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

Last modified: 16/05/2023

Unit in charge: Barcelona School of Industrial Engineering
Teaching unit: 737 - RMEE - Department of Strength of Materials and Structural Engineering.

Degree: BACHELOR'S DEGREE IN INDUSTRIAL TECHNOLOGY ENGINEERING (Syllabus 2010). (Optional subject).

Academic year: 2023 **ECTS Credits:** 4.5 **Languages:** Catalan

LECTURER

Coordinating lecturer: JORDI BONADA BO

Others:

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:
2. Knowledge and capacities to apply fundaments 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.
-Analyse the results of a finite element simulation.

STUDY LOAD

Type	Hours	Percentage
Self study	67,5	60.00
Hours medium group	45,0	40.00

Total learning time: 112.5 h

CONTENTS

Introduction to the finite element method

Description:
Definition of the finite elements used in a structural analysis, types of material behaviours and solution characteristics.

Full-or-part-time: 5h 30m
Theory classes: 3h
Self study : 2h 30m

Structural beam elements

Description:
Deduction of the local stiffness matrix for a 2D beam element. Global stiffness matrix. Boundary conditions. Displacement loads. Internal forces.

Related activities:
Exercises done in classroom. Work 1.

Full-or-part-time: 43h 30m
Theory classes: 13h 30m
Self study : 30h

Structural and mechanical 3D elements

Description:
Analysis of the displacement field and the stress state in 3D models. Implementation of the boundary conditions to reproduce joints. Introduction of the modal analysis through FEM. Introduction of the nonlinear analysis.

Related activities:
Case of study. Work 2.

Full-or-part-time: 54h
Theory classes: 24h
Self study : 30h

Simulations with contact elements

Description:
Definition and implementation of contact analysis.

Full-or-part-time: 9h 30m
Theory classes: 4h 30m
Self study : 5h

GRADING SYSTEM

NF=0,3*NT1+0,3*NT2+0,4*NAC

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

EXAMINATION RULES.

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.

BIBLIOGRAPHY

Complementary:

- Madenci, E.; Guven, I. The finite element method and applications in engineering using ANSYS [on line]. 2nd ed. New York: Springer, cop. 2015 [Consultation: 26/08/2022]. Available on: https://link-springer-com.recursos.biblioteca.upc.edu/book/10.1007/978-1-4899-7550-8. ISBN 9781489975492.
- Oñate, Eugenio. Cálculo de estructuras por el método de elementos finitos. 2a ed. Barcelona: Centro Internacional de Métodos Numéricos en Ingeniería, 1995. ISBN 8487867006.