Course guide

250577 - MODINTSIMA - Integral Modelling of Marine Systems

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: MARC MESTRES RIDGE

Others: MARC MESTRES RIDGE, JUAN PABLO SIERRA PEDRICO

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

General:
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 4 hours per week of classroom activity.

During the lectures, the teacher can combine a theoretical part, in which the basic concepts and topics of the subject are presented, examples are shown and exercises are solved, and a practical part in which exercises are solved in order to consolidate the general and specific learning objectives, and with greater interaction with the students.

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.

Although most of the sessions will be given in the language indicated, sessions supported by other occasional guest experts may be held in other languages.

LEARNING OBJECTIVES OF THE SUBJECT

This course will show the students the most relevant aspects of meteorological-oceanographic research through numerical modeling, for purposes of prediction and operational management. Emphasis will be placed on ocean circulation modeling using the ROMS model (Regional Oceanic Model System), wave modeling using the SWAN (Simulating Waves Nearshore) model and pollutant transport modeling with the LIMIX model. It will be shown how evaluations of the impacts on the coast and on port facilities of changing marine environment conditions are carried out for different management and climate scenarios.

1.- Establish the integral conceptual framework of mechanisms that interact in natural marine and coastal systems.
2.- Determine the experimental-numerical approach that allows to address the integral modeling of the marine and coastal systems, including the role of the physical, geological and ecological aspects.
3.- Make a critical analysis of the results of conceptual and numerical modeling, assessing the role of boundary conditions, and performing model sensitivity analysis.

This subject is focused on showing, familiarizing and training students with techniques of observation, monitoring, acquisition and treatment of marine data, as well as modeling techniques, physical and numerical, which allow to characterize practically all of the real problems that will have to address in the professional practice and that will allow the students to finish a generic training cycle but with advanced and transversal knowledge in Marine Sciences and Technologies.

STUDY LOAD

<table>
<thead>
<tr>
<th>Type</th>
<th>Hours</th>
<th>Percentage</th>
</tr>
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<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>Hours small group</td>
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<td>10.00</td>
</tr>
<tr>
<td>Guided activities</td>
<td>6,0</td>
<td>4.00</td>
</tr>
</tbody>
</table>

Total learning time: 150 h
CONTENTS

Introduction
Description:
- Introduction to the subject, approach, evaluation methodology - Motivation / need for modeling - Physical, mathematical, numerical models

Full-or-part-time: 7h 11m
Theory classes: 3h
Self study : 4h 11m

Construction of a numerical model
Description:

Problems

Full-or-part-time: 31h 12m
Theory classes: 10h
Practical classes: 3h
Self study : 18h 12m

Wave models
Description:

Problems
There will be a practical wave modeling exercise using the SWAN model, starting from scratch and following all the steps necessary to run the model (domain selection and bathymetry construction, definition of initial, boundary and forcing conditions, model setup files, model execution and analysis of results)

Full-or-part-time: 43h 12m
Theory classes: 6h
Practical classes: 4h
Laboratory classes: 8h
Self study : 25h 12m

Hydrodynamic models
Description:
Relevant equations. Types of models. Forcings; atmosphere-ocean interaction. Simple models (tides, storm surges ...). Complex models (eg, ROMS). Application examples

Problems
Programming of a simple hydrodynamic model using Matlab.

Full-or-part-time: 33h 36m
Theory classes: 4h
Practical classes: 4h
Laboratory classes: 6h
Self study : 19h 36m
Ecosystem modeling

**Description:**
Ecological models. Types and characteristics.

**Problems**

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

Dispersion models

**Description:**
Relevant equations. Types of models and characteristics.

**Practice with a dispersion model**

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

Modelling in coastal areas

**Description:**
Particularities of modeling in coastal areas: boundary problems, asymmetries, shallow-depth, density

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

**GRADING SYSTEM**

The qualification of the subject is obtained from a system of continuous assessment that includes the realization of two partial examinations and a set of numerical assignments.

The partial exams will cover the theoretical component of the subject, and will consist of a number of quiz-type questions.

The practical assignments will consist of the realization of different activities of an additive and formative character, so much individual as in group, done both inside and outside the classroom. The completion of the assignments and the presentation of the corresponding reports will be a necessary condition to be able to pass the course.

The final mark of the course will be obtained by weighting the average mark of the partial exams (60%) and that of the assignments (40%). This percentage distribution could vary slightly if, for some reason, any of the planned assignments cannot be done.

Criteria for re-evaluation qualification and eligibility: students that failed the ordinary evaluation and have regularly attended all evaluation tests will have the opportunity of carrying out a re-evaluation test during the period specified in the academic calendar. Students who have already passed the test or were qualified as non-attending will not be admitted to the re-evaluation test. The maximum mark for the re-evaluation exam will be five over ten (5.0). The non-attendance of a student to the re-evaluation test, in the date specified will not grant access to further re-evaluation tests. Students unable to attend any of the continuous assessment tests due to certifiable force majeure will be ensured extraordinary evaluation periods.

These tests must be authorized by the corresponding Head of Studies, at the request of the professor responsible for the course, and will be carried out within the corresponding academic period.
EXAMINATION RULES.

The partial tests will be carried out individually, with test-type questions, with 4 possible options of which only one is correct. Correct answers add X points, incorrect answers subtract X / 4. The questions can be either theoretical or simple problems.

BIBLIOGRAPHY

Basic:

Complementary: