 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 review some of the most important physical-chemical processes that occur in seawater, and which have great relevance in organic and inorganic processes related to primary productivity, pollution and sustainability in the use and exploitation of coastal waters. Emphasis will be placed on aspects such as seawater chemistry, reducing agents, photochemical reactions, solubility, precipitation and dissolution, ionic force and balance, etc.

1.- The redox chemistry of seawater. Reducing agents. The role of microorganisms. Photochemical reactions

This subject focuses on highlighting aspects related to the state of health of the marine environment, mainly oriented to two well differentiated but complementary aspects. On the one hand, the ecological, ecosystemic and environmental aspects, which will give the students a specific vision of the environmental problems present in the marine environment, produced by the use and exploitation of the resources that it provides.

On the other hand, this subject represents a transition of knowledge for students between the Extension of the subject of Basic Sciences, the subject of Applied Sciences and Techniques.

This course will review some of the most important physicochemical processes that take place in seawater, and which are of great relevance in organic and inorganic processes related to primary productivity, pollution and sustainability in the use and exploitation of coastal waters. Emphasis will be placed on aspects such as seawater chemistry, reducing agents, photochemical reactions, solubility, precipitation and dissolution, ionic strength and equilibrium, and so on. This subject focuses on highlighting aspects related to the state of health of the marine environment, mainly aimed at two well-differentiated but complementary aspects. On the one hand, the ecological, ecosystemic and environmental aspects, which will give students a specific view of the environmental problems present in the marine environment, produced by the use and exploitation of the resources it provides. On the other hand, this subject represents a transition of knowledge for the students between the Extension of the subject of Basic Sciences, to the subject of Applied Sciences and Techniques.

STUDY LOAD

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

Total learning time: 150 h

CONTENTS

**General principles of Physical Chemistry**

Description:
Description of generic concepts such as internal energy and the first principle. Enthalpy Heating capacities. Ideal gases and first principle. Entropy and second principle. Calculation of entropy differences. Entropy, reversibility and irreversibility.

Specific objectives:
Conditions of equilibrium between phases. The rule of phases. Diagram of phases of water. The Clapeyron and Clausius-Clapeyron equations.

Full-or-part-time: 14h 23m
Theory classes: 6h
Self study : 8h 23m
### Equations of Gibbs. Thermodynamic functions.

**Description:**

**Specific objectives:**
Know Gibbs Equations, a condition of balance. Chemical potential, condition of material balance: phase balance, chemical equilibrium and apply to marine conditions.

**Full-or-part-time:** 4h 48m
- Theory classes: 2h
- Self study: 2h 48m

### Chemical equilibrium of phases. Systems of a component

**Description:**
Phase Component Degree of freedom. Rule of phases. Single component systems.

**Specific objectives:**
Analyze and know how to solve ideal systems of a component.

**Full-or-part-time:** 9h 36m
- Theory classes: 4h
- Self study: 5h 36m

### Physical Chemistry of ideal solutions

**Description:**

**Specific objectives:**

**Full-or-part-time:** 9h 36m
- Theory classes: 4h
- Self study: 5h 36m

### Sea water as an electrolytic solution

**Description:**

**Specific objectives:**
Explore the properties of electrolyte dissolutions, conductance measurements, conductivity, molar conductivity, equivalent conductivity and molar conductivity to infinite dilution. Concept of ionic strength and Debye-Hückel equation.

**Full-or-part-time:** 14h 23m
- Theory classes: 6h
- Self study: 8h 23m
Physical Chemistry of real processes

**Description:**
Chemical balance and degree of progression of a reaction. Chemical equilibrium in ideal gases. Variation of the equilibrium constant with the temperature. Principle of Le Chatelier.

**Specific objectives:**
Learn how chemical equilibrium occurs in real dissolutions. Chemical equilibrium in electrolyte solutions. Effect of the ionic strength on balance.

**Full-or-part-time:** 14h 23m
Theory classes: 6h
Self study : 8h 23m

Electrochemistry of seawater.

**Description:**

**Specific objectives:**
Redox reaction concept and electron transference.

**Full-or-part-time:** 4h 48m
Theory classes: 2h
Self study : 2h 48m

Chemical kinetics

**Description:**

**Specific objectives:**
Determine chemical kinetics. See the effect of temperature on the kinetic constant.

**Full-or-part-time:** 4h 48m
Theory classes: 2h
Self study : 2h 48m

Troubleshooting

**Description:**
Calculation of entropy differences. Entropy, reversibility and irreversibility.

**Specific objectives:**
Reinforce and consolidate learning

**Full-or-part-time:** 19h 12m
Practical classes: 8h
Self study : 11h 12m
Laboratory practices

**Description:**
Practice in the computer room - Thermodynamic determination of a balanced system

**Specific objectives:**
Experiment in the modeling of systems through digital procedures.

**Full-or-part-time:** 9h 36m
Laboratory classes: 4h  
Self study: 5h 36m

Evaluation

**Description:**
Through an introductory session and materials of the subject by the teacher, the students will prepare and carry out a flipped classroom on the proposed theme.

**Specific objectives:**
Through an introductory session and materials of the subject by the teacher, the students will prepare and carry out a flipped classroom on the proposed theme.

**Full-or-part-time:** 38h 24m
Practical classes: 4h  
Laboratory classes: 12h  
Self study: 22h 24m

**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.

**EXAMINATION RULES.**

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

**BIBLIOGRAPHY**

**Basic:**