Universidad Zaragoza

Academic Year/course: 2024/25

30026 - Deformable Solids Theory

Syllabus Information

Academic year: 2024/25
Subject: 30026 - Deformable Solids Theory
Faculty / School: 110 - Escuela de Ingeniería y Arquitectura
Degree: 436 - Bachelor's Degree in Industrial Engineering Technology
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 elements that make up structures, like, for example, buinding machines, industrial installations and machine elements.

The student is introduced to the Finite Element Method as a numerical method commonly used in engineering practice for the resolution of the general elastic problem, although this method allows the analysis and design of more complex elements.

The subject covers both the fundamentals of the Mechanics of Deformable Solids and the Finite Element Method and its most applied aspects.

These approaches and goals are aligned with the following Sustainable Development Goals (SDGs) of the United Nations Agenda 2030 (https://www.un.org/sustainabledevelopment/es/), so that the acquisition of the learning results of the subject provides training and competence to contribute, to some extent, to the achievement of the Objective 9.4 of Goal 9.

2. Learning results

- Knowing how to identify problems where it is necessary to apply the equations of the mechanics of deformable solids, handling concepts of stress, deformation and constitutive laws.
- 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.
- To know how to identify and apply the models of material behavior (linear elastic, non-linear elastic, inelastic, etc.) from experimental stress-strain curves.
- To know how to apply the basic equations of elasticity. The student must be able to formulate the equations of the mathematical model : equilibrium, behavior and compatibility at different point, element andstructure levels and solve simple problems analytically.
- To know the necessary methodology to solve the elastic problem by means of finite elements and to handle a FE software, identifying and selecting the type of finite element software, identifying and selecting the type of finite element.
- To know how to assess the admissibility of analytical and numerical results.

3. Syllabus

Planned agenda:

0. Motivation of the subject

Block I: Mechanics of the deformable solid

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

Block II: Finite Element Mechanics

7. Introduction to FEM
8. FEM formulation of 1-D problems
9. FEM formulation in plane elasticity
10. FEM formulation in 3D elasticity

11. Introduction to the application of FEM in other structural typologies

4. Academic activities

1. Theoretical classes (T1). In them, the scientific body contained in the program is developed and examples of its application are presented.

2. Practical problem classes (T2). They complement the theoretical ones by introducing problem solving in engineering practice.

3. Computer Simulation Practices (T3). To familiarize students with another of the basic tools of the subject, such as calculus and numerical simulation.

4. Subject Work (T6). It aims to develop the project-based learning formula, to reinforce the rest of teaching activities and, together with the laboratory and simulation practices, to allow the student to acquire teamworkskills.

5. Tutoring. Resolution of doubts in a more individualized way or in small groups.

6. Study and personal work.

7. Assessment tests.

5. Assessment system

There are two evaluation methods to pass the subject: gradual and global .

In order to allow the **gradual** assessment of the student, the following tests are proposed:

Subject work (20 %)

- A work related to the general contents of the subject will be presented, including the analytical and numerical resolution of a mechanical component.
- Its assessment will be based on the written report submitted and its oral defense.

Practices (20%)

- There will be five 3-hour sessions of individual computer practice.
- Its assessment will be based on questionnaires filled out by the students in the course's ADD

Exam (60%):

- There will be a mid-term partial exam evaluating the contents of the elasticity part. It will allow to release subject as long as it reaches a grade equal or higher than 4.
- Final exam during the period set by the School. Students with a grade equal or higher than 4 in the partial exam will be allowed to take only the Finite Elements part. The grade of the exam will be 50% elasticity and 50% FE.

A minimum grade of 4.0 on the exam grade is required to mediate with all other activities.

For an **overall** assessment of the subject, the following is proposed:

Final exam. It will consist of a theory/problem part (80%) and a practical part (20%), and a score of 5/10 must be reached in each part.

6. Sustainable Development Goals

9 - Industry, Innovation and Infrastructure