Solid Mechanics

Academic Year: (2022 / 2023) **Review date: 09-05-2022**

Department assigned to the subject: Continuum Mechanics and Structural Analysis Department

Coordinating teacher: ARANDA RUIZ, JOSUE

Type: Compulsory ECTS Credits : 6.0

Year : 4 Semester : 1

REQUIREMENTS (SUBJECTS THAT ARE ASSUMED TO BE KNOWN)

-- Elasticity
-- Mechanics of Structures

OBJECTIVES

By the end of this course, students will be able to:
1. Understand the criteria that establish the limit of classical elasticity, the behavior of materials in elasto-plastic regime and the constitutive equations that determine this relationship.
2. Analyze the response of advanced materials that incorporate viscoelastic and viscoplastic behavior.
3. Apply its knowledge and understanding to identify, formulate and solve problems of calculation and design of components that require incorporating the inelastic behaviour of materials, by means of the use of specifically established methods.
4. Apply both analytical and numerical resolution methods in the calculation of structural problems with visco-elastic-plastic materials.
5. Apply the acquired knowledge to interpret experimental results, and to carry out designs of structural components that meet specific requirements.
6. Understand and use in an appropriate way the different methods that exist to characterize and analyze the mechanical response of materials with visco-elastic-plastic behavior.
7. Design and carry out experiments for the characterisation of materials with inelastic behaviour, as well as to interpret the data and draw conclusions.
8. Obtain technical and laboratory skills.
9. Have the ability to select and use the appropriate tools and methods to characterize materials with viscoelastic-plastic behavior.
10. Acquire the ability to combine theoretical concepts and practical exercises to solve problems involving mechanical and/or structural components in which it is required to use materials with inelastic behavior.
11. Understand the methods, both analytical and numerical, that are used in the characterization and analysis of the behavior of visco-elastic-plastic solids; being aware of the existing limitations, mainly from the analytical point of view.

DESCRIPTION OF CONTENTS: PROGRAMME

Chapter 1. Introduction to Mechanical Behaviour of Materials (No. of sessions: 1)

Chapter 2. Equations of Solids Mechanics. Deformable Solid Kinematics (No. of sessions: 1)

Chapter 3. Plasticity (No. of sessions: 6)
-- Yield Criteria.
-- Strain Hardening.
-- 1D plasticity.
-- Equations of Plasticity. Incremental Theory of Plasticity.
-- The Finite Element Method in Plasticity.

Chapter 4. Viscoelasticity (No. of sessions: 2)
-- Phenomenology
-- Viscoelastic constitutive models based on linear analogies
-- Principle of Correspondence and Hereditary Integrals

Chapter 5. Viscoplasticity (No. of sessions: 2)
-- Phenomenology

-- Laws of stationary creep
-- Viscoplastic constitutive models based on non-linear analogies

Chapter 6. Introduction to Fracture Mechanics (No. of sessions: 1)
-- Introduction to Linear Elastic Fracture Mechanics.

LEARNING ACTIVITIES AND METHODOLOGY

Each week will be taught:
-- a master class session (in aggregate group), oriented to the acquisition of main theoretical concepts of the subject, through the use of IT and audiovisual support.
-- A session of resolution of exercises (in reduced group), oriented to the acquisition of practical skills related to the theoretical concepts of the magistral session.

In addition to this teaching, four laboratory sessions will be given at specific times in small groups (maximum 20 students).

Along with the activities mentioned, the FORMATIVE ACTIVITIES are completed with the work and personal study of the student, who will also have the possibility of requesting individual tutoring sessions in the corresponding timetable.

There will be an optional (at the request of the students) session of collective tutoring in the last week of the course, in the schedule assigned to the master session.

ASSESSMENT SYSTEM

The assessment of the subject is carried out in two parts: on the one hand, a Final Exam is carried out, consisting of a test that can involve both practical problems and conceptual questions and, on the other hand, there is a system of Continuous Evaluation, based on work, participation in class and partial tests of evaluation of skills and knowledge.

A MINIMUM NOTE of 4.5 is required at the FINAL EXAM of the course in order for the Continuous Evaluation to be taken into account in the final grade.

In order to pass the course, the attendance and performance of the laboratory practices foreseen in the weekly planning are compulsory. The weighting of the laboratory practice mark in the continuous assessment corresponds to what it is established in the course, in accordance with the regulations of the university. In the subject "Solids Mechanics", the weighting of the laboratory practices takes the value of 37,5% of the continuous assessment grade.

Weighting:

Case 1 - If the score on the Final Exam is equal to or higher than 4.5, then:

FINAL EXAM : 60%
CONT. EVAL. : 40% broken down as follows:

- Laboratory Practice Report : 15%
- Partial test of knowledge: 25%.

Case 2 - If the score on the Final Exam is lower than 4.5, then:

FINAL EXAM : 100%
CONT. EVAL. : 0%

% end-of-term-examination:	60
% of continuous assessment (assigments, laboratory, practicals…):	40

BASIC BIBLIOGRAPHY

- Bertram, A. (Albrecht) Elasticity and plasticity of large deformations: an introduction, Berlin: Springer, 2008

- Dill, Ellis Harold Continuum mechanics: elasticity, plasticity, viscoelasticity , Boca Raton (Florida): CRC Press, 2007

- Lemaître, Jean Mécanique des matériaux solides, París: Bordas, 1988

- Ottosen & Ristinmaa The mechanics of constitutive modeling, Elsevier, 2005

BASIC ELECTRONIC RESOURCES

- Matweb . propiedades físicas y mecánicas de diversos materiales: http://www.matweb.com/search/search.aspx

- Prof. Allan F. Bower (Brown University) . Course on Solid Mechanics: http://solidmechanics.org/

- Prof. Kelly (University of Auckland) . Mechanics Lecture Notes: http://homepages.engineering.auckland.ac.nz/~pkel015/SolidMechanicsBooks/