240636 - Analysis of Structural and Mechanical Components by the Finite Element Methodology

Coordinating unit: 240 - ETSEIB - Barcelona School of Industrial Engineering
Teaching unit: 737 - RMEE - Department of Strength of Materials and Structural Engineering
Academic year: 2019
Degree: BACHELOR'S DEGREE IN INDUSTRIAL TECHNOLOGY ENGINEERING (Syllabus 2010). (Teaching unit Optional)
BACHELOR'S DEGREE IN MATERIALS ENGINEERING (Syllabus 2010). (Teaching unit Optional)
BACHELOR'S DEGREE IN CHEMICAL ENGINEERING (Syllabus 2010). (Teaching unit Optional)
ECTS credits: 4,5
Teaching languages: Catalan, Spanish

Teaching staff
Coordinator: JORDI BONADA BO
Others: ALBERTO SATURNINO VALLESPIN OMEADAS

Degree competences to which the subject contributes

Specific:
2. Knowledge and capacities to apply fundamentals of materials' elasticity and resistance to the behaviour of real solids.

Transversal:
1. TEAMWORK. Being able to work as a team player, either as a member or as a leader. Contributing to projects pragmatically and responsibly, by reaching commitments in accordance to the resources that are available.

Teaching methodology
Theory lessons: Mixed theory and problems sessions and self-assessment activities done outside the classroom.
Case studies: The knowledge will be acquired by the analysis of real models/problems.
Course team work: Self-learning and cooperative.

Learning objectives of the subject
At the end of the course, students should be able to:
- Calculate the displacements, reactions and internal forces of structural beam components by the finite element method.
- Implement and develop a calculation algorithm to solve structural 2D beam problems.
- Develop models to analyse the behaviour of 3D structural or mechanical components using the finite element method.
- Reproduce different type of mechanical joints using the finite element method.
- Define contact elements.
- Employ the finite element method to analyse the structural behaviour of a railway vehicle.
- Analyse the results of a finite element simulation.
### Study Load

<table>
<thead>
<tr>
<th></th>
<th>Hours large group:</th>
<th>0h</th>
<th>0.00%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total learning time:</td>
<td>Hours medium group:</td>
<td>45h</td>
<td>40.00%</td>
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<tr>
<td></td>
<td>Hours small group:</td>
<td>0h</td>
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<td></td>
<td>Guided activities:</td>
<td>0h</td>
<td>0.00%</td>
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<tr>
<td></td>
<td>Self study:</td>
<td>67h 30m</td>
<td>60.00%</td>
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## Content

<table>
<thead>
<tr>
<th>Description</th>
<th>Learning time</th>
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<tbody>
<tr>
<td><strong>Introduction to the finite element method</strong></td>
<td>5h 30m</td>
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<tr>
<td>- Theory classes: 3h</td>
<td></td>
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<tr>
<td>- Self study: 2h 30m</td>
<td></td>
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<tr>
<td><strong>Structural beam elements</strong></td>
<td>43h 30m</td>
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<tr>
<td>- Theory classes: 13h 30m</td>
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<tr>
<td>- Self study: 30h</td>
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<tr>
<td><strong>Structural and mechanical 3D elements</strong></td>
<td>54h</td>
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<tr>
<td>- Theory classes: 24h</td>
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<tr>
<td>- Self study: 30h</td>
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<tr>
<td><strong>Simulations with contact elements</strong></td>
<td>9h 30m</td>
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<tr>
<td>- Theory classes: 4h 30m</td>
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<tr>
<td>- Self study: 5h</td>
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### Description

- **Introduction to the finite element method**: Definition of the finite elements used in a structural analysis, types of material behaviours and solution characteristics.


- **Structural and mechanical 3D elements**: Analysis of the displacement field and the stress state in 3D models. Implementation of the boundary conditions to reproduce joints. Introduction of the finite element method to the railway industry. Introduction of the modal and vibration analysis through FEM.

- **Simulations with contact elements**: Definition and implementation of contact analysis.

### Related activities

- Exercises done in classroom. Work 1.
- Real application for a railway vehicle. Work 2.
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Qualification system

NF=0,3*NT1+0,3*NT2+0,1*NAC+0,3*NEF

NF: Final Mark
NT1: Mark of Work 1
NT2: Mark of Work 2
NAC: Mark of continuous assessment
NEF: Mark of final exam

Regulations for carrying out activities

NT1 and NT2: All teams have to do a report for each course work and prepare the oral presentation of one of the two works.
NAC: During the course the students have to deliver different problems.
NEF: It is allowed to use a formulary, notes and a calculator.

Bibliography

Complementary:


Others resources: