295402 - MNEM - Numerical Methods in Mechanical Engineering

Coordinating unit: 295 - EEBE - Barcelona East School of Engineering
Teaching unit: 737 - RMEE - Department of Strength of Materials and Structural Engineering
Academic year: 2017
Degree: BACHELOR'S DEGREE IN MECHANICAL ENGINEERING (Syllabus 2009). (Teaching unit Optional)
ECTS credits: 6

Teaching language: Catalan, Spanish

Teaching staff
Coordinator: Di Capua, Daniel
Others: Carbonell Puigbo, Josep Maria
Di Capua, Daniel

Opening hours
Timetable: Office hours to be arranged with the lecturers of the course.

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.

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 structures in civil engineering constructions, buildings and historical constructions, mechanical components and structural parts in automotive, naval and aerospace engineering, among many other applications.

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></th>
<th>Hours large group:</th>
<th>Hours medium group:</th>
<th>Hours small group:</th>
<th>Guided activities:</th>
<th>Self study:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total learning time:</td>
<td>150h</td>
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<td></td>
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<tr>
<td></td>
<td>45h</td>
<td>0h</td>
<td>15h</td>
<td>0h</td>
<td>90h</td>
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<td></td>
<td>30.00%</td>
<td>0.00%</td>
<td>10.00%</td>
<td>0.00%</td>
<td>60.00%</td>
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</table>
## Content

<table>
<thead>
<tr>
<th>Topic</th>
<th>Description</th>
<th>Learning time</th>
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<tbody>
<tr>
<td><strong>Topic 1: Introduction to finite element method</strong></td>
<td>‘What is a finite element? Analytical and numerical methods, structural modeling and analysis with the MEF, discrete systems. Bar structures. Direct assembly of the global stiffness matrix. Development of matrix equations balance using the virtual work. Treatment calculation prescribed displacements and reactions.</td>
<td><strong>Learning time:</strong> 16h</td>
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<td><strong>Learning time:</strong></td>
<td>Theory classes: 4h</td>
<td>Laboratory classes: 4h</td>
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<td>Self study : 8h</td>
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<tr>
<td><strong>Description:</strong></td>
<td>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.</td>
<td><strong>Learning time:</strong> 20h</td>
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<td><strong>Learning time:</strong></td>
<td>Theory classes: 6h</td>
<td>Laboratory classes: 2h</td>
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<td>Self study : 12h</td>
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<tr>
<td><strong>Learning time:</strong></td>
<td>Theory classes: 9h</td>
<td>Laboratory classes: 2h</td>
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<td></td>
<td>Self study : 18h</td>
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<td><strong>Description:</strong></td>
<td>Bending of Beams: Euler-Bernoulli and Timoshenko beam theories. Thin and thick plates: Kirchhoff and Reissner Mindlin plate theories. Revolution shells. Shell analysis with flat elements.</td>
<td><strong>Learning time:</strong> 26h</td>
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<tr>
<td><strong>Learning time:</strong></td>
<td>Theory classes: 8h</td>
<td>Laboratory classes: 2h</td>
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<tr>
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<td>Self study : 16h</td>
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### Qualification system

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

The subject has not re-evaluation test.

### Regulations for carrying out activities

If any of the ongoing evaluation activities are not performed in the scheduled period a zero mark will be assigned to that activity.

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:


Others resources:

Computer material

Programa GiD+Ramseries_Educational
Software GiD+Ramseries_Educational

Programa Ansys
Software Ansys