Course guides
250570 - GECCATMOEP - Planetary Scale Circulation of the Atmosphere and Ocean

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, Spanish

LECTURER

Coordinating lecturer: MANEL ESPINO INFANTES
Others: MANEL ESPINO INFANTES, MARC MESTRES RIDGE, OCTAVIO CESAR MÖSSO ARANDA

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.
13401. Apply spatial and cartographic representation techniques for different environments and scales.
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.

General:
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.
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 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 the circulation of the oceans and the atmosphere, with emphasis on global scale processes, in order to give students a view of large-scale circulation and its relationship with the climate. The course will address topics related to the characteristics of water and air masses, heat fluxes, influence of temperature, density and salinity, equations of motion, wind influence, geostrophic currents, as well as an introduction to numerical models.

1.- Know the main laws that govern the dynamics of gases in the atmosphere. Understand the dynamics of gases in the atmosphere and know how to interpret the movements of gases as well as the main convective phenomena that give rise to the global atmospheric circulation.
2.- Understand the Coriolis effect and its influence on a planetary scale, both at the level of water masses and at the atmospheric level.
3.- Understand the effect of high and low pressures as well as their control over climate and their effects on sea level and atmospheric and oceanic circulation.

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.

STUDY LOAD

<table>
<thead>
<tr>
<th>Type</th>
<th>Hours</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<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 medium group</td>
<td>15,0</td>
<td>10.00</td>
</tr>
<tr>
<td>Self study</td>
<td>84,0</td>
<td>56.00</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

### Introduction to Geophysical Fluid Dynamics

**Description:**
- Geophysical Fluid Dynamics
- Geophysical Fluid Dynamics Problems
- Principles and laws of mechanics important to oceanography and meteorology
- Problems on principles and laws of mechanics
- Types of forces and movement in the ocean and in the atmosphere
- Problems about types of forces and movement

**Full-or-part-time:** 28h 47m  
Theory classes: 7h 30m  
Practical classes: 4h 30m  
Self study : 16h 47m

### Dimensional Analysis in Geophysical Fluid Dynamics

**Description:**
- Reynolds, Richardson, Rossby and Eckman numbers
- Problems on Reynolds, Richardson, Rossby and Eckman numbers

**Full-or-part-time:** 9h 36m  
Theory classes: 2h 30m  
Practical classes: 1h 30m  
Self study : 5h 36m

### Waves

**Description:**
- Wave generation and types of wind waves
- Wave generation problems
- Wave prediction. Significant wave height.
- Wave prediction problems.

**Full-or-part-time:** 19h 12m  
Theory classes: 5h  
Practical classes: 3h  
Self study : 11h 12m

### Tides

**Description:**
- Astronomical Tide and Meteorological Tide
- Astronomical and meteorological tidal problems

**Full-or-part-time:** 9h 36m  
Theory classes: 2h 30m  
Practical classes: 1h 30m  
Self study : 5h 36m
Subject evaluation

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

Continity equation

Description:
Application of the continuity equation.

Full-or-part-time: 9h 36m
Theory classes: 2h 30m
Practical classes: 1h 30m
Self study: 5h 36m

Motion Equation

Description:
Eulerian equations. Analysis of terms according to time-space scales. Equations for the average movement. Reynolds efforts.
Application of the Navier-Stokes equations.
Application of the Navier-Stokes equations.

Full-or-part-time: 9h 36m
Theory classes: 2h 30m
Practical classes: 1h 30m
Self study: 5h 36m

Friction currents

Description:
The effect of the wind. Drag coefficient.
Drag coefficient calculation problems.
Ekman model. Ekman transport.
Ekman Model Applications

Full-or-part-time: 19h 12m
Theory classes: 5h
Practical classes: 3h
Self study: 11h 12m
Frictionless currents

Description:
Inertial currents
Inertial current problems
Geostrophic calculation

Full-or-part-time: 19h 12m
Theory classes: 5h
Practical classes: 3h
Self study: 11h 12m

Vorticity

Description:
Sverdrup and Munk solutions for wind circulation

Full-or-part-time: 9h 36m
Theory classes: 2h 30m
Practical classes: 1h 30m
Self study: 5h 36m

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:

Complementary: