Course guides
250560 - GECCHCAPCM - Coastal Water Cycle and Continental Transfer to the Sea

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: DANIEL SEMPERE TORRES
Others: ALLEN BATEMAN PINZON, MARC BERENGUER FERRER, DANIEL SEMPERE TORRES

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.
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.
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.
13381. Address in a comprehensive manner the analysis and preservation of the marine environment with sustainability criteria.
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.

TEACHING METHODOLOGY

The subject consists of 4 hours per week of face-to-face classes in the classroom. They are devoted to theoretical classes 2 hours in which the teacher exposes the concepts and basic materials of the subject, presents examples and carries out exercises. They dedicate 2 hours to the resolution of problems with a greater interaction with the student. Practical exercises are carried out in order to consolidate the general and specific learning objectives. Support material is used in the format of a detailed teaching plan through the ATENEA virtual campus: contents, programming of assessment activities and directed learning and bibliography.
LEARNING OBJECTIVES OF THE SUBJECT

In this subject students will be introduced to basic aspects of meteorology and climate and they will review the processes related to the hydrological cycle, its relationship with the transformation of the earth’s surface, the related contributions of fresh water, sediments and nutrients to the sea, and their relationship with the coastal zone.

1.- Identify the main agents of the coastal hydrological cycle, the main associated physical processes as well as their quantification through mathematical modeling.
2.- Capacity to carry out a hydrological modeling study in a basin, as well as aspects of quality and management of surface water resources.
3.- Capacity to carry out a study of hydrogeological modeling in an aquifer, as well as of the transport of pollutants, including aspects of quality and management of underground water resources.

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.

The main objective proposed for the course is to introduce the basic aspects of meteorology, climate and hydrology necessary to understand the processes of the hydrological cycle, and in particular to understand the key hydrometeorological processes in the interaction atmosphere-oceans, atmosphere-hydrosphere and river systems-aquifers-coastal zone.

For this, the description and quantification of the processes of the atmospheric hydrological cycle of ocean-atmosphere interaction, atmospheric transport, atmospheric instability and precipitation generation are first addressed. Below, the description and quantification of the processes of the continental hydrological cycle, with particular emphasis on those of generation of runoff and transport both fluvial and in saturated and unsaturated media. Finally, the relationship of these transport phenomena with the contributions of fresh water, sediments and nutrients to the sea is described.

The specific objectives are:

1.- Identify the main phenomena of the hydrological cycle, the main associated physical processes, as well as their quantification through mathematical modeling.
2.- Acquire the necessary knowledge to be able to interpret the maps and products provided by observations and forecasts of meteorological models usually available. In particular to be able to interpret various meteorological situations and their relationship with the generation of precipitation and waves.
3.- Acquire the necessary knowledge to carry out a basic hydrological quantification study in a basin, including the quantification of the expected rain with a certain probability threshold, the characterization of the associated hydrograph and the flow to and in the saturated area. Emphasis will be placed on the notion of risk, with application to the management of water resources, the understanding of the phenomenon of floods and floods and the implications on the quality of the resource.
4.- Understand the transport phenomena that occur in the atmosphere, aquifers and rivers and their interaction with the coastal zone. The focus of the course is to provide not only a basic description of these processes, but also the methods to estimate the key variables in the hydrological cycle.

STUDY LOAD

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

**Description:**
Introduction to the Subject
The hydrological cycle. Hydrometeorological processes. Water balance

**Specific objectives:**
General introduction of the course
General introduction to the planetary hydrological cycle and the hydrometeorological processes that comprise it, emphasizing the relationship with the oceans and with the importance for living beings and human society as it is linked to the availability of fresh water, essential for life in the planet

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

## Atmospheric Component of the Hydrological Cycle

**Description:**

**Exercises**
1. Atmospheric models. Global, mesoscale and very high resolution models. Climate models. 2. NWP models for forecasting meteorological variables. Lead time, Uncertainty. Models by sets or ensembles. 3. Types of products of the different models. Interpretation of meteorological model products.
1. Analysis and interpretation of different types of meteorological situations through the products of weather forecast models. 2. Exercises with the METOCAT, AEMET, ECMWF, METEOSWISS AND METEOBLUE web pages.

**Specific objectives:**
Introduction to applied meteorology aimed at understanding the phenomena of atmospheric transport and ocean-ocean interaction.
Introduction to atmospheric thermodynamics applied to understand the phenomena of atmospheric transport of water, energy and entropy.
The focus is to understand the phenomenon of precipitation as the engine of the processes of the continental hydrological cycle, and the atmosphere-hydrosphere interactions. Principles of measurement and quantitative estimation are introduced, as well as methods for forecasting precipitation
Become familiar with the different types of meteorological models currently available and with their outputs and products by understanding the basic concepts of how they work and their limitations.
Learn how to manage meteorological model outputs and understand the meaning of the different products available with a focus on anticipating the phenomena of interaction of the atmosphere with the hydrosphere and with the oceans.

**Full-or-part-time:** 40h 48m
Theory classes: 7h
Practical classes: 6h
Laboratory classes: 4h
Self study : 23h 48m
CONTINENTAL COMPONENT OF THE HYDROLOGICAL CYCLE

Description:

Exercises

Exercises
1. Adjustment of models based on real data. Objective functions. Sensitivity analysis. 2. Exercises with real data with the SCS, TOPMODEL and HBV models.

Specific objectives:
Introduction to hydrological processes at basin scale.
Introduction to the statistical analysis of time series of observed data. Exercises with daily rains and flows, annual averages and annual maximums. Usual probability distribution laws in hydrological analysis. Calculation of frequencies and verification of the goodness of the chosen distribution law.
Introduction to the evapotranspiration and infiltration processes with an approach oriented to understand the complexity of the phenomena and understand the empirical approaches usually used.
Introduction to the runoff generation processes with an approach oriented to understand the complexity of the phenomena and understand the empirical approaches usually used.
Introduction to the principles of flow measurement and exercises for obtaining hydrographs with real data.
Introduction to the fundamental processes of flow in saturated areas with an approach aimed at understanding the complexity of phenomena and understanding the interactions in coastal areas.
Introduction to the calculation of hydrographs in basins from the data usually available with an approach aimed at understanding the complexity of the phenomena and applying the most common empirical formulas to real data.
Introduction to the use of hydrological models. Familiarization with some of the most common of different complexity. Understanding the limitations.
Practice focused on becoming familiar with the operation of hydrological models with the support of computer programs. Manual and automatic parameter calibration exercises based on real data. Understanding the degree of complexity they have and the limitations in real use cases.

Full-or-part-time: 57h 35m
Theory classes: 11h
Practical classes: 9h
Laboratory classes: 4h
Self study : 33h 35m
Sediment transport

Description:

Specific objectives:
Introduction to transport phenomena and review of basic concepts aimed at preparing laboratory practices. Introduction to transport phenomena through laboratory practices to illustrate complex transport phenomena through simple experiences (thermal and density currents, initiation of movement, flow in a porous medium, displacement by Coriolis force, etc.).

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

GRADING SYSTEM
The qualification of the subject is obtained based on the continuous assessment qualifications and the corresponding laboratory and / or computer classroom. Continuous assessment consists in doing different activities, both individual and group, of an additive and formative nature, carried out during the course (inside and outside the classroom). Continuous assessment: - Exercises in class and report of the laboratory practice: 10% - Parcial 1: 20% (Without form, with calculator) - Group work: 20% - Final exam: 50% Test without form, and problems with "official" form (loaded in Athena) and calculator. The course mark is obtained as the geometric mean of the notes of the continuous assessment exercises (20% of tests in class and 30% of exercises and deliverables) and of the final exam (50%)

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

BIBLIOGRAPHY

Basic:

Complementary: