Course guide
280801 - 280801 - Advanced Mathematics for Ship and Ocean Engineering

Unit in charge: Barcelona School of Nautical Studies
Teaching unit: 749 - MAT - Department of Mathematics.
Degree: MASTER'S DEGREE IN NAVAL AND OCEAN ENGINEERING (Syllabus 2017). (Compulsory subject).
Academic year: 2022  ECTS Credits: 5.0  Languages: Catalan, Spanish

LECTURER
Coordinating lecturer: MARIA ÂNGELA GRAU GÓTÉS
Others: Primer quadrimestre:
        MARIA ÂNGELA GRAU GÓTÉS - MUENO

PRIOR SKILLS
Mathematical concepts studied during the Degree in Naval Systems and Technology or the Degree in Marine Technologies or the Degree in Naval Architecture.

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

General:
MUENO.CG1. Ability to solve complex problems and to make responsible decisions based on the scientific and technological knowledge acquired in basic and technological subjects applicable in naval and ocean engineering, and in management methods
MUENO.CG3. Ability to project ships and boats of all kinds
MUENO.CG6. Ability to conduct research, development and innovation in naval and ocean products, processes and methods

Transversal:
CT4. EFFECTIVE USE OF INFORMATION RESOURCES: Manage the acquisition, structuring, analysis and visualization of data and information in the field of specialty, and critically evaluate the results of this management.
CT5. THIRD LANGUAGE Learning a third language, preferably English, with adequate oral and written and in line with the future needs of the graduates.

Basic:
CB6. Possess knowledge and understanding that provide a basis or opportunity be original in the development and / or application of ideas, often in a research context.
CB7. That the students can apply their knowledge and ability to solve problems in new or unfamiliar environments within broader (or multidisciplinary) contexts related to their study area.
CB8. Students should be able to integrate knowledge and handle the complexity of making judgments based on information that, being incomplete or limited, includes reflections on the responsibilities social and ethical linked to the application of their knowledge and judgments.
CB9. That students can communicate their conclusions and the knowledge and Latest rationale underpinning to specialists and non Specialty clearly and unambiguously.
CB10. Students must possess the learning skills that enable them continue studying in a way that will be largely self-directed or autonomous.
TEACHING METHODOLOGY

Three types of teaching methodologies are used:
- Face-to-face sessions of content exposition, in which the professor introduces the theoretical foundations of the subject illustrated with examples that facilitate their understanding.
- Face-to-face sessions of practical work with the development of exercises, problems and algorithms in which the teacher will guide the student in the application of the theoretical concepts.
- Autonomous work of study and realization of exercises and activities, in which the student will apply the knowledge acquired in the face-to-face sessions. Short practices in MATLAB are included that will require the delivery of a report.

LEARNING OBJECTIVES OF THE SUBJECT

Ability to solve complex mathematical problems and their application to the resolution of naval engineering problems. Knowledge of existing numerical tools to solve these problems.

STUDY LOAD

<table>
<thead>
<tr>
<th>Type</th>
<th>Hours</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Guided activities</td>
<td>24,0</td>
<td>19.20</td>
</tr>
<tr>
<td>Self study</td>
<td>56,0</td>
<td>44.80</td>
</tr>
<tr>
<td>Hours small group</td>
<td>16,0</td>
<td>12.80</td>
</tr>
<tr>
<td>Hours large group</td>
<td>29,0</td>
<td>23.20</td>
</tr>
</tbody>
</table>

Total learning time: 125 h

CONTENTS

1. Iterative methods for nonlinear equations

Description:
Iterative methods for systems of nonlinear equations: Newton method and fixed point methods.
The teacher will introduce the concepts corresponding to: classic methods of resolution, iterative methods, theorem of convergence, order and efficiency of the methods.
The student must attend the class, participate actively and solve the exercises proposed within the prescribed period

Related activities:
1.- Basic concepts on Matlab
2.- Root finding
4.- Practical work 1

Full-or-part-time: 39h
Theory classes: 9h
Laboratory classes: 2h
Guided activities: 12h
Self study: 16h
2. Numerical approximation of functions

**Description:**

**Related activities:**
3. Approximation of functions  
4. Practical work 1

**Full-or-part-time:** 34h  
Theory classes: 6h  
Laboratory classes: 2h  
Guided activities: 11h  
Self study: 15h

3. Numerical methods for partial and differential equations

**Description:**

**Related activities:**
5. Ordinary differential equations  
6. Partial differential equations  
7. Practical work 2

**Full-or-part-time:** 36h  
Theory classes: 8h  
Laboratory classes: 12h  
Guided activities: 1h  
Self study: 15h

4. Analysis of the dynamics of systems in the frequency domain

**Description:**
Fourier analysis. Wavelet transform and fast Fourier transform. Analysis of the dynamics of systems in the frequency domain.

**Related activities:**
5. Ordinary differential equations  
6. Partial differential equations

**Full-or-part-time:** 8h  
Laboratory classes: 3h  
Self study: 5h
5. Numerical Methods for Continuous Mechanics Equations

Description:
Equations of continuous media dynamics.
Introduction to Numerical Methods of Solving Continuous Media Dynamics Equations

Related activities:
5.-Ordinary differential equations
6.-Partial differential equations

Full-or-part-time: 8h
Laboratory classes: 3h
Self study: 5h

GRADING SYSTEM

Continuous assessment

It is the recommended option for students who regularly attend class. A **minimum attendance** of **80%** of the sessions is recommended. It consists of different activities that are carried out throughout the course.

Continuous assessment activities:

In the evaluation of the course will participate together several concepts that will lead to the final grade:
COURSE NOTE = max (0.3NAC + 0.35NEP1 + 0.35NEP2, NEF)

1. NAC: Continuous assessment note, exercises that students must submit throughout the course. (30%)
   - Matlab® self-study courses.
   - Two or more practices in MATLAB®. Personal work of analysis, synthesis and interpretation on proposed statements. A report and the corresponding code must be submitted.
2. NEP1: grade of the first partial exam (35%).
3. NEP2: mark of the second partial examination (35%).
4. NEF: final exam mark. The final exam includes all the course material. The date is set by the Faculty in the final exam calendar (100%).

5. Both the partial exams and the final exam consists of two different parts,
   - Control of theory, test with the aim of monitoring the learning related to the properties of the models and algorithms studied. (40%)
   - Laboratory controls, test with the aim of monitoring learning related to mathematical formulation, implementation and computational problem solving with MATLAB®. (60%)

Single assessment

Although it is not the most recommended option, it can be accepted by students who do not follow the continuous assessment. It is the most recommended option when you cannot attend class regularly.

The unique assessment consists of an exam, NEF, with part of theory and part of problems and practice, which assesses the knowledge of the whole subject. In the practice and problems section, the student is asked to use the MATLAB® software. The date is set by the Faculty in the final exam calendar.

EXAMINATION RULES.

1. The duration of the continuous assessment tests will be between one hour and one hour and a half. It will be held during class hours.
2. Failure to attend one of these continuous assessment tests will have a score of 0 on the test note.
3. It will be necessary to take identification to all the exams (DNI for example).
4. Any FRAUD in the punctual tests of the subject will apply the Academic Regulations of the University.
5. Any student who fails to take the final exam and does not perform any of the activities of the continuous assessment will be considered not submitted.
BIBLIOGRAPHY

Basic:

Complementary:

RESOURCES

Hyperlink:
- https://matlab.mathworks.com/. Login Matlab Online
- https://es.mathworks.com/matlabcentral/fileexchange/. Versions of classic algorithms worked in the classroom