Universidad Zaragoza

Academic Year/course: 2023/24

29722 - Mechanics of Deformable Solids

Syllabus Information

Academic year: 2023/24
Subject: 29722 - Mechanics of Deformable Solids
Faculty / School: 110 - Escuela de Ingeniería y Arquitectura
Degree: 434 - Bachelor's Degree in Mechanical Engineering
ECTS: 6.0
Year: 3
Semester: First semester
Subject type: Compulsory
Module:

1. General information

The objective of the subject is to enable the student to analyze and design any deformable element, such as, for example, building structures, industrial installations, as well as countless machine elements. The student is introduced to the Finite Element Method as a numerical method for solving the general elastic problem that allows the analysis and design of more complex elements. The different activities proposed also aim to enhance the reasoning, synthesis, resolution and subsequent analysis of the results of different problems.

The goals are aligned with Goal 9 of the SDGs, of the 2030 Agenda: Industry, Innovation and Infrastructure. Target 9.1 Develop reliable, sustainable, resilient and quality infrastructure.

2. Learning results

The learning results obtained in the subject enable the student to be able to deal with problems related to Structural Mechanics that arise in the field of Mechanical Engineering: design and testing of mechanical components, industrial and building structures, strength analysis of all types of machines and installations, vehicle design, etc.

1.Identify problems where it is necessary to apply the equations of the Mechanics of Deformable Solids. Manage the concepts of stress, deformation and constitutive laws.
2.Understand the meaning of stress and strain tensors and should be able to express these tensors in different reference systems, including the principal system, and know the importance of principal stresses and directions.
3.Identify and apply material behavior models (linear elastic, nonlinear elastic, inelastic, etc.) from experimental stress-strain curves.
4. Know how to apply the basic equations of elasticity.
5.Know how to formulate the equations of the mathematical model (equilibrium, behavior and compatibility at different levels, point, element and structure) and to solve simple problems analytically.
6. Identify thye main structural typologies.
7.To know the necessary methodology to solve the elastic problem using finite elements and to handle a software.
8. Identify and select finite element types.
9. Know how to assess the acceptability of analytical and numerical results.
10. It establish the limit states of elastic behavior: large deformations, plasticity, instability, etc.

3. Syllabus

Block I: Mechanics of the deformable solid

1. Introduction to Linear Elastic Solid Mechanics
2. Deformation analysis
3. Stress analysis
4. Principal stresses and strains
5. Behavioral equations.
6. Differential approach to the elastic problem
7. Limits of elastic behavior

Block II: Finite Element Mechanics

1. Introduction to FEM
2. FEM formulation of 1-D problems
3. FEM formulation in plane elasticity
4. FEM formulation in 3D elasticity
5. FEM user instructions

4. Academic activities

Theoretical classes. The scientific body is developed and examples of its application are presented.

Practical problem classes. They allow the student to apply the concepts to the resolution of problems of the engineering practice.

Computer Simulation Practices. They familiarize students with another of the basic tools of calculus and numerical simulation.

Assignment work. Project-based learning, to reinforce the rest of the teaching activities and allow the student to acquire teamwork skills.

Tutoring. They allow, in a more individualized way or through small groups, students to integrate the different contents and consolidate the object of their learning.

5. Assessment system

Continuous assessment

Subject work (Weighting: 20%, Minimum grade: 4,5/10)

An individual work will be carried out in which analytical calculus will be related to computational simulation.

Its assessment will be based on the written report submitted (which may be in Spanish or English).

An oral presentation and defense may be requested.

Practices (Weighting: 10%, Minimum grade: 4,5/10)

There will be five 3-hour sessions of individual computer practice.

Their assessment will be based on an exam on the contents covered in the same.

Partial exams (Weighting: 70 %, Minimum grade in each: 4,5/10)

There will be two partial exams of Elasticity and Finite Elements.

They will have an estimated duration of two hours each.

Global assessment of the subject:

Examination (Weighting: 85 %, Minimum grade: 5/10)

Final exam in which the complete content of the subject will be evaluated.

It will have an estimated duration of three hours.

Practice Exam (Weighting: 15 %, Minimum grade: 5/10) It will have an estimated duration of one hour. The contents covered in the practicals will be evaluated.

In both cases the final weighted average must be higher than 5 out of 10 to pass the subject. The second call will be evaluated by means of a global assessment.