Course guide
250569 - MATCIENMAR - Mathematics in Marine Science

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: Spanish

LECTURER
Coordinating lecturer: ALBERTO GARCIA GONZALEZ
Others: PEDRO DIEZ MEJIA, ALBERTO GARCIA GONZALEZ

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.

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
Theoretical, problem solving and practical classes will be given. The subject is face-to-face and the work in class will be evaluated, in addition to the exams proposed for the course. Participation in class will be highly valued. Class attendance will not be sufficient to pass the subject, which implies that the student must devote an average of 4 hours per week to study outside of class. Support material is used in the format of a detailed teaching plan through the ATENEA virtual campus: contents, programming of evaluation activities and directed learning and bibliography.
LEARNING OBJECTIVES OF THE SUBJECT

In this subject, advanced tools for fluid mechanics, such as partial differential equations, will be presented to study physical phenomena of interest in marine sciences. An introduction to numerical techniques to solve systems of differential equations will also be given, such as the finite element method.

1.- Program numerical analysis algorithms to carry out a sensitivity analysis of a problem that is solved by ordinary differential equations (ODEs).
2.- Solve boundary problems in fluid mechanics by means of differential equations in partial derivatives, starting from its approach to its numerical solution via Finite Differences (FDM) or the Finite Element Method (FEM).
3.- Solving of modeling problems applied to marine sciences, by means of numerical techniques (systems of equations, zeros of functions, integration, interpolation).

This is where students are expected to obtain a vision of real environmental problems in the marine environment from a perspective that combines, on the one hand, chemistry and biology, as well as the mathematical techniques to address these problems (Marine Ecology, Ecosystems and Productive Processes) and, on the other, the tools of chemistry, biology and physics (Marine Pollution, Origin, Transport and Impacts), which are needed to solve common problems in coastal and platform waters.

This subject also includes applied techniques in the visualization, interpretation and resolution of the problems addressed in this same subject.

STUDY LOAD

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

Total learning time: 150 h

CONTENTS

Numerical Integration

Description:
Definition of Square
Composite Square
Problem resolution
Calculation of squares with Matlab
Applications of Numerical Integration in Marine Sciences

Full-or-part-time: 31h 12m
Theory classes: 6h
Practical classes: 5h
Laboratory classes: 2h
Self study : 18h 12m
Numerical Integration

Description:
Definition of Square
Composite Square
Problem resolution
Calculation of squares with Matlab
Applications of Numerical Integration in Marine Sciences

Full-or-part-time: 31h 12m
Theory classes: 6h
Practical classes: 5h
Laboratory classes: 2h
Self study: 18h 12m

Equations in Partial Derivatives

Description:
Definition
Classification
Separation of Variables
Application exercises

Full-or-part-time: 31h 12m
Theory classes: 8h
Practical classes: 5h
Self study: 18h 12m

Numerical resolution of EDP’s with Finite Differences

Description:
Approach concept for finite differences
Resolution of diffusion problems
Programming and simulation
Resolution of 1D diffusion convection problems

Full-or-part-time: 31h 12m
Theory classes: 6h
Practical classes: 3h
Laboratory classes: 4h
Self study: 18h 12m
## Numerical resolution of EDP's with Finite Differences

**Description:**
- Approach concept for finite differences
- Resolution of diffusion problems
- Programming and simulation
- Resolution of 1D diffusion convection problems

**Full-or-part-time:** 31h 12m
- Theory classes: 6h
- Practical classes: 3h
- Laboratory classes: 4h
- Self study: 18h 12m

## Environmental modeling of problems described by EDPs

**Description:**
- Introduction to the finite element method
- General formulation of for simulation by finite elements
- Resolution of environmental problems
- Simulation of environmental problems

**Full-or-part-time:** 38h 24m
- Theory classes: 10h
- Practical classes: 2h
- Laboratory classes: 4h
- Self study: 22h 24m

## Environmental modeling of problems described by EDPs

**Description:**
- Introduction to the finite element method
- General formulation of for simulation by finite elements
- Resolution of environmental problems
- Simulation of environmental problems

**Full-or-part-time:** 38h 24m
- Theory classes: 10h
- Practical classes: 2h
- Laboratory classes: 4h
- Self study: 22h 24m

## Evaluation

**Full-or-part-time:** 12h
- Laboratory classes: 5h
- Self study: 7h
GRADING SYSTEM

The grade of the subject will consist of: - Class work (NA). - Two exams (NE1 and NE2). 1. The work in class (NA) will include, among others, the resolution of problems in class. The voluntary participation in class will be valued positively. 2. The contents of the NE1 and NE2 exams will be in accordance with all the subject taught since the beginning of the course. The test scores will be calculated as: \[ NE = \max \left( 0.5 \times NE1 + 0.5 \times NE2, 0.3 \times NE1 + 0.7 \times NE2 \right) \] The Final Note of the asinatura will be: Final Note = 0.35 * NA + 0.65 * NE

EXAMINATION RULES.

Students suspended to the ordinary assessment that have been submitted regularly to the evaluation tests of the subject suspended will have the option to carry out a reassessment test in the period set in the academic calendar. Students who have already passed the qualification as not yet submitted may not be submitted to the re-evaluation test of a subject. The maximum qualification in the case of re-evaluation will be five (5.0). The non-attendance of a student summoned to the test of re-evaluation, celebrated in the fixed period, will not be able to give rise to the accomplishment of another test with later date. Extraordinary assessments will be made for students who have not been able to complete some of the continuous assessment tests because of their proven accreditation. These tests must be authorized by the corresponding head of studies, at the request of the professor responsible for the subject, and will be carried out within the corresponding teaching period.

Once each exam has been completed, there is the possibility that a student may be called to conduct an oral interview as validation of their written exam, this interview being on the subject of the exam. In case of not obtaining a satisfactory assessment in the interview, the exam will be given as suspended with a grade of zero.

BIBLIOGRAPHY

Basic: