Course guide
295021 - MN - Numerical Methods

Unit in charge: Barcelona East School of Engineering
Teaching unit: 737 - RMEE - Department of Strength of Materials and Structural Engineering.
Degree: BACHELOR’S DEGREE IN MATERIALS ENGINEERING (Syllabus 2010). (Compulsory subject).
Academic year: 2023  ECTS Credits: 6.0  Languages: Catalan, Spanish

LECTURER

Coordinating lecturer: DANIEL DI CAPUA
Others: Primer quadrimestre:
IGNASI DE POUPLANA SARDÀ - Grup: M11
ESTEBAN RIBAS MOREU - Grup: M11

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:
CEB-01. Solve mathematical problems that may arise in engineering. Apply knowledge of linear algebra; geometry; differential geometry; differential and integral calculus; differential equations and partial differential equations; numerical methods; numerical algorithms; statistics and optimisation.
CEB-03. Understand the basics behind the use and programming of PCs, operating systems, databases and software with applications in engineering.

Transversal:
06 URI N1. EFFECTIVE USE OF INFORMATION RESOURCES - Level 1. Identifying information needs. Using collections, premises and services that are available for designing and executing simple searches that are suited to the topic.

TEACHING METHODOLOGY

The course consists of 3 hours per week of classroom sessions that will be held in two sessions of 1 and 2 hours respectively. In these sessions theoretical classes and problems will be combined. Additionally, laboratory practices will be held 2 hours every two weeks. Attendance at laboratory practices is compulsory.

LEARNING OBJECTIVES OF THE SUBJECT

The course is particularly addressed to those interested in the analysis and design of solids and structures, understood here in a broad sense. The Finite Elements Method (FEM) concepts explained in the course are therefore applicable to the analysis of mechanical components and parts in material engineering.

The following general objectives of this course can be considered:

1. Introduction to the basic concepts of the resolution problems of solid mechanics with the FEM.
2. Acquisition of a specific vocabulary of FEM.
3. Ability to read, correctly interpret and understand texts, figures and tables in technical literature related to FEM.
4. Ability to handle basic FEM software.
5. Acquire basic knowledge of literature and ability to perform literature searches relating to the scope of the FEM.
6. Knowledge of sources of information, institutional and private, related to the FEM.
7. Capacity for independent learning issues within the scope of the FEM.
STUDY LOAD

<table>
<thead>
<tr>
<th>Type</th>
<th>Hours</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Self study</td>
<td>90,0</td>
<td>60.00</td>
</tr>
<tr>
<td>Hours large group</td>
<td>45,0</td>
<td>30.00</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

**Topic 1: Introduction to finite element method**

**Description:**

**Full-or-part-time:** 16h
Theory classes: 4h
Laboratory classes: 4h
Self study: 8h

**Topic 2: Finite elements of axially loaded bar**

**Description:**
Introduction. Axially loaded bar of constant section. Interpolating finite element displacements. Discretization a linear bar element. Discretization with two linear bar elements. Generalization of the solution with N linear bar elements. Matrix formulation of the basic equations. Summary of steps for structural analysis with the MEF.

**Full-or-part-time:** 20h
Theory classes: 6h
Laboratory classes: 2h
Self study: 12h

**Topic 3: 2D Solid**

**Description:**

**Full-or-part-time:** 29h
Theory classes: 9h
Laboratory classes: 2h
Self study: 18h
**Topic 4: 3D Solids**

**Description:**

**Full-or-part-time:** 26h  
Theory classes: 8h  
Laboratory classes: 2h  
Self study : 16h

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**Topic 5: Thermal Problems**

**Description:**

**Full-or-part-time:** 23h  
Theory classes: 7h  
Laboratory classes: 2h  
Self study : 14h

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**Topic 6: Dynamic Analysis**

**Description:**

**Full-or-part-time:** 36h  
Theory classes: 11h  
Laboratory classes: 3h  
Self study : 22h

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**GRADING SYSTEM**

Mid-term exams: 30%  
Exercises / problems: 30%  
Laboratory Practices: 20%  
Final Project: 20%

The subject has not re-evaluation test. The students will be able to access the re-assessment test that meets the requirements set by the EEBE in its Assessment and Permanence Regulations (https://eebe.upc.edu/ca/estudis/normatives-academiques/documents/eebe-normativa-avaluacio-i-permanencia-18-19-aprovat-je-2018-06-13.pdf)

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**EXAMINATION RULES.**

If any of the ongoing evaluation activities are not performed in the scheduled period a zero mark will be assigned to that activity. Attendance at laboratory practices is compulsory.

In case of failure to attend an assessment test due to a justifiable reason, the student must notify the professor in charge of the course BEFORE THE TEST and hand in an official certificate excusing his absence. In this case, the student will be allowed to take the test another day, ALWAYS BEFORE THE FOLLOWING ASSESSMENT.
BIBLIOGRAPHY

Basic:

RESOURCES

Computer material:
- Programa GiD+Ramseries_Educational. Software GiD+Ramseries_Educational
- Programa Ansys. Software Ansys